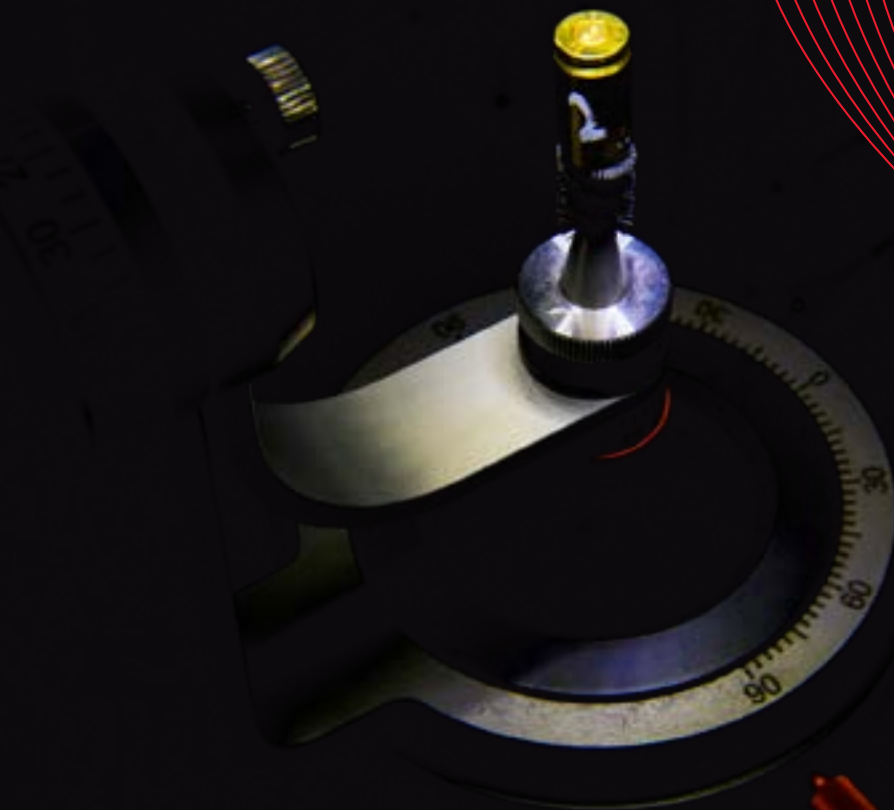


EAFS | STOCKHOLM 2022

9th EUROPEAN ACADEMY OF
FORENSIC SCIENCE CONFERENCE

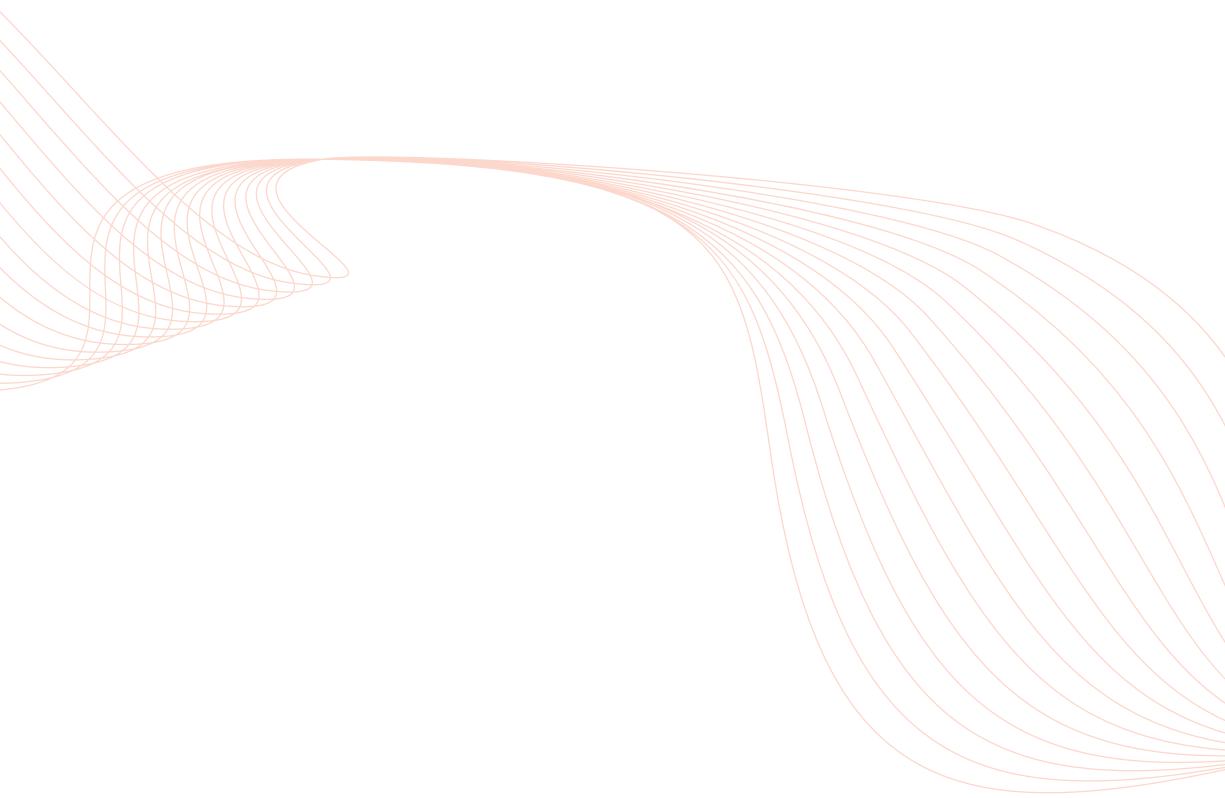
30th May - 3rd June 2022



ABSTRACT BOOK

EAFS | STOCKHOLM
2022

Together for a Safer World
ABSTRACT BOOK



Editor: Christina Bertler-Edlund

Design: Modulmedia Sverige AB | Jens Sjunnesson

Print: AB Normalmstryckeriet

Edition: 300 copies

Request for extra copies: nfc.kansli@polisen.se

All photos taken by: Minna Ridderstolpe, The Swedish Police Authority,
if not otherwise mentioned

© All rights reserved. *Reproduction in any form or by any means is allowed only with the prior permission of EAFS 2022 Organisers or The European Network of Forensic Science Institutes (ENFSI).*

Table of Content

Themes and Tracks	1
Themes	2
Tracks	4
Symbols, Colors and Abbreviations	13
Management Day	14
European Day	15
Plenary Speakers	16
Keynote Speakers	29
Oral Presentations	39
Plenary Presentations	40
Chemistry	49
Digital Evidence	106
DNA/Forensic Genetics	140
Forensic Medicine and Toxicology	165
Marks, Impressions and Biometric Traces	184
Scene of Crime	232
European Perspective	279
Forensic Management	301
Forensic Statistics	333
Legal & Ethical Aspects	347
Posters	355
Chemistry	356
Digital Evidence	387
DNA/Forensic Genetics	397
Forensic Medicine and Toxicology	424
Marks, Impressions and Biometric Traces	441
Scene of Crime	455
European Perspective	471
Forensic Management	476
Forensic Statistics	483
Legal & Ethical Aspects	488
Workshops	490
Index	
Authors	536
Abstracts	546

The MSAB Ecosystem: An all-round approach to Mobile Forensics

Join the **MSAB Workshop** at EAFS 2022 to see how MSAB Ecosystem **tools** and **solutions** help our customers face and address modern Mobile Forensics challenges in time and resource efficient ways.

- ▶ Participants will be offered to solve a number of hands-on investigation and analysis tasks!

MSAB

Trusted Partner in Digital Forensics

The background features a series of horizontal color bands: dark red at the top, olive green, dark blue, dark purple, and dark teal. Overlaid on these are several glowing fiber optic cables in shades of pink, blue, and yellow. A central black hexagonal shape with a red outline contains the text. Thin white lines swirl around the cables, suggesting light paths or data flow.

**THEMES
& TRACKS**

Themes

The conference Themes, as selected by the Scientific Committee, highlight some important areas for the future of Forensic Science. The Themes have served as a compass in the development of the scientific program. It is our ambition that EAFS 2022 will contribute to further develop these areas.

We have offered the authors of abstracts for EAFS 2022 to, if they so wish, indicate one or more themes that they consider to be linked to their contribution. As many of our authors have chosen to exercise this opportunity we encourage everyone to explore areas outside of their field of expertise with help of the theme symbols displayed for each abstract.

Digital Transformation of the Forensic Process



New digitalized products and services are entering our society in many ways as new technologies and innovations become available at an increasing rate. The digital transformation itself is not new, but the effects and impact of the transformation are continuously finding themselves into new areas. It is not only about technology, the transformation also involves people, workflow, judicial and ethical considerations etc.

In the field of Forensic Science, we now have the opportunity to improve our way of working by harvesting the benefits from the digital transformation. The question is, how do we accomplish this in a way that will fit the forensic processes and workflows? How do we bring all colleagues on board? And, how do we make sure that we maintain quality and a scientific approach within our forensic processes?

Forensic Data Science



Data Science is an interdisciplinary field that combines the use of mathematical methods, data and expert knowledge. It is a fundamental part of Forensic Science as a tool for the evaluation of evidence and to communicate the findings. The increased capabilities to capture, store, share and process data, propelled by the development of Artificial Intelligence and Big Data, are enabling Forensic Scientists to automate and address more complex problems. There is no field within Forensic Science that will not experience the impact of this development.

What are the future opportunities in Forensic Data Science? How do we share data and knowledge in order to benefit from these opportunities?

Forensic Human Factor



A fundamental aspect of Forensic Science is the evidence-based approach to the treatment and evaluation of forensic findings. In order to make the forensic outcomes as indisputable and inarguable as possible, there needs to be a common understanding among experts and scientists of the scientific principles upon which our conclusions are based.

From recovery processes, hypothesis generation, context information management, calibration of the human-based interpretation to the presentation of results in a scientifically correct, understandable and unbiased way, the impact of human factors within forensic science is essential and unavoidable.

Forensic Social Responsibility



Forensic Science has an important role in our judicial systems. Our environment and our capabilities are affected not only by technological advancements and laws, but also by ethics and societal perceptions. In many situations technology or science itself is not a limiting factor. Balancing concepts such as personal integrity and technical capabilities is becoming increasingly important.

The challenge of balancing the need for efficient Forensic Science services to the judicial system while maintaining and assuring quality and future-proofing is a question that many Forensic Science laboratories faces. How we manage this delicate balancing act will be important for how Forensic Science develops in the future.

Forensic Technology Innovation



Forensic Science spans across a broad range of areas, each with constant development of new technologies and solutions. Many of these achievements have the potential to become valuable tools in the hands of Forensic Scientists. But how do we work actively with innovation to make sure that new technologies are made available in Forensic Science? What are the areas with the largest potential impact? How can we ensure an efficient innovation uptake?

These are questions that will need to be addressed within the Forensic Science community in order to stay relevant and continue to support the judicial system.

Tracks

Selected by the EAFS 2022 Scientific Committee the conference tracks are selected to cover the field of Forensic Science covered by the ENFSI Expert Working Groups (EWG). The ambition is to help attendees at EAFS 2022 find the sessions that match their areas of interest and navigate the conference. For some of our tracks the sub-tracks will provide further guidance to specific fields.



Chemistry

Chair: Professor Arian van Asten

MFS/CLHC, Univ. of Amsterdam, The Netherlands

Co-chair: Associate Professor Simon Dunne, NFC, Sweden

Routed in a single science domain the actual application of chemistry in a forensic setting is very diverse. Various forensic expertise areas focus on the criminal misuse of chemical knowledge and products (drugs, explosives and ignitable liquids and fire debris analysis). Other forensic experts specialize in the chemical characterization of microtraces such as fibers, glass, paint and gunshot residues that are often generated and exchanged during incidents and can constitute important evidence linking individuals to crime scenes and criminal activities. Finally, chemistry is applied in the laboratory to assist the forensic investigation, for instance to visualize latent traces such as fingermarks. At EAFS 2022 the Chemistry sub-tracks have been defined according to forensic area, reflecting how chemistry expertise is typically organized in forensic institutes.

Sub-tracks:

- **Drugs**
- **Environment**
- **Explosives**
- **Fingermark Development**
- **Gunshot Residues (GSR)**
- **Ignitable Liquids and Fire Debris Analysis**
- **Material (Paint and Glass/Textile and Hair)**
- **Trace, Transfer and Persistence**



Chair: Professor Zeno Geradts, NFI/Univ. of Amsterdam, The Netherlands
Co-chair: Philip Engström, NFC, Sweden

This Track focuses on all kinds of digital evidence, ranging from any kind of computer system, digital imaging, forensic visualizations as well as using artificial intelligence. The rate of change is high in this field since new devices are being developed with ever increasing tempo. This also creates a challenge to implement quality assurance since the amount of data generated is growing rapidly and millions of apps are developed in many versions. At the same time explainability in court is always a factor that needs to be considered.

Sub-tracks:

- **Artificial Intelligence**

Any form of artificial intelligence used in digital forensics, including topics such as bias and explainability as well as ethical implications, big data analysis and use of systems for analysis of huge amounts of data – implemented in a reliable and valid way for forensic purposes.

- **Computer, Cybercrime, Malware and Database Forensics**

The wide range of computer and database forensics as well as forensic investigation of malware and ransomware attacks. The sub-track also includes other forms of cybercrime such as anti-forensic software and decryption and data hiding.

- **Digital Imaging**

Any form of forensic digital imaging, such as manipulation detection, interpretation, video recovery, comparison and camera identification.

- **Forensic Visualization (VR, AR, 3D)**

The use of technologies, such as virtual reality and augmented reality glasses, for 3D visualizations, e.g. as a tool for investigation or presentation in court.

- **Mobile Device, Network and Location Forensics**

Examination of smartphones, other mobile and IoT devices, as well as the analysis of networks and related services.

- **Vehicle Forensics**

The number of on-board systems and sensors in cars is rapidly expanding and information can be extracted from those for use, e.g. as evidence in Court.

DNA/Forensic Genetics

Chair: Dr. John Butler, NIST, US

Co-chair: Associate Professor Ricky Ansell, NFC/Linköping Univ., Sweden

The field of forensic biology and genetic profiling, including the analysis of human and non-human nucleic acids (DNA/RNA).

Sub-tracks:

- **Body Fluids**
Search, recovery, characterisation, transfer and persistence of stains and cellular material (for subsequent nucleic acid analysis)
- **Disaster Victim Identification (DVI)**
Aspects of genetic profiling as a tool for disaster victim identification
- **Evaluative DNA**
Interpretation and evidentiary strength of DNA or RNA findings including statistics, mixture interpretation, and activity level propositions
- **Investigative DNA**
Generating intelligence and investigative leads, including phenotyping & ancestry, investigative genetic genealogy, familial searches, and databases



Forensic Medicine and Toxicology

Chair: Professor Bela Kubat, Maastricht Univ./NFI, The Netherlands

Co-chair: Associate Professor Martin Josefsson, NFC/Linköping Univ., Sweden

Forensic medical science can both contribute to and profit from the extensive knowledge in other forensic fields presented at this conference. In particular, in the much-discussed fields of physical child abuse or death in custody, novel psychoactive substances, human performance substances, forensic neuropathology, age estimation of injuries or innovative in vitro and in vivo models for predictions of drug action and toxicity, forensic medicine and toxicology play a key role.



Marks, Impressions and Biometric Traces

Chair: Professor Christophe Champod, UNIL, Switzerland

Co-chair: Professor Didier Meuwly, NFI/Univ. of Twente, The Netherlands

This Track focuses on the forensic examination of all types of marks and impressions (e.g. firearms, tools, footwear, garment and documents) and all types of biometric traces (e.g. friction ridge skin, face, speech, body, gait, handwriting and signature). Particular emphasis will be placed upon examiner-based and automatic approaches, reporting on the source and activity level inference and reporting on the intelligence, investigative and evaluative phase of the forensic process, together with multidisciplinary topics such as the combination of biometric traces or the combination of toolmarks and biological traces.

Sub-tracks:

- **Body and Gait**
- **Document, Handwriting and Signature**
- **Face Recognition**
- **Firearms and Tools**
- **Footwear and Garment**
- **Friction Ridge Skin**
- **Speaker Recognition**

Scene of Crime

Chair: Professor Niamh Nic Daeid, LRCFS, Univ. of Dundee, UK

Co-chair: Mike Groen NFI/Leiden Univ., The Netherlands

There are many competing priorities that crime scene investigators and forensic experts attending crime scenes must address including enabling a scientific approach to the scene investigation that maintains quality so that a reconstruction that is valid in science can be developed for the courts; ensuring that new technologies are implemented in a reliable and valid way; ensuring that technology and methods of practice used in crime scene training or competency testing are fit for purpose; understanding the impact of the developing digital technologies on crime scene investigation and its practitioners and understanding how crime scene examiners make decisions at crime scenes.

Sub-tracks:

- **Bloodstain Pattern Analysis**
New developments in the recording and interpretation of blood pattern analysis.
- **Capturing the Crime Scene**
New and emerging technologies used to capture the crime scene, e.g. laser scanning, hyperspectral cameras or other type of sensors.
- **Complex Scenes**
Scientifically based investigations of complex scenes, for example DVI scenes or CBRN scenes.
- **Fire and Explosion Investigation**
Recent developments in practices of fire and explosion scene investigations.
- **Forensic Archaeology and Anthropology**
Recent developments in the use of forensic anthropology and archaeology in scene investigations.
- **Implementing New Technologies at Crime Scenes**
How are new technologies introduced safely to crime scene investigations so as to be accepted in the Courts?
- **Trace Evidence and Interpretation**
The detection, recovery, analysis and interpretation (including transfer, persistence, recovery and background abundance) of trace evidence and their relevance to the reconstruction of an alleged crime.
- **Training and Education for Crime Scene Investigators**
Ensuring that training, education and competency testing is fit for purpose, fills the gaps and is educationally valid.

European Perspective

Chair: Dr. Bart Nys, *NICC, Belgium*

Co-chair: Dr. Nada Milisavljevic, *DG Home, European Commission*

Forensic science and crime fighting are ever more dependent on international collaboration on a global level and between all levels of authority. ENFSI – as implied in its very name – has always been very focused on European information exchange and cooperation between its member laboratories and this has been observed and recognised by the European Commission.

In this track collaborative projects primarily financed or co-financed by the European Commission will be presented to a broad audience of forensic practitioners, forensic researchers etc, thereby creating the opportunity for dissemination of results as well as finding new, both European and international, partners.



Forensic Management

Chair: Distinguished Professor Claude Roux, UTS, Australia

Co-chair: Honorary Professor Sheila Willis, LRCFS, Univ. of Dundee, UK

In recent years there is a trend for forensic science managers to be professional managers who may have little knowledge of the field before taking up the position. This section of the conference caters for all interested in the management of forensic science, whether forensic scientists or not.

Sub-tracks:

- **“Doing the Right Thing”**

“Doing the Right Thing” invites speakers with views or reflections on what managers and all concerned need to do to ensure that forensic science remains fit for purpose in an ever-changing world. Innovation is frequently discussed, but many will recognise that moving from research to operation is not trivial, and the speakers have been encouraged to share their experiences or reflections. The importance of the scene, whether that be a location, a hard drive or a body, is acknowledged. Yet, the complexity of bureaucracy moves laboratory functions further away from the scene. This track addresses how to manage disruptive change.

- **“Doing Things the Right Way”**

The concerns today include effectiveness, quality systems, coordination and above all, the people who deliver the various functions.

- **Education and Training**

People are a vital component to the effective delivery of forensic science across the many different fields, models and jurisdictions. Education and continuing professional development (CPD) is the responsibility of management and that of the education and training providers and individuals. It is also recognised that some culture change must happen in forensic science, which is greatly facilitated by education.



Forensic Statistics

Chair: Associate Professor Anders Nordgaard,
NFC/Linköping Univ., Sweden

Co-chair: Dr. Tereza Neocleous, *Univ. of Glasgow, UK*

Probabilistic modelling and statistical inference with forensic data, including methods for prediction and decision-making. Machine learning methods comprising statistical inference applied to big datasets. Connections with data analysis in the field of digital evidence, evaluative DNA approaches, trace material evaluation and other instances of probabilistic-based interpretation.



Legal & Ethical Aspects

Chair: Dr. Justice Tettey, *UNODC*

Co-chair: Professor Niamh Nic Daeid, *LRCFS, Univ. of Dundee, UK*

The relationship between forensic science and the law is critical in supporting fair and transparent criminal justice systems, and thus enforcing the rule of law. Forensic science is experiencing rapid advances in the use of data science, machine and deep learning tools for both intelligence and evidence purposes, all of which require professional competence and ethics. This presents profound ethical challenges to both the legal and scientific communities on how and what data are retrieved, triaged, analysed and presented in our Courts while protecting human rights, ensuring the right to a fair trial and presenting evidence in a competent and ethical manner.

This track will see three fundamental questions being discussed:

- What are the challenges and ethical issues to the use of AI in legal processes and as an evidential tool?
- How do we rationalise the right to privacy of the individual and the use of their data in criminal cases?
- How do we address personal competence and ethical dilemmas in forensic science practice?



PHOTO: SWEDISH POLICE

Symbols, Colors and Abbreviations

Building



Folkets Hus



Norra Latin

Theme



Digital Transformation of the Forensic Process



Forensic Data Science



Forensic Human Factors



Forensic Social Responsibility














Forensic Technology Innovation

Other



Project/Cooperation has received funding from the European Union

Track

-  Chemistry
-  Digital Evidence
-  DNA/Forensic Genetics
-  Forensic Medicine and Toxicology
-  Marks, Impressions and Biometric Traces
-  Scene of Crime
-  European Perspective
-  Forensic Management
-  Forensic Statistics
-  Legal & Ethical Aspects
-  Plenary Speaker

Abbreviation

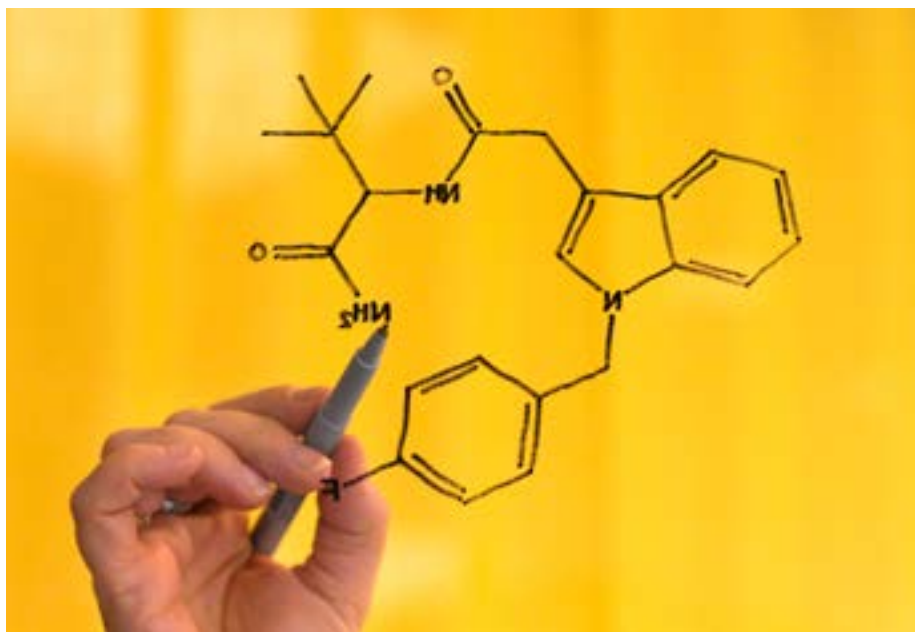
- FH Folkets Hus (building)
- KN Keynote Speech
- NL Norra Latin (building)
- OP Oral Presentation
- PP Poster Presentation
- PS Plenary Speech
- WS Workshop

EAFS
STOCKHOLM
2022

Management Day

On EAFS 2022 Management Day we put a special focus on the management questions relevant to the field of Forensic Science. As needs of users of forensic result change or increase, due to new types of crime or new policies within the judicial system, the Forensic Science community needs to share results from projects, reflect on how to meet future demands, explore best practice related to management of the process, e.g. effective case handling routines, communication strategies with the end user of results, handling requirements of quality and competence assurance.

During the Management Day we aim to create an opportunity for the attendees of EAFS 2022 to exchange knowledge and experience from dealing with the challenges in forensic management. Throughout the day our plenary speakers, keynotes, workshops, and presenters of oral and poster contributions will share their experience and knowledge within this field. In the afternoon's panel debate we aim to reflect on and discuss one of the most relevant topics within this field. The topic will also be further addressed within the Management Track (see page 10), with activities Monday to Wednesday.





European Day



EAFS 2022 in Stockholm includes a European Day, on Thursday 2nd June, promoting the work supported by EU funding over the last decade and at present, disseminating results and discussing future challenges for the forensic community and law enforcement.

The aim is to;

- facilitate a broader awareness of projects delivered, their results and benefits.
- explore and discuss the way forward for cooperation in forensic R&D to support law enforcement agencies.

The program of the European Day will start with an introductory speech followed by plenary speakers, a panel discussion, keynote presenters, oral and poster presentations and workshops. In the Auditorium, EC-funded projects and initiatives will exhibit their activities during the day.

*The **European Day** of the EAFS 2022 Conference is co-funded by the European Union's Internal Security Fund – Police.*

Grant Agreement number: 101051099 — CERTAIN-FORS — ISFP-2020-AG-IBA-ENFSI





**PLENARY
SPEAKERS**

PLENARY SPEAKERS



Forensic biometrics: Let's face it

Name & Title Professor Christophe Champod
Affiliation School of Criminal Justice University of Lausanne – UNIL, Switzerland

Date for Plenary Presentation: Monday 30th May

Christophe Champod received his M.Sc. and Ph.D. (summa cum laude) both in Forensic Science, from the University of Lausanne, in 1990 and 1995 respectively. Remained in academia until holding the position of assistant professor in forensic science. From 1999 to 2003, he led the Interpretation Research Group of the Forensic Science Service (UK), before taking a full professorship position at the School of Criminal Justice (ESC) of the University of Lausanne. He is in charge of education and research on identification methods (interpretation of DNA, facial images, fingerprints, toolmarks, footwear marks and firearms) and has the privilege to work with a group of 20 PhD students. The research carried out by his group is mainly devoted to the inferential aspects associated with forensic identification techniques. The value to be attached to forensic evidence is at the core of their interests.

He is also operational manager of the ISO/SEC 17025 accredited forensic laboratory of the ESC. He maintains an activity as an expert witness in areas of marks and biological evidence interpretation both at a national and international level.

He is a steering committee member for the International Fingerprint Research Group (IFRG) and an invited member of Friction Ridge subcommittee of the Organization for Scientific Area Committees (OSAC).



Name & Title: **Professor Didier Meuwly**

Affiliation: Netherlands Forensic Institute – NFI and University of Twente, the Netherlands

Didier Meuwly is born in Fribourg, Switzerland. After a classical education (Latin/Philosophy), he graduated as a criminalist and criminologist (1993) and received his PhD (2000) at the School for Forensic Science (ESC) of the University of Lausanne, Switzerland.

He currently shares his time between the Forensic Institute of the Dutch Ministry of Security and Justice (Netherlands Forensic Institute – NFI), where he is a principal scientist, and the University of Twente (UT), where he holds the chair of Forensic Biometrics from 2013 onwards. He specializes in the automation and validation of the probabilistic evaluation of forensic evidence, and more specifically biometric traces. From 2002 to 2004 he worked as a senior forensic scientist at the R & D department of the UK Forensic Science Service (FSS), then an executive agency of the UK Ministry of the Interior.

Didier has served as a criminalist in several international terrorist cases on request of the ICTY, STL, UN and UK, has authored and coauthored more than 60 scientific publications and book chapters in the field of forensic science.

Didier is an associate and guest editor of Forensic Science International (FSI), a member of the R & D standing committee for research and development of the European Network of Forensic Science Institutes (ENFSI) and a member of the ISO Technical Committee 272 editing the first ISO forensic science standard (21043).

PLENARY SPEAKERS



The Role and Value of the Forensic Science Laboratory in an Ever-Changing World

Name & Title: Distinguished Professor Claude Roux
Affiliation: University of Technology Sydney (UTS), Australia and The Centre for Forensic Science, Australia

Date for Plenary Presentation: Tuesday 31st May

Claude Roux is a Professor of Forensic Science and the founding Director of the Centre for Forensic Science at the University of Technology Sydney. His research activities cover a broad spectrum of forensic science, including microtraces and chemical criminalistics, documents, fingerprints, forensic intelligence and the contribution of forensic science to policing and security. His professional motivation has been largely driven by his vision of forensic science as a distinctive academic and holistic research-based discipline.

Claude has a long history of establishing strong partnership with a variety of government and industry organisations. He has published more than 190 refereed papers and 26 book chapters.

His research has been funded by the Australian Research Council, the Australian Defence Science and Technology Group, the US Combating Terrorism Technical Support Office and the US National Institute of Justice.

Claude is a member of a number of expert and advisory groups in Australia and overseas. He is the current President of the International Association of Forensic Sciences (IAFS), immediate Past-President of the Australian & NZ Forensic Science Society and a Fellow of the Royal Society of New South Wales. He also serves on the Scientific Advisory Board of the International Criminal Court. He earned his undergraduate and PhD degrees in forensic science and criminology from the University of Lausanne, Switzerland.



'Customer' perspectives on forensic science

Name & Title: Professor Gillian Tully CBE, PhD HonFCSFS Hon FFFLM
Affiliation: Kings College London (KCL), United Kingdom

Date for Plenary Presentation: Tuesday 31st May

Gill has over 30 years' experience spanning research, casework and regulation in forensic science. Her current roles are Professor of Practice for Forensic Science Policy and Regulation at King's College London and consultant at Tully Forensic Science Ltd.

From November 2014 to February 2021, she was the Forensic Science Regulator for England and Wales, responsible for setting quality standards for forensic science in the Criminal Justice System and for advising and challenging Government. Gill has given evidence to multiple Parliamentary Committees as well as providing expert evidence in courts in this jurisdiction and overseas. With several granted patents, numerous peer reviewed publications and experience of taking research ideas from inception to court, Gill has a record of effective innovation. She has advised the Government and companies on bringing research to market and has collaborated actively internationally. Her research interests include improving the quality and effectiveness of forensic science and improving the interface between science and the law.

In her consultancy role, Gill works with forensic science leaders and practitioners to assist with improving the quality and effective application of forensic science, from crime scene to court.

In 2020, Gill was awarded a CBE for services to forensic science. She is an Honorary Fellow of the Chartered Society of Forensic Sciences, an Honorary Fellow of the Faculty of Forensic and Legal Medicine, an Honorary Member of the Society of Legal Scholars, and a member of the International Society of Forensic Genetics.

PLENARY SPEAKERS



Crowdsourcing Digital Forensic Science

Name & Title: Professor Eoghan Casey

Affiliation: Chief Scientist of the Defense Cyber Crime Center (DC3),
University of Lausanne – UNIL, Switzerland

Date for Plenary Presentation: Wednesday 1st June

Eoghan Casey is a professor at the School of Criminal Sciences in University of Lausanne, and he is the chief scientist at the DoD Cyber Crime Center (DC3). For over two decades, he has dedicated himself to advancing digital forensic science. He has extensive experience working in digital forensic laboratories in the public and private sectors, and he has analyzed many types of digital evidence to support complex cases.

His most recent work includes co-creating the Digital Artifact Catalog in collaboration with DC3 and NIST, and contributing to a formalized model of the Trace to support a unified understanding across scientific disciplines. He helped develop advanced capabilities for extracting and analyzing digital evidence, including the open source SQLite Dissect and the patented performant process for salvaging renderable content from digital data sources (US patent 16/014067). He has consulted globally with many agencies and companies on a wide range of digital investigations, and he has delivered expert testimony in the North America, Europe, and international tribunals. He leads an international initiative that develops and implements the ontology-based Cyber-investigation Analysis Standard Expression (CASE), now part of the Linux Foundation.

Dr. Casey serves on the Digital Forensic Research Workshop (DFRWS) Board of Directors. He wrote the foundational book Digital Evidence and Computer Crime, now in its third edition, and he created advanced smartphone forensics courses taught worldwide. From 2004 to 2020, he was the Editor-in-Chief of FSI Digital Investigation, publishing cutting edge work by and for practitioners and researchers.

“I’m not sure that you understood what I think it was that I just said” – the critical importance of communication



Name & Title: Professor Niamh Nic Daeid

Affiliation: University of Dundee, United Kingdom, and The Leverhulme Research Centre for Forensic Science (LRCFS)

Date for Plenary Presentation: Wednesday 1st June

Professor Niamh Nic Daeid is an award winning Chartered Chemist and Authorised forensic scientist.

She is a Professor of Forensic Science and Director of the Leverhulme Research Centre for Forensic Science at the University of Dundee. She has been involved in forensic science education, research and casework for over 25 years.

She is a Fellow of the Royal Society of Edinburgh and holds fellowships of the Royal Society of Chemistry, the Chartered Society of Forensic Science, the Institute of Chemistry of Ireland, the Royal Statistical Society and the UK Association of Fire Investigators. Niamh has previously chaired the ENFSI working group for fire and explosion investigation and the INTERPOL forensic science managers symposium. She was vice chair of the scientific advisory board of the International Criminal Court for 6 years and acts as an advisor to the United Nations Office of Drugs and Crime (UNODC). She is an appointed Commissioner on the Dundee Drugs Commission investigating drug related deaths in Dundee. Niamh has received a range awards including the ENFSI distinguished scientist award, the Pete Ganci award for services to fire investigation and the Stephen Fry Award for public engagement. Her Centre was awarded a UK National Gold Watermark for public engagement in 2019.

She has published over 200 peer reviewed research papers and book chapters and holds a research grant portfolio in excess of £28 million.

PLENARY SPEAKERS



A European Perspective on Artificial Intelligence in Law Enforcement

Name & Title: Professor Fredrik Heintz
Affiliation: Linköping University (LiU), Sweden

Date for Plenary Presentation: Thursday 2nd June

Fredrik Heintz is a Professor of Computer Science at Linköping University, Sweden. He leads the Reasoning and Learning group. His research focus is artificial intelligence especially Trustworthy AI and the intersection between knowledge representation and machine learning.

He is the Director of the Graduate School for the Wallenberg AI, Autonomous Systems and Software Program (WASP), coordinator of the TAILOR ICT-48 network developing the scientific foundations of Trustworthy AI, and the President of the Swedish AI Society. He is also very active in education activities both at the university level and in promoting AI, computer science and computational thinking in primary, secondary and professional education. Fellow of the Royal Swedish Academy of Engineering Sciences (IVA).

Recent advances in forensic DNA phenotyping: the VISAGE Enhanced Tool offering new methods and markers for predicting appearance, ancestry and age



Name & Title: Professor Dr. Peter M. Schneider

Affiliation: Professor Emeritus at the Institute of Legal Medicine, University of Cologne, Germany

Date for Plenary Presentation: Thursday 2nd June

Peter M. Schneider is professor emeritus at the Institute of Legal Medicine, University of Cologne, Germany, working in the Division of Forensic Molecular Genetics. Having been active in this field for more than 30 years, he has extensive experience in routine DNA typing of criminal evidence material, identification cases, as well as relationship testing. His research interests include forensic DNA phenotyping, various forensic applications of massively parallel sequencing, as well as mRNA analysis for body fluid identification.

He has been coordinator of the EU-funded “European Forensic Genetics Network of Excellence – EUROFORGEN-NoE” (2012-1016) and work package leader in the “VISible Attributes through GENomics – VISAGE” Consortium (2017-2021). He is associate editor of the scientific journal *Forensic Science International: Genetics*, chairman of the German Forensic Stain Commission organizing the annual proficiency testing GEDNAP (www.gednap.org), as well as former President and current Secretary of the International Society for Forensic Genetics (ISFG)..

PLENARY SPEAKERS



Trust me? I am a forensic scientist

Name & Title: Dr. Justice Tettey

Affiliation: Chief, Laboratory and Scientific Section
United Nations Office on Drugs and Crime (UNODC)

Date for Plenary Presentation: Thursday 2nd June

Dr. Justice Tettey holds a Bachelor of Pharmacy (Hons) degree from the University of Science and Technology, Ghana, and degrees of Master of Science in Pharmaceutical Analysis (quality management) and a Doctor of Philosophy in Pharmaceutical Sciences (pharmaceutical analysis and drug metabolism studies) from the University of Strathclyde, Glasgow, UK.

Dr. Tettey joined the United Nations Office on Drugs and Crime in 2008 as Chief of the Laboratory and Scientific Section, Division of Policy Analysis. He is responsible for the implementation of the Office's Global Scientific and Forensic Services Programme, the Global Synthetic Drugs Monitoring Analysis Reporting and Trends (SMART) Programme and the Integrated Strategy on the Global Opioid Crisis.

Dr. Tettey has over 28 years of experience in various aspects of medicines regulation and international drug control and has published extensively on a wide range of topics including, pharmaceutical analysis, drug metabolism and toxicity, illicit synthetic drug markets, international drug policy and forensic science. He was awarded the Fellowship of the Royal Society of Chemistry of the United Kingdom in 2008 and an honorary degree of the Doctor of Laws by the University of Dundee, United Kingdom in 2019.



Are We On the Right Side of the Equation? Becoming Outcome-Focused Versus Process-Driven

Name & Title: **Dr. John M. Butler**

Affiliation: NIST Fellow & Special Assistant to the Director for Forensic Science U.S. Government-Department of Commerce, National Institute of Standards and Technology-NIST, US

Date for Plenary Presentation: Friday 3rd June

John M. Butler is an internationally recognized expert in forensic DNA analysis and holds a Ph.D. in analytical chemistry from the University of Virginia. He has written five textbooks on Forensic DNA Typing (2001, 2005, 2010, 2012, and 2015) and given hundreds of invited talks to scientists, lawyers, and members of the general public throughout the United States and in 27 other countries so far.

Dr. Butler's research, first conducted at the FBI Laboratory and now at the National Institute of Standards and Technology (NIST), pioneered the methods used today worldwide for DNA testing in criminal casework, paternity investigations, and many DNA ancestry procedures. Dr. Butler is a NIST Fellow (highest scientific rank at NIST) and Special Assistant to the Director for Forensic Science. He served as the Vice-Chair of the National Commission on Forensic Science from 2014 to 2017. In 2019, he was elected the President of the International Society for Forensic Genetics (ISFG).

Dr. Butler and his wife have six children, all of whom have been proven to be theirs through the power of DNA testing.



One Window into the Evidence

MORE DIGITAL EVIDENCE SOURCES. DIVERSE FORMATS. EXPLODING DATA VOLUMES.

The tried and true investigative methods of imaging every device and piecing together the results just don't work. The time has come to bring all your evidence under one roof with Nuix digital forensics and analytics software.

ALL CASE DATA AT YOUR FINGERTIPS

Only Nuix investigation technology can process, analyse, cross-reference and collaborate on terabytes of data per day. Knock down the silos inside your investigative team with Nuix's processing, collaboration, analytics, scripting and integration with third-party tools.

BUILT FOR POWER AND EFFICIENCY

A national police agency used Nuix to halve the time it took officers to complete forensic analyses, slashing digital forensic processing time by 60% and report preparation time by 76%.

Visit [nuix.com/EAFS](https://www.nuix.com/EAFS) to open your one window into the evidence today.

“ Nuix has the ability to dramatically improve digital forensic capabilities in comparison to existing processes, subsequently reducing backlogs and enhancing service delivery.”

Senior Investigator, Police Scotland

Nuix (www.nuix.com) creates innovative software that empowers organizations to simply and quickly find the truth from any data in a digital world. We are a passionate and talented team, delighting our customers with software that transforms data into actionable intelligence and helps them overcome the challenges of litigation, investigation, governance, risk and compliance.

Nuix (and any other Nuix trademarks used) are trademarks of Nuix Ltd. and/or its subsidiaries, as applicable. All other brand and product names are trademarks of their respective holders. Any use of Nuix trademarks requires prior written approval from the Nuix Legal Department. The Nuix Legal Department can be reached by e-mail at Legal@nuix.com.

THIS MATERIAL IS COMPRISED OF INTELLECTUAL PROPERTY OWNED BY NUIX LTD. AND ITS SUBSIDIARIES ("NUIX"), INCLUDING COPYRIGHTABLE SUBJECT MATTER THAT HAS BEEN NOTICED AS SUCH AND/OR REGISTERED WITH THE UNITED STATES COPYRIGHT OFFICE. ANY REPRODUCTION, DISTRIBUTION, TRANSMISSION, ADAPTATION, PUBLIC DISPLAY OR PUBLIC PERFORMANCE OF THE INTELLECTUAL PROPERTY (OTHER THAN FOR PREAPPROVED INTERNAL PURPOSES) REQUIRES PRIOR WRITTEN APPROVAL FROM NUIX.

Copyright ©2022 Nuix. All rights reserved.



**KEYNOTE
SPEAKERS**

Keynote Speakers of EAFS 2022

Below you find information about the Keynote Presentations at EAFS 2022.

CHEMISTRY

Name and Title Professor Maurice Aalders
Affiliation Amsterdam University Medical Centers, location AMC, Department of Biomedical Engineering and Physics, The Netherlands
Title of Presentation The Progress and Promise of Forensic Chemical Imaging
Date for Presentation 30 May



Name and Title Associate Professor Simon J. Dunne
Affiliation The National Forensic Centre (NFC), The Swedish Police Authority
Title of Presentation Chemical Intelligence: Impurity Profiling in Real Time Meets Impurity Profiling in Real Labs
Date for Presentation 31 May



Name and Title Dr. Tatiana Trejos
Affiliation West Virginia University (WVU) Department of Forensic and Investigative Science, US
Title of Presentation Analysis and Interpretation of Organic and Inorganic Gunshot Residues: Lessons Learned from a Large Population Study
Date for Presentation 31 May



Name and Title Associate Professor Pierre Esseiva
Affiliation School of criminal justice, University of Lausanne - UNIL, Switzerland
Title of Presentation Real time analysis of illicit drugs, an opportunity to cope with the trend toward the decentralization of forensic capabilities.
Date for Presentation 1 June



Name and Title Dr. Hans Önnerud
Affiliation Swedish Defence Research Agency, FOI
Title of Presentation Homemade explosives - a multifaceted detection challenge
Date for Presentation 2 June



Name and Title Jonas Malmberg
Affiliation The National Forensic Centre (NFC), The Swedish Police Authority
Title of Presentation The Forensic Comparison of Mineral Oils
Date for Presentation 3 June



DIGITAL EVIDENCE

Name and Title Aya Fukami
Affiliation Netherlands Forensic Institute (NFI) and
University of Amsterdam, The Netherlands

Title of Presentation Modern Mobile Forensic Techniques
Date for Presentation 31 May

Name and Title Manon Fischer
Affiliation School of criminal justice, University of
Lausanne – UNIL, Switzerland

Title of Presentation Smart objects (IoT) as crime scene witnesses
Date for Presentation 1 June



Name and Title Niclas Appleby
Affiliation The National Forensic Centre (NFC),
The Swedish Police Authority

Title of Presentation Using AI and automatic image analysis as an
investigative tool
Date for Presentation 2 June



Name and Title Professor Katrin Franke
Affiliation Norwegian Center for Cybersecurity in Critical
Sectors, Norwegian University of Science and
Technology (NTNU)

Title of Presentation Reliability of Artificial Intelligence in Forensic
Sciences
Date for Presentation 3 June



Elevating investigations for greater impact

Our mission is to empower the law enforcement community to solve vital cases as efficiently as possible. We do this by innovating and building tech solutions that enable law enforcement professionals all over the world to sort and analyze large amounts of visual data. Read more about us at griffeye.com

**Innovate
your career.
Come work
with us!**



KEYNOTE SPEAKERS

DNA/FORENSIC GENETICS

Name and Title **Professor Bas Kokshoorn**
Affiliation Netherlands Forensic Institute (NFI) and Amsterdam University of Applied Sciences (AUAS), The Netherlands

Title of Presentation Reflections on 10 years of activity level reporting; where to from here?


Date for Presentation 1 June



Name and Title **Dr. Corina Benschop**
Affiliation Netherlands Forensic Institute (NFI) Division of Biological Traces, Team Research

Title of Presentation Advancing the analysis, comparison and interpretation of DNA profiling data: What does the future hold for us?


Date for Presentation 2 June



Name and Title **Associate Professor Andreas Tillmar**
Affiliation National Board of Forensic Medicine, Sweden and Linköping University (LiU), Sweden

Title of Presentation Investigative genetic genealogy: Current practice and future challenges

Date for Presentation 3 June




FORENSIC MEDICINE AND TOXICOLOGY

Name and Title **Dr. Ing. Arjo Loeve**
Affiliation Delft University of Technology, The Netherlands

Title of Presentation Infant Head Injury by Shaking Trauma – a biomechanical engineering perspective

Date for Presentation 31 May



MARKS, IMPRESSIONS AND BIOMETRIC TRACES

Name and Title Henry Swofford
Affiliation HJS Consulting, LLC, (US/CH)
Title of Presentation Toward Computational Algorithms in Forensic Fingerprint Examination: Navigating a Path Forward
Date for Presentation 31 May



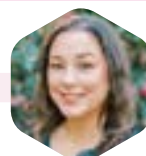
Name and Title Dr. Erwin Mattijssen
Affiliation Netherlands Forensic Institute (NFI)
Title of Presentation Forensic judgments and computer-based methods: Validity, reliability and bias
Date for Presentation 1 June



Name and Title Dr. Geoffrey Stewart Morrison
Affiliation Forensic Data Science Laboratory, Aston University Forensic Evaluation Ltd, UK
Title of Presentation Advancing a paradigm shift in evaluation of forensic evidence: The rise of forensic data science
Date for Presentation 1 June



Name and Title Nicole Richetelli
Affiliation Noblis Inc., US
Title of Presentation Forensic footwear evidence, stepping forward
Date for Presentation 1 June



SCENE OF CRIME

Name and Title Mike Groen
Affiliation Netherlands Forensic Institute (NFI) and Leiden University, The Netherlands
Title of Presentation Reconstructing Crime Scenes: An Archeological Approach
Date for Presentation 30 May



Name and Title Eva Ljungkvist
Affiliation National Forensic Services (NKC) Special Crime Unit, Danish Police
Title of Presentation Forensic science means science - how to thrive in the future by cutting the edge together
Date for Presentation 1 June



KEYNOTE SPEAKERS

SCENE OF CRIME

Name and Title Professor Christianne de Poot
Affiliation Amsterdam University of Applied Sciences (AUAS) and the Police Academy of The Netherlands, Professor of Criminalistics at the VU University, Amsterdam, The Netherlands

Title of Presentation The reconstruction of crimes

Date for Presentation 1 June



Name and Title Professor Keith Inman
Affiliation Leverhulme Research Centre for Forensic Science, UK and California State University, US

Title of Presentation How we look determines what we see

Date for Presentation 2 June



EUROPEAN PERSPECTIVE

Name and Title Dr. Nada Milisavljevic
Affiliation Directorate-General Migration and Home Affairs (DG HOME), European Commission

Title of Presentation Forensics – EU Security Research and Innovation Perspective

Date for Presentation 2 June



Name and Title Dr. Erkki Sippola
Affiliation National Bureau of Investigation Forensic Laboratory (NBIFL), Finland

Title of Presentation ENFSI collaboration and communication in the international playground

Date for Presentation 2 June



Name and Title ENFSI Quality and Competence Committee (QCC)
Affiliation

Title of Presentation The effectiveness of the deliverables of Monopoly Projects

Date of Presentation 2 June

Name and Title Raimonds Apinis
Affiliation ENFSI Direct Grant Manager

Title of Presentation The promotion of European forensic cooperation through EU funding to ENFSI

Date of Presentation 2 June



EUROPEAN PERSPECTIVE

Name and Title **Arnoud Heeres**
Affiliation Directorate-General Migration and Home Affairs (DG HOME), European Commission
Title of Presentation Internal Security Fund (ISF) 2021-2027
Date of Presentation 2 June



FORENSIC MANAGEMENT

Name and Title **Melissa Taylor**
Affiliation National Institute of Standards and Technology (NIST), US
Title of Presentation The Dirty Dozen - Understanding the 12 Most Common Preconditions for Human Error
Date for Presentation 30 May



Name and Title **François Heulard, Colonel**
Affiliation Institut de Recherche Criminelle de la Gendarmerie Nationale, France
Title of Presentation The Forensic Science Laboratory of the French Gendarmerie (IRCGN): An original and singular management
Date for Presentation 31 May



Name and Title **Dr. Simon Walsh**
Affiliation Australian Federal Police (AFP), Canberra, Australia
Title of Presentation Essential strategic, operational and enabling reforms to Implement a forensic operating model for the contemporary criminal and security environment
Date for Presentation 31 May



Name and Title **Dr. Annemieke de Vries**
Affiliation Netherlands Forensic Institute (NFI)
Title of Presentation Innovation for the Forensic Questions of Tomorrow
Date for Presentation 1 June



KEYNOTE SPEAKERS

FORENSIC STATISTICS

Name and Title Associate Professor **Silvia Bozza**
Affiliation Ca' Foscari University of Venice Department Economics, Italy and School of criminal justice, University of Lausanne - UNIL, Switzerland
Title of Presentation Statistical modelling of complex forensic data
Date for Presentation 3 June



LEGAL AND ETHICAL ASPECTS

Name and Title **Donatella Casaburo**
Affiliation KU Leuven Centre for IT & IP Law - imec, Belgium
Title of Presentation AI evidence and data protection safeguards: The European legal perspective
Date for Presentation 2 June



Fast DNA & Rapid Drugs

Reducing the time from offence to conviction

Working in partnership with local police forces and forensic institutes, Eurofins has challenged the end-to-end process in Drugs and DNA casework to dramatically reduce the time taken from the offence being committed, to offenders facing the judicial system:

- DELIVERING early identification of suspects and offenders.
- SUPPORTING police in making our streets safer.
- IMPROVING public confidence in policing and criminal justice.

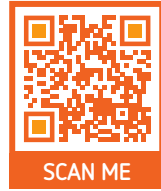


For more details visit the Eurofins EAFS booth.
Or contact us: EFSenquiries@eurofins.co.uk

LabVantage Forensic Navigator

Full forensic life cycle
evidence and data management

VISIT STAND # 16



SCAN ME

HD International

- The law enforcement marketplace
- Leveraging over thirty years of international product sales and service experience
- Bringing innovative law enforcement products to the global market
- Dedicated to providing top in class sales, service and logistic

Check us out today at <https://hdinternational.com>
We look forward to serving you!



Document Examination



Fingerprint/Shotprint Evidence



Digital Forensics



Physical Evidence Collection




Custom Products

<https://hdinternational.com> Email: sales@hongdenet.com




Chainalysis

Automated Imaging Driven by Artificial Intelligence



Forensic Sperm Detection

Meet us at
Booth #11



www.metasystems.ai



Welcome to the Spectrum Family

Big and Powerful, or Small and Mighty.
The Choice Is Yours.



Certified Reference Materials for Clinical, Forensic and Toxicology Applications

- Certified Reference Materials in Solution
- Ready-to-use, accurate and time saving
- Highly stable - flame sealed ampoules

Scan QR code to contact us

MERCK

Supelco[®]
Analytical Products

The Life Science business of Merck operates as MilliporeSigma in the U.S. and Canada.
© 2022 Merck KGaA, Darmstadt, Germany and/or its affiliates. All Rights Reserved. Merck and the vibrant M are trademarks of Merck KGaA, Darmstadt, Germany or its affiliates. All other trademarks are the property of their respective owners. Detailed information on trademarks is available via publicly accessible resources. 41090



**ORAL
PRESENTATIONS**



30 May

Abstract no: PS001

**Christophe Champod¹**
Didier Meuwly²

| PLENARY

¹ School of Criminal Justice University of Lausanne- UNIL, Switzerland² Netherlands Forensic Institute – NFI and University of Twente, the Netherlands

Forensic biometrics: Let's face it

Biometric traits are distinctive characteristics of the human body, such as the fingerprint and iris patterns or the face and voice features. They are personal and sensitive data per nature, and their use is governed by privacy and data protection regulation.

Biometric data are at the core of many forensic applications, originally to infer who is the source of the probes or traces and more and more to reconstruct activities of persons of interest. Biometric probes are used for the identification and the identity verification of persons of interest along the justice identity chain. Biometric traces collected on crime scenes help establish links between cases, allow to generate shortlist of candidates from very large databases of biometric references and to provide evaluative evidence in court.

This plenary session will focus on the case of facial recognition to describe and discuss the challenges (development, validation, implementation and combination with other biometric traits) of the human-based and computer-assisted (or artificial intelligence – AI) methods. Some of the questions that will be debated are: What should be the forensic scope of facial recognition? How to validate these techniques while maintaining accountability and transparency? What are the acceptable error rates associated with the technique? What will be the role of human experts in a field dominated by AI methods? Should the community aim at a specific regulation framework for forensic usage?



31 May

Abstract no: PS002

**Claude Roux**

| PLENARY

*Centre for Forensic Science, University of Technology Sydney Australia
International Association of Forensic Sciences*

The Role and Value of the Forensic Science Laboratory in an Ever-Changing World

We live in a rapidly ever-changing world where technology not only takes an increasingly important part in our lives but also drives societal changes. These changes have an impact on the criminal and security landscape itself. They also provide new ways to abate and even prevent crime. For example, the digital transformation of society facilitates the traceability of people and behaviours. Further, technology, including field-portable instrumentation, enables quicker, remote and more connected exploitation of traces that take more diverse shapes and forms than ever. This situation offers vast opportunities but also presents significant challenges, including data management and potential ethical issues. Further, today, there is an increased demand for formalised quality assurance and reliability from forensic science services. However, there is also an increased demand for forensic science's more proactive role in the investigation, intelligence and contribution to non-judicial pathways (e.g. harm minimisation and prevention). This overall situation is challenging the role of the traditional forensic science laboratory. We ought to ask the questions:

- Is there a risk that the traditional forensic science laboratory may quickly become less relevant or irrelevant?
- Should we grasp this challenge as an opportunity to re-imagine the forensic science laboratory?
- What is the value proposition of the forensic science laboratory, and, more broadly, forensic science, in 2022 and beyond?

Answering these questions forces us to re-think the purpose of forensic science and better develop its fundamental underpinnings. These interrogations and this debate are crucial for forensic science, practitioners, and stakeholders. How can we be effective in our everyday work if we do not have a clear view of the purpose of what we are doing and if we poorly understand where we come from and where we are heading to? This presentation will discuss all these questions, along with some supporting case studies.



31 May

Abstract no: PS003

**Gillian Tully***Kings College London, UK***| PLENARY**

‘Customer’ perspectives on forensic science

Forensic science is above all a scientific endeavour in the service of justice. Is there, then, a role for the concept of the ‘customer’?

A simple definition of a customer is a person who buys goods or services. If we applied this definition directly, it would identify the organisation procuring (or funding) forensic science services as our customer. The funder has a legitimate interest in the service provided, but as forensic scientists, we operate in a wider context.

In the early stages of a case, police investigators may request assistance with understanding whether a crime has been committed and providing investigative leads. If a case proceeds towards prosecution, an investigator will need to assemble a case, part of which may include evaluation of scientific evidence. A prosecutor will need to satisfy themselves that the case is reliable and credible, and then a court will need to understand the evidence and be assured that it is reliable and balanced. A victim/complainant and/or their supporters may want every possible avenue to identifying a suspect and building a case to be explored. A suspect/defendant will want to know that the science has not been applied in a restricted manner that favours the prosecution.

There are consequently widely differing requirements on forensic scientists from participants across the justice system, added to which are systematic requirements for building rigour into our discipline and innovating to meet future requirements.

This presentation will explore the competing demands on forensic science in the context of our over-riding obligation to serve justice and consider whether the concept of a ‘customer’ for forensic science is helpful or should be discarded.



1 June

Abstract no: PS004

**Niamh Nic Daeid****| PLENARY***University of Dundee, UK and The Leverhulme Research Centre for Forensic Science (LRCFS)*

"I'm not sure that you understood what I think it was that I just said" – the critical importance of communication

The communication, whether in writing or orally, of the validity, relevance and case contextualised evaluation of scientific evidence is a critical aspect of the work of the forensic scientist. And yet, most forensic scientists are not trained in science communication or public engagement. When we speak with other colleagues, at crime scenes, during an investigation or when we give evidence in court to an audience of legal practitioners or the public, we often do not know how well we are understood. This plenary presentation will explore the importance of science communication, the critical role that communication plays in understanding about data, evidence and science, why it matters to forensic science and why we should be worried about it.



1 June

Abstract no: PS005

**Eoghan Casey****| PLENARY**

Digital Forensic Science and Investigation Ecole des Sciences Criminelles (ESC) Université de Lausanne

Crowdsourcing Digital Forensic Science

Utilization of data for forensic purposes is being undermined by multiple problems of isolation, including conflicting interpretations of digital traces, differing conceptions of domain knowledge, growing disconnects between lab and field, and inconsistent practices across cyber domains.

While the global pandemic increased physical isolation, it fueled computer-assisted collaboration and innovation that can strengthen digital forensic science. Crowdsourcing can overcome the problems of isolation in digital forensic science by consolidating diverse community inputs to amplify knowledge sharing, general acceptance, standard data format, and common practices across criminal justice, military, and cybersecurity contexts. Crowdsourcing amplifies human capacities, typically using technology such as: 1) Artifact Catalog for curating knowledge about digital traces and their meaning in a structured form for ease of reference by humans and automation; 2) CASE (Cyber-investigation Analysis Standard Expression) ontology for representing information to enable interoperability; 3) DFaaS (Digital Forensics as a Service) for codifying digital forensic methods and bridging between lab and field; and 4) KIEP (Knowledge & Information Exchange Platform) for exchanging expertise between practitioners and researchers. Technical aspects of these initiatives are in place and just require resources to develop fully.

The greater challenge is to engage and educate individuals in order to cultivate a culture of common comprehension and collaborative problem solving. Success of these crowdsourcing solutions depends on a unified understanding of the Trace, digital artifact, virtual identity, and scientific inference.



2 June

Abstract no: PS006

**Fredrik Heintz***Linköping University (LiU), Sweden*

| PLENARY

A European Perspective on Artificial Intelligence in Law Enforcement

Europe has taken a clear stand that we want AI, but we do not want just any AI. We want AI that we can trust. It is important to keep in mind that AI is not something in a distant future, but something already here and influencing all aspects of our modern society. This talk will give an overview of the European perspective on AI and its relation to law enforcement. The starting point is the Ethical Guidelines on Trustworthy AI published in 2018 which is now being followed up by the AI Act for regulating the use of AI. The regulating in the AI Act will also influence law enforcement, as a ban on remote biometrical identification may be included. Then I will present some of the main European initiatives and what they can provide.

A special focus will be placed on the TAILOR network of AI research excellence centers that is developing the scientific foundations for Trustworthy AI through the integration of learning, optimisation and reasoning. I will present some of the major research themes and give some concrete examples related to law enforcement. The talk will conclude with opportunities and challenges related to AI in law enforcement.



2 June

Abstract no: PS007

**Peter M. Schneider**

| PLENARY

Institute of Legal Medicine, Faculty of Medicine, University of Cologne, Germany,

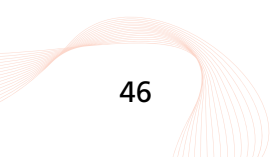
Recent advances in forensic DNA phenotyping: the VISAGE Enhanced Tool offering new methods and markers for predicting appearance, ancestry and age

The VISible Attributes Through GENomics – VISAGE – Consortium has been funded 2017-2021 by the EU under the Horizon 2020 Security Program. It has aimed to overcome the general limitation of current forensic DNA analysis by broadening forensic DNA evidence towards constructing composite sketches of unknown perpetrators from biological traces, working within current legal frameworks and ethical guidelines.

The VISAGE Project has developed and validated prototype tools for DNA analysis and biostatistical interpretation to predict a person's appearance, biogeographic ancestry and age from DNA traces. The data obtained can help to identify unknown perpetrators of crime not recognised from standard DNA profiling via focussed police investigation, as well as contribute to the identification of unknown human remains. The enhanced toolkit consists of two separate library kits for MPS platforms, one for genotyping to analyse SNP markers for appearance and ancestry, and the other for bisulfite sequencing of epigenetic CpG markers suitable for age prediction.

Based on an improved set of SNPs for the currently used markers for eye, hair and skin colour, additional externally visible characteristics that include freckles, eyebrow colour, hair structure, and male pattern baldness. Ancestry prediction covers seven geographic regions for bi-parental ancestry based on autosomal SNPs and in addition, paternal ancestry based on Y-SNPs. Age prediction is designed for analysing blood, saliva, semen and bone samples. The results of the genotyping and bisulfite sequencing analyses are processed using the VISAGE Software Tool that generates probabilities or linear predictions for the targeted traits, respectively, that the software enables based on the legal framework in a given country.

Acknowledgement: The VISAGE Project & Consortium has received funding from the European Union Horizon 2020 Framework Programme for Research and Innovation, Secure Societies Challenge under grant agreement 740580.





2 June

Abstract no: PS008

**Justice Tettey****| PLENARY***Laboratory and Scientific Section, United Nations Office on Drugs and Crime (UNODC)*

Trust me? I am a forensic scientist

Forensic science, the interface between science and the law, continues to play a vital role in drug control, crime prevention and criminal justice systems. The quality of forensic science findings may have profound implications on human rights and the development of evidence-based policies, for example in response to emerging drug threats. Like most scientific disciplines, forensic science is not immune to ethical dilemmas associated with issues such as professional competence, objective testimony, independence and resource constraints.

The presentation looks at some of the challenges faced by forensic scientists today from a global perspective which affects the basic assumptions of ethics and trust in preserving human rights and administering justice. It concludes with an outlook of how forensic science practice at a global level, can overcome some of its ethical dilemmas.



3 June

Abstract no: PS009

**John M. Butler***U.S. National Institute of Standards and Technology***| PLENARY**

Are We On the Right Side of the Equation? Becoming Outcome-Focused Versus Process-Driven

Involvement of the U.S. National Institute of Standards and Technology (NIST) in forensic science spans almost a century beginning with Wilmer Souder's efforts in the 1920s involving handwriting, typewriting, and ballistics analysis. NIST increased its involvement in the field after a 2009 National Academy of Sciences study identified areas for improvement in forensic science. Today, NIST conducts collaborative research, partners with the community to strengthen policies and practices, convenes meetings to examine issues, and explores scientific foundations of forensic methods and practices (see <https://www.nist.gov/forensic-science>).

Perspectives gained in the past few years from conducting scientific foundations of multiple forensic methods and practices will be discussed. For example, do we understand principles behind how things work and why things are done? Do we spend sufficient time to understand important findings published in the scientific literature? Have our approaches in forensic science become too task- or process-driven compared to outcome-focused?

As researchers or practitioners, do we regularly step back and critically consider our performance with those activities in which we are involved? What data demonstrate what we think we know about the performance of a particular methodology or interpretation approach? Who should have access to validation data? How might validation studies and data sharing differ if performance criteria were emphasized to understand method limitations versus simply meeting accreditation requirements? Are reports clear enough to end users? Simply put, are we on the right side of the equation?

A blurred background image of a scientist in a lab coat holding a rack of test tubes. The test tubes have various colored caps (purple, blue, pink). In the center, there is a black hexagonal graphic with a red border containing the word 'CHEMISTRY' in white capital letters. White wavy lines are overlaid on the image, flowing around the central graphic.

CHEMISTRY



31 May

Abstract no: KN001

**Simon Dunne**

| KEYNOTE

The National Forensic Centre, The Swedish Police Authority, Linköping, Sweden

Chemical Intelligence – impurity profiling in real time meets impurity profiling in real labs

Chemical profiling of narcotics often leads to a wealth of information regarding synthetic routes, cutting agents, ageing history and possible links to other seized materials. Taken together with indices such as the nature of the impurities, concentration of the illicit substance and packaging characteristics, a complex web of data is amassed, needing thorough evaluation in order to provide forensic evidence. Whilst traditional profiling methods have relied upon visual comparisons of chromatographic traces, a greater degree of objectivity can be achieved using automated chromatogram processing coupled with multivariate data analysis.

The success of any mathematical model relies strongly on data quality. In-depth knowledge of the profile's chemical constituents, their physiochemical properties, chemical interrelationships, matrix effects, instrumental attributes and data processing strategies are essential for reliable comparative analyses. The chemist thereby becomes an indispensable filter for data applicability. A likelihood-based material-specific pairwise ratio comparison method for impurity profiling will be used to demonstrate how the application of Chemical Intelligence can provide strategic intelligence within an operative timeframe. The internal pairwise ratio metric utilized in this method is robust and highly suited for intersequence data comparison. Whilst qualitative visual evaluation of the profile at the macro and micro level remains a feature of current methodology, the transition from quantitative analysis of a finite subset of reference peaks to that of the complete profile awaits as the next challenge, representing a step into the world of Big Data.



1 Jun

Abstract no: KN002

**Pierre Esseiva**

| KEYNOTE

School of Criminal Justice, University of Lausanne, Switzerland

Real time analysis of illicit drugs, an opportunity to cope with the trend toward the decentralization of forensic capabilities

The analysis of drugs (illicit products or counterfeit medicines) faces many challenges, mainly regarding the production of timely and reliable results and the production of added value from the generated data. It is essential to rethink the way this analysis is performed, in order to cope with the trend toward the decentralization of forensic applications. This presentation describes the quantitative and qualitative validation of an ultra-portable near-infrared detector connected to a mobile portable application. This methodology allows the analysis and display of results to end users within 5 seconds. The possibility to geolocate the measurements and to monitor them in real-time generates a new set of tools to interpret the data and to extract intelligence.

We will describe the building and deployment of dedicated databases as well as the development of statistical models and their validation. A particular focus will be placed on the presentation of real case studies demonstrating the utility of the approach as well as the use of these results in a legal perspective.



30 May

Abstract no: OP011

**Jennifer Bonetti****| ORAL**

Virginia Department of Forensic Science; University of Amsterdam van 't Hoff Institute for Molecular Sciences

International inter-instrument stability and chemometric analysis of mass spectral data for NPS isomer differentiation

Chemometric analysis of mass spectral data for the purpose of differentiating positional isomers of novel psychoactive substances (NPS) has seen a substantial increase in popularity in recent years. However, the process of generating a large and robust database for chemometric isomer identification is time consuming, especially if new reference data needs to be acquired over time and for different instruments. To address this problem, an international collaboration has been established with the goal of collecting sufficient data across multiple gas chromatography/mass spectrometry (GC/MS) systems from various instrument vendors in order to generate a model dataset that reflects inter-instrument variability. Particular emphasis is placed on data pre-processing techniques and hyperparameter tuning resulting in a chemometric model that is minimally sensitive to instrumental fluctuations. In doing so, the long-term goal of the project is that forensic experts worldwide will ultimately be able to use this model as a tool for isomer identification of their MS data without requiring the purchase of primary drug standards and the creation of a reference GC-MS dataset.

To begin this collaborative effort, three sets of positional ring isomers (fluoroamphetamine, fluoromethamphetamine, and methylmethcathinone) have been analyzed over a twelve-week period using multiple instruments at both the Virginia Department of Forensic Science and the illicit drug analysis laboratory of the Amsterdam Police. Several supervised machine learning algorithms have been applied to this dataset and are able to successfully classify both randomly chosen and instrument-based held-out test sets.



30 May

Abstract no: OP013

**Jennifer Bonetti**

| ORAL

University of Amsterdam Van't Hoff Institute for Molecular Sciences; Virginia Department of Forensic Science

Machine learning for the differentiation of positional NPS isomers with direct analysis in real time mass spectrometry

The differentiation of positional isomers is an established analytical challenge for forensic laboratories. As more novel psychoactive substances (NPS) are introduced, improved methods of isomer identification are needed. Although Direct Analysis in Real Time – Time-of-Flight mass spectrometry (DART-ToF) can currently be used to differentiate some positional isomers, it is unclear whether this capability extends to isomers whose only structural difference is the exact location of a single substitution on an aromatic ring.

The aim of this work was to determine whether chemometric analysis of DART-ToF data could offer forensic laboratories an alternative method of differentiating NPS positional ring isomers. To test the feasibility of this technique, three positional isomer sets (fluoroamphetamine, fluoromethamphetamine, and methylmethcathinone) were analyzed ninety-six times each over an eight-week timespan. The classification methods investigated included a univariate approach, a multivariate approach, and a machine learning approach. For each method, multiple validation techniques were used including restricting the classifier to data that was only generated on one day. Of the three, the machine learning option, the Random Forest algorithm, was ultimately the most accurate and robust, consistently achieving out-of-bag error rates below 5%. At an inconclusive rate of approximately 5%, a success rate of 100% was obtained for isomer identification when applied to a randomly selected test set. The model was further tested with data acquired as a part of a different batch. The highest classification success rate was 93.9%, and error rates under 5% were consistently achieved.



30 May

Abstract no: OP016

**Ruben Kranenburg**

| ORAL

Dutch National Police, Amsterdam, The Netherlands; University of Amsterdam, Amsterdam, The Netherlands

NPS Identification in Forensic High-Volume Casework Laboratories: Chemical Challenges and Analytical Solutions

In the last decade, forensic laboratories are confronted with the rise of over 1000 different new psychoactive substances (NPS). These substances often appear in groups of closely related, isomeric species. In addition, legal status may change among individual isomers fueling the replacement of recently controlled substances by novel, unknown drug compounds.

This has significantly complicated the analytical workflow for forensic drug-testing laboratories. Traditional GC-MS-based approaches fall short since ring-isomeric NPS yield similar retention times and mass spectra. In this talk, various novel strategies are discussed for NPS identification: GC-Vacuum Ultraviolet (VUV)¹ and GC-solid deposition-FTIR² are highly diagnostic for ring-isomers. Both proved successful in NPS identification as an orthogonal addition to MS. For unknown substances, Infrared Ion Spectroscopy (IRIS) was capable of identifying the precise isomeric form of unknowns, without reference standard and even at low concentration and in mixtures.³

Most excitingly, even routine GC-MS instrumentation was found suitable for ring-isomeric NPS differentiation. Two approaches for ring-isomer differentiation by GC-MS are presented: i) by means of derivatization and ii) by applying chemometric modelling on the mass spectral data.⁴

[1] Kranenburg et al., 2019, For. Sci. Int. DOI: 10.1016/j.forsciint.2019.109900

[2] Kranenburg et al., 2021, For. Chem. DOI: 10.1016/j.forc.2021.100346

[3] Kranenburg et al., 2020, Anal. Chem. DOI: 10.1021/acs.analchem.0c00915

[4] Kranenburg et al., 2020, For. Chem. DOI: 10.1016/j.forc.2020.100225



30 May

Abstract no: OP021

**Benedikt Pulver**

| ORAL

State Bureau of Criminal Investigation Schleswig-Holstein, Kiel, Germany; Institute of Forensic Medicine, Forensic Toxicology, Medical Center – University of Freiburg, Freiburg, Germany

Synthetic cannabimimetics with cyclobutyl- and norbornyl methyl side chain – Pharmacological data and legislation

Synthetic cannabimimetics (SC), the largest group of NPS, possess unique dynamics in Germany, where designer drug producers continuously bring new variants to the market to circumvent legislation. In 2019-2020, the cyclobutyl methyl (CBM) group, unknown as a building element of SCs before, was identified in three SCs. The following year, indole, indazole and γ -carbolinone SCs featuring a norbornyl methyl (NBM) side chain were detected post-amendment of the new psychoactive substances act (NpSG). Both moieties underpin the drug market dynamics to design SCs without precedent in scientific literature or patents reacting to changes in the NpSG. Structural elucidation and analytical characterization of the six SCs were performed by the ADEBAR project (GC-MS, (N)-IR, GC-sIR, NMR, LC-(HR)MS and Raman). Pharmacological evaluation allows for estimation of in vivo potency and potential harm required as scientific evidence for NpSG amendment. All six SCs are full agonists at CB₁ compared to Δ^9 -THC and CP-55940. The three cannabimimetics of the CBM group showed binding affinities from 29.4 to 0.65 nM (CBMICA » CBMINACA > CBMeGaClone). The potency of the compounds increased in the same order (EC₅₀: 483-40.1 nM). The norbornyl derivatives exhibit higher affinities (K_i: 1.87 – 0.25 nM), with indazole the most affine. Functional activity confirms the indazole being the most potent and efficacious of all three NBM SCs (EC₅₀: 169-1.78 nM). New CBM and NBM SCs have been detected by the ADEBAR project in Germany, all being full agonists at the CB₁ receptor. The pharmacological data underpin the abuse potential and facilitated NpSG amendments.



30 May

Abstract no: OP022

**Mia Abbott**

| ORAL

Staffordshire University, Stoke-on-Trent, United Kingdom

The development of methodologies for the identification of new synthetic cannabinoids

Introduction: Synthetic cannabinoids (SC) are extremely popular within the prison system and cause problems for prisoners, law enforcement and health services. SC are often soaked into paper then posted into prisons therefore, one of the aims of this research is to collaborate with Rapiscan Systems Ltd. and local prisons to measure the effectiveness of trace detection methods for the identification of SC in letters using the Itemiser®3Enhanced.

Method: To ensure compounds do not go undetected, samples that flag up on the Itemiser® as unknown are analysed using Gas Chromatography-Mass Spectrometry, Liquid Chromatography-Quadrupole Time-of-Flight Mass Spectrometry and Nuclear Magnetic Resonance Spectroscopy to identify chemical characteristics which allow comparison to online reference spectra. Sample data spanning three years from one prison Itemiser® was collated to identify trends and influences of updates to the library on trace detection.

Results: To date, the method has identified seven compounds: ADB-FUBINACA, MMB-FUBINACA, 5F-ADB, 5F-MDMB-PICA, MMB-022, 4F-MDMB-BUTINACA and MDMB-4en-PINACA on documents entering the prison which were not already included on the Itemiser® library. As a result, the libraries on prison instruments have been updated to ensure future detection of such compounds. Trends and influences from the processed Itemiser® data were also reported back to the prison.

Conclusion: This research directly benefitted both the prison service and Rapiscan Systems Ltd. and it is anticipated that the continuation of this research could lead to a mutual exchange of information expanding to forensic providers and other research institutions.



31 May

Abstract no: OP005



Kelly Brown

University of Strathclyde, Glasgow, UK

| ORAL

Electrogenerated luminescence the future strategy for drug detection: making light work of complex matrices

Novel psychoactive substances (NPS) are often considered one of the major ticking time bombs in regard to public health. With increased NPS abuse, the stereotypical drug user no longer exists. Instead, a culture of multi-drug use, with users spanning all classes has emerged making these substances increasingly difficult to identify. Yet, their popularity amongst consumers is not mirrored within forensic research. With current screening methodologies largely unable to detect these substances, they seem almost invisible to authorities with distribution concealed within decorative plant material or impregnated book pages. This inability to identify these substances, sees their distribution remain largely uninterrupted compounding the high death rates amongst users.

To tackle this trend, it is vital that new robust screening methods are developed, addressing the limitation of those currently in place, namely colour subjectivity and a lack of matrix compatibility. To this end, the development of electrochemiluminescent (ECL) sensors are detailed. These low cost and extremely portable systems have been successfully applied for the direct detection of target analyte's in a range of forensically relevant matrices including, herbal material, commercial drinks and biological fluids (serum, saliva, sweat and urine) all of which have direct relevance to the forensic arena. Moreover, the abrasive ECL technique developed, allowed direct detection from a roughened surface via mechanical application, including plant material or impregnated objects, with no surface damage or signal detriment of note. With direct NPS detection achieved the system is primed for use in-field by non-experts.



31 May

Abstract no: OP009

**Torsten Schoenberger****| ORAL**

Federal Criminal Police Office, Forensic Science Institute, Central Analytics II, Wiesbaden, Germany

Global collaboration in sharing analytical data – The NPS Data Hub

The NPS Data Hub (NPS DH) is an excellent example of how the forensic community is working together to create valid data sets by leveraging new technological capabilities. It has been developed by a cooperation between the BKA, NIST, and DEA (both USA) and the software company Sciformation (Germany). The principle idea is sharing analytical data and additional information on New Psychoactive Substances (NPS) and now also on other drugs and drug-related substances. With that tool, analytical data needed for identification can be provided for newly emerging substances without any bigger delay.

Currently, more than 4600 datasets (different substances) are included. 900 users of 410 institutes from all over the world are connected.

The NPS DH can cope with all kinds of data formats. Most of the analytical data formats are readable here. A lot of metadata is also given for all substances, such as other names, CAS numbers, and clear identifiers (e.g. INCHI). The key information on a dataset is the unique chemical structure.

The NPS DH follows a community-driven Wiki-like approach. All users can upload or download data. Numerous search options are provided. Many interfaces to other platforms and systems have been developed in order to collect even more data, increase the reliability of the data, and assess the validity of the data added. The data validity is rated by a scoring system. This part will be significantly improved and expanded in the near future. The plans for this will be presented.

The NPS DH should become also the collection portal for data provided by the ENFSI Drug Working Group members. It will be synchronized with the ENFSI databases for MS, IR, and NMR.



31 May

Abstract no: OP010

**Lynn Dennany***University of Strathclyde*

| ORAL

Illuminating Electrochemical Forensic Evidence

Within forensic science, the need for rapid, portable, sensitive and selective detection is one of the fore front challenges within current sensor development. Electrochemistry offers a unique option to fulfil these demands. Through an understanding of physical properties of target compounds, including illicit drugs, and exploiting these properties, reliable and portable sensors can be developed for forensic applications. Within this contribution, we report on the variety of approaches which can be utilized to screen for a wide variety of illicit substances and the novel approaches made to discriminate different illicit substances dramatically adding to the information available at crime scenes. This additional knowledge, beyond that provided by presumptive tests, can aid the forensic scientist in their decision making at the crime scene.

In addition, the potential of these sensors to be exploited for a wider variety of evidence at crime scenes, from gun shot residue, explosives to bodily samples is explored. This contribution will examine the potential of electrochemical sensors as well as the current limitations to translation. This will form the basis of a proof of concept for the provision of novel, flexible and innovative solution to the detection of target drugs, active metabolites for toxicological examination, through to crime scene investigation. The key objective will be to determine the feasibility of this electrochemical technique for portable, as well as multiplexed sensing.



31 May

Abstract no: OP015



Elodie Lefrançois

| ORAL

School of Forensic Science, University of Lausanne, Lausanne, Switzerland

Monitoring illicit drug use: added value from the chemical analysis of used syringes

Forensic science relies on the analysis of physical evidence left during activity, potentially criminal. We decide to apply such an approach to the remnant of traces conveyed by used injecting equipment. This project which is based on syringe residues analysis seeks to complement existing data on substances injected by users, by providing timely and local information.

During five consecutive years, injecting equipment was collected from injection kit dispenser with bin located in Lausanne over a one-week period. Their residual content was analysed by GC/MS. Over the five years, 931 syringes were analysed. Cocaine was the most commonly detected substance showing the large consumption of this substance by injecting drug users in Lausanne, Switzerland. Cocaine and heroin was the most frequent combination. In the first two years, drugs identified by analysis were compared with drug type self-reported by injecting drug users. The two datasets show similar patterns. Evolution over the years and European trends will be discussed, regio-specificity and breaks in time series will be highlighted.

According to the latest World Drug Report, the available substances and their compositions on the market are becoming increasingly diversified and complex. However, the same type of indicators has been used to monitor consumption since over twenty years (self-reported surveys). While this data is informative, it is often delayed due to the collection procedure and is not analytically confirmed. No individual measure provides an accurate representation of local drug consumption. Our approach allows to combine analytical with other data in order to have an overall picture of the drug market.



31 May

Abstract no: OP018

**Michael Cole**

| ORAL

Life Sciences, Faculty of Science and Engineering, Anglia Ruskin University, Cambridge, United Kingdom

Profiling of the South African street drug “nyaope” using GC-MS

Nyaope is a mixture of heroin and cannabis products containing antiretroviral and other drugs. We describe the development of an analytical method for the storage, extraction, identification, profiling and comparison of the drug using gas chromatography – mass spectrometry (GC-MS).

The drug mixture was stable for at least 24 hours when stored in a refrigerator protected from moisture to prevent the photodecomposition of Δ^9 -tetrahydrocannabinol and the hydrolysis of diamorphine.

Δ^9 -tetrahydrocannabinol, the components of heroin, caffeine, dextromethorphan, phenacetin and the antiretrovirals efavirenz and nevirapine were stable when extracted into tertiary butyl alcohol, exhibiting stability on a GC-MS autosampler for up to 72 hours.

The method had a quantitation accuracy of 80–120%, precision values of less than 20% and linearity of detector response where $R^2 \geq 0.99$. Detection limits for diamorphine, efavirenz, nevirapine and Δ^9 -tetrahydrocannabinol were 14.2, 18.6, 18.7 and 9.94 pg on column, and limits of quantitation of 43.1, 56.3, 56.6 and 30.1 pg on column. Recoveries and ruggedness achieved recognised standards.

Samples could be discriminated into original batches using the method and Principal Component Analysis and Hierarchical Clustering. The matches were confirmed by comparison of the chromatographic profiles.

It is now possible to identify / profile the Southern African drug nyaope. The method will assist law enforcement agencies in the identification / comparison of nyaope samples, facilitating the prosecution of nyaope related offences in South Africa and neighbouring countries. It also provides a method should nyaope be found within the European context.



31 May

Abstract no: OP020

**Kathryn Burton****| ORAL**

Leverhulme Research Centre for Forensic Science, University of Dundee, Dundee, United Kingdom

Selective and sensitive LSPR enhanced fluorescent ZnSe/In₂S₃@AuNP nanobiosensor for cocaine detection

We report on the development of a new ultrasensitive fluorescent nanobiosensor for the detection of cocaine. A novel quantum dot (QD) consisting of an amphiphilic polymer (Amp-P)-coated ZnSe core-In₂S₃ shell was synthesised, with a quantum yield of 87% (fluorescence-ON). These were then electrostatically bound to cetyltrimethylammonium bromide (CTAB)-coated gold nanoparticles (NPs) resulting in fluorescence-OFF. A thiolated anti-cocaine aptamer (Apt) was physically adsorbed onto the QD-NPs nanohybrid complex to be the biological receptor. Adding cocaine to the Apt-Amp-P-QD-CTAB-NP nanobiosensor assay using a novel buffer MES-Trizma® acetate-NaAc-Kac-KCl-HCl at pH 5 resulted in the cocaine molecules binding with the anti-cocaine aptamer causing a signal to the QDs leading to fluorescence-ON which was amplified by the localised surface plasmon resonance (LSPR) effect of the AuNPs. Under optimum conditions, the LSPR enhanced detection of cocaine gave a detection limit of 5.3 nM in under 90 seconds and excellent selectivity against other drugs and the two most common metabolites of cocaine were achieved. Detection of cocaine within spiked samples of mixed drugs was also successful.



31 May

Abstract no: OP024

**Edward Sisco***National Institute of Standards and Technology***| ORAL**

Tools and Resources for Seized Drug Analysis

The emerging drug crisis continues to present challenges to the community, including an ever-changing drug landscape, polydrug mixtures, and increasing toxicity. To manage these challenges, laboratories are required to consider new workplace practices, new technologies, and new safety protocols. Adopting and implementing these changes can be difficult as many laboratories have little to no research funding. To ease this burden, the National Institute of Standards and Technology (NIST) has been working with practicing forensic laboratories to develop a number of tools and resources for the community that are focused on various aspects of the analysis chain. This talk presents an overview of these efforts along with discussion of the methods, tools, databases, and other products.

Much of the recent research efforts have been focused on increasing the analytical capabilities of new, and existing, instrumentation in laboratories. Given the need for more rapid, and information-rich screening approaches, NIST has developed a number of resources for implementation of ambient ionization mass spectrometry (AI-MS). These include validation packages, spectral databases, and AI-MS specific search algorithms and software. The use of information-rich screening tools allows laboratories to develop new approaches for confirmation. These could include the use of class-specific gas chromatography mass spectrometry (GC-MS) methods to enhance compound separation or the use of replicate measurements – both areas where recent efforts have been focused and will be discussed. Tools to assist in the identification of unknown compounds, such as the fentanyl classifier, will also be highlighted.



1 Jun

Abstract no: OP001

**Mirjam de Bruin-Hoegée**

| ORAL

University of Amsterdam, The Netherlands; TNO Defence, Safety and Security, Rijswijk, The Netherlands

Chemical attribution of fentanyl from biomedical samples

Chemical attribution typically aims to establish a link between material found at a crime scene and a person or location. In the field of illicit drugs, chemical attribution signatures are usually impurity profiles. Extending these to metabolized samples would create new possibilities in forensic investigations. The possibility of impurity profiling in human biological samples, such as blood, was explored using the potent opioid fentanyl. Two different methods were used to synthesize fentanyl, after which the samples were incubated with liver microsomes to mimic human metabolism. Synthesis-specific marker compounds were identified pre- and post-metabolism by gas chromatography-mass spectrometry (GC-MS), gas chromatography with flame ionization detector (GC-FID), liquid chromatography quadrupole-time of flight mass spectrometry (LC-Q-TOF-MS) and liquid chromatography orbitrap mass spectrometry (LC-Orbitrap-MS). These markers could be detected up to levels relevant in forensic casework. Subsequently, two distinct synthesis signatures could be modeled using chemometrics. This research demonstrates for the first time the possibility of profiling in biomedical samples, which can provide valuable intelligence with respect to the synthesis method of consumed drugs of abuse.¹

¹M. de Bruin-Hoegée, D. Kleiweg, D. Noort, A.C. Asten, Chemical attribution of fentanyl: The effect of human metabolism, *Forensic Chem.* 24 (2021). <https://doi.org/10.1016/j.forc.2021.100330>.



1 Jun

Abstract no: OP002



Laura Hintikka

| ORAL

National bureau of investigation, Forensic laboratory, Finland

Development and validation of a flexible liquid chromatographic method for the quantitative analysis of seized drugs

The research focuses on quantitative analysis of seized drug samples. At present, there is increasing requirements for testing laboratories in order to confirm their competence. The Forensic laboratory in Finland has several separate quantitative methods based on two different techniques. Maintenance of these methods is laborious and time-consuming. In addition, the extreme conditions in previous methods developed over 20 years ago, were causing problems in the modern liquid chromatography instrumentation.

The objective of the research was to modernize and combine all quantitative methods into one flexible method enabling the addition of new analytes when needed. The liquid chromatographic method with diode array detection was developed and validated during 2021. Simplicity and robustness as well as analytical performance were the main objectives in every step of the method development. Modern reversed-phase column offering good peak shape for basic analytes was selected and used with low-pH mobile phases. Seven analytes were included in the method: amphetamine, methamphetamine, MDMA, cocaine, heroin, α -PVP and α -PHP. The validation indicated that the developed method performed exceedingly well with all these analytes. The sample preparation is straightforward and the linear range covered 0,1-125 wt% of the expected analyte concentration. The method was repeatable and reproducible producing suitable measurement uncertainty.

The proposed presentation will cover the background and performance of the developed quantitative method as well as the summary of the research performed during the method development.



1 Jun

Abstract no: OP003



Anaam Ameen

University of Strathclyde

| ORAL

Development of direct electrochemical detection of synthetic cannabinoid metabolites

Synthetic cannabinoid (SC) metabolites are products of metabolic reactions of the parent SCs, exhibiting higher binding affinity with the CB1 and CB2 cannabinoid receptors than Δ^9 -tetrahydrocannabinol (Δ^9 -THC). In marijuana, Δ^9 -THC is the only active metabolite. However, SCs contain several metabolites that are still active with a high binding affinity with cannabinoid receptors causing toxicological effects. The rise in hospitalisations and fatalities resulting from the prevalence of these SC and their abuse emphasises the need for rapid and accurate screening of the substance within toxicological samples. Research has shown that while SC metabolites are minimal concentrations (nanomolar), they remain fully agonist. Initially, the metabolism of SCs showed little to no change in the parent drugs in urine. However, with changes in SC compound mixture and composition, more and more metabolites are found in urine samples, making it challenging to understand how to detect them using electrochemical ways. Within this contribution, an electrochemical approach to detecting BB-22 and 5F-ADB-PINACA metabolites will be explored. In addition, the feasibility of this approach for direct analysis without the need for pretreatment or extraction will also be demonstrated at low concentrations.



1 Jun

Abstract no: OP004

**Florine Joosten****| ORAL**

*A-Sense Lab, Department of Bioscience Engineering, University of Antwerp, Antwerp, Belgium.;
NANOLab Center of Excellence, University of Antwerp, Antwerp, Belgium*

Electrochemical detection of drug use in oral fluid for roadside drug testing

Illicit drug consumption remains a problem to public safety and health, with abuse of illicit drugs having increased significantly over the last years. A concern related to this abuse is driving under the influence of drugs (DUID). Currently, police and law enforcement agencies rely on the use of lateral flow immunoassays (LFAs), which suffer from a lack of specificity. We present a rapid, sensitive, and affordable electrochemical method for the detection of illicit drugs and their metabolites in oral fluid at screen printed electrodes (SPE). For low level detection, the use of modification of the SPE with nanostructured materials is investigated. Importantly, for the first time, the effects of the oral fluid matrix on the electrochemical sensing of illicit drugs and their metabolites is explored. Interestingly, the electrochemical signals for the drugs are shown to be partially suppressed by the biofouling properties of albumin and most probably other proteins in the OF matrix. Strategies to mitigate these biofouling properties are explored. Additionally, the interference of common cutting agents and adulterants on the electrochemical profile of the selected drugs and metabolites is evaluated. Finally, several commercial oral fluid collection devices are evaluated in combination with the electrochemical method. The developed method shows promising potential in on-site testing for recent illicit drug use.



1 Jun

Abstract no: OP006

**Marc Wermelinger**

| ORAL

University of Lausanne, School of Criminal Justice, Switzerland

Exploring the added value of portable devices in the field of illicit drugs analyses

Facing the problem of backlogs in the forensic laboratories, the field of illicit drugs analyses has recently seen the development of different types of portable devices. Their main purpose is to be used directly by the police in order to reduce the number of specimens that are sent to the laboratories. Although not as powerful as lab equipment, several portable devices have shown promising results. To avoid misuses, the added value of these devices should be explored, in order to establish “good practices” and keep the communication channels open between the police and the laboratories.

A preliminary exploration of this topic has been performed on a drug seizure containing 100 cocaine fingers presenting the same packaging. Every single unit has been analysed using an ultraportable near infrared spectrometer and confirmatory analyses have been performed with gas chromatography-mass spectrometry on a sample of 26 units, selected using a Bayesian sampling plan.

Obtaining qualitative and quantitative data in real time allows the forensic scientist to rapidly assess the distribution heterogeneity of the lot and the validity of the chosen sampling plan. It is then possible to decide if further analyses are needed, whether for validation or profiling and intelligence purposes, and to report in a transparent way the sampling and analysis process.



1 Jun

Abstract no: OP007

**Hervé Rais***School of Criminal Justice, University of Lausanne, Lausanne, Switzerland*

| ORAL

Forensic intelligence through instant non-destructive analysis of falsified medicines via ultra-portable NIR technology

Falsified medicines represent a significant illicit market that is, at least in part, a matter of organized crime. In addition to potentially endangering the lives of those who use them, they can lead to significant economic losses and a drop of confidence in the health system. Although the scale of the problem varies greatly from region to region, it shows no sign of slowing down. It is therefore critical to maintain, strengthen and diversify strategies to understand and disrupt this phenomenon.

In this context, ultra-portable NIR technology can make a major contribution by providing a real time, portable, non-destructive and highly informative approach to tackle various problems associated with medicines. This may include, for example, control of authenticity, establishment of links between counterfeits, screening of imported medicines and quality check.

This presentation showcases the results of several NIR analysis campaigns conducted on falsified and suspect drugs. The instrument used is an OnSite-W MicroNIR from Viavi Solutions (Scottsdale, USA) coupled with a mobile application (via Bluetooth) that send the NIR spectra to a server where the statistical data treatment takes place.

Two case situations are studied. One on medicines used for erectile dysfunction (Viagra and others), the other on medicines used for HIV preventive treatment (HIV PrEP). In both cases, we explore the wide range of information that can be obtained. We also look at some fairly simple but already effective implementation models. Finally, we discuss future analyses and perspectives that should confirm and develop the practical uses of this technology in the field of falsified medicines.



1 Jun

Abstract no: OP008

**Daniel Ruotsalainen**

LECO Nordic, Stockholm, Sweden

| ORAL

GCxGC-TOFMS as a complementary tool in doping control analysis of anabolic androgenic steroids

Current analytical methodologies to detect the abuse of Anabolic Androgenic Steroids (AAS) in athletes consists of extensive sample preparation steps followed by gas chromatography/triple quadrupole mass spectrometry (GC/MS-MS). These determinations encompass the detection of exogenous AAS, i.e. their urinary metabolites, and the quantification of endogenous steroids.

The use of GCxGC-TOFMS adds an additional separation dimension to achieve sufficient resolution and improved mass spectral quality whilst enabling high acquisition rates up to 500 spectra/s on the full mass spectral range. This allows to choose the most selective ions for peak identification and the monitoring of numerous prohibited substances can easily be employed as the number of ion transitions per time frame in the chromatographic run is not limited. Furthermore, the use of routine data for a downstream data mining if new doping agents enter the market or novel long-term metabolites of a known substance are detected, can be performed retrospectively.

To test the suitability of the GCxGC-TOFMS system to fulfil the requirements of sports drug testing, the chromatographic conditions were optimized and tested by parallel measurements of doping control samples including the detection of exogenous steroids and the quantification of endogenous steroids in a single analysis.

The preliminary results demonstrate that GCxGC-TOFMS is a valid complementary tool for sport drug testing. The sensitivity attained for the determination of exogenous steroids is comparable to GC/MS-MS as well as the quantification of endogenous steroids showed comparable values between the two methodologies employed.



1 Jun

Abstract no: OP014



Yu-Hsiang Chang

| ORAL

Criminal Investigation Bureau, National Police Agency, TAIWAN

Mass spectrometry-based identification of NPS in urine samples and abuse trends in Taiwan

The huge amounts of new psychoactive substances (NPS) have been a challenging issue for more than a decade. Hence, a powerful identification tactic and a better understanding of the abuse trend are crucial to shaping future policies. As a national forensic examination institute, we utilize supportive liquid extraction (SLE) and UPLC-Q-ToF mass spectrometer to identify trace amounts of NPS in urine samples. With a database containing more than 700 compounds, analytes can be identified via a single process with merely 500 µL of urine sample. We validated the method by testing 45 NPS out of 9 categories and traditional illicit drugs. All limits of detection (LOD) and limits of quantification (LOQ) are satisfactorily low (0.55-3.56 ng/mL and 5-25 ng/mL, respectively), and most of the linearity is established with the coefficients of determination (R^2) above 0.999 from 5-500 ng/mL to 10-250 ng/mL (33 of 45), demonstrating that the method is suitable for multiple aims of both identification and quantification in NPS/drug examination. Due to its high compatibility, we have employed the methodology to process the massive number of NPS/illicit drug identification cases since 2018 and issued more than 15,000 expertise reports. According to these reports (until Oct. 2021), more than 250 NPS/drug intakes and metabolites have been successfully identified; ketamine and mephedrone are found to be the most commonly abused NPS in Taiwan, which account for 38.10% and 10.51% of positive cases. By analyzing case statistics, we are able to keep up with the abuse trend and inform future drug-controlling strategies.



1 Jun

Abstract no: OP017

**Ruben Kranenburg**

| ORAL

Dutch National Police, Amsterdam, The Netherlands; University of Amsterdam, Amsterdam, The Netherlands

On-scene identification of illicit drugs in seized samples using rapid and portable spectroscopic techniques

Law enforcement agencies are faced with a rise in both the total amount of seizures and the chemical diversity of substances encountered. To effectively cope with these developments, investigators require fast and reliable methods to detect a broad scope of potential illicit substances real-time and on-site. This way, time-consuming transport to a forensic laboratory is avoided and results that can steer the investigative process become available directly at the crime scene.

Unlike colorimetric tests, spectroscopy-based techniques can detect a wide variety of molecules. Raman and Near-Infrared (NIR) analyzers are both fast and portable. In this talk, the performance of a handheld Raman spectrometer is shown by i. retrospective comparison with GC-MS data and ii. analysis of cocaine diluted with various adulterants.¹ In addition, NIR sensors are discussed. Due to their lower price range, these sensors have the potential of becoming a generic tool for the police force. To achieve this, hurdles with respect to spectral selectivity, data modelling, and robustness need to be tackled. Two strategies on both ends of the spectrum are presented: a pocket size, narrow range 740 – 1040 nm NIR², and a tabletop 1300 – 2600 nm NIR³. Both were able to reliably detect cocaine, however the higher wavelength range of the latter instrument enables a broader applicability and more efficient chemometric modelling.

[1] Kranenburg et al., 2021, Drug Test. Anal. DOI: 10.1002/dta.2993

[2] Kranenburg et al., 2020, Drug Test. Anal. DOI: 10.1002/dta.2895

[3] Kranenburg et al., 2022, Drug Test. Anal. submitted Dec. 2021



1 Jun

Abstract no: OP019

**Tobias Rautio***Linköping University, Linköping, Sweden*

| ORAL

Selective alkylation of Indazole-3-carboxylic acid in the synthesis of synthetic cannabinoid metabolites

Synthetic cannabinoids constitute a common subgroup of New Psychoactive Substances (NPS) that is frequently abused. As of December 2020, a total of 1047 unique NPS, of which the synthetic cannabinoids made up 29 %, have been reported to the UNODC Early Warning Advisory on NPS. An intake of synthetic cannabinoids can be difficult to prove as the parent substance is commonly extensively metabolized. In the analysis of urine samples, which is a common sample type in forensic toxicology, the parent compound will often be absent, while formed metabolites may instead be detected. Hence, knowledge of the exact structures of metabolites that are unique for specific synthetic cannabinoids and their availability as certified reference material are prerequisites for successful identification of the abused cannabinoid through the analysis of urine samples.

Synthetic cannabinoids and their metabolites can be synthesized by alkylation of Methyl 1H-indazole-3-carboxylate using an alkyl bromide, followed by hydrolysis and amide coupling of e.g. an amino acid. There are two nitrogen atoms in the indazole core, positions N1 and N2, where position N2 should be alkylated in this case. Unfortunately, the alkylation is not selective and both nitrogen atoms of the indazole may be alkylated, why the final product contains both isomers. In this work, a method that selectively alkylates nitrogen N2 (>99%) of the indazole core was developed and 13 alkyl bromides were used to produce 13 alkylated indazole intermediates. These intermediates were used to produce several metabolites as a proof of concept. Additional metabolites can easily be made as the intermediates are available on the shelf.



1 Jun

Abstract no: OP025



Thomas Castaing-Cordier
Nantes Université, CNRS, France

| ORAL

Toward an integrated and mobile NMR-based analytical platform for the characterization of illicit drugs

New Psychoactive Substances (NPS) are an increasing threat for the health of citizens. NPS are not regulated and can be easily purchased on the internet or in the street. To regulate in real time NPS appearing on the market, it is essential to quickly characterize them. In this framework, there is a great need of analytical techniques with efficient structure elucidation capabilities such as Nuclear Magnetic Resonance (NMR) spectroscopy. During the last decade, a new generation of compact NMR instruments has emerged. Such instruments are cheap, do not require dedicated staff and can be installed on a benchtop¹. However, compact NMR has some limitations such as a weaker spectral resolution and a reduced signal sensitivity. To enhance compact NMR performance for characterizing NPS, we implemented NMR experiments as bricks of a new integrated analytical platform. In addition, a workflow combining NMR and IR with the assistance of a multi-technical database of 60 entries in the ACD/Labs software has been created to characterize NPS. A blind validation of the workflow has been carried out with 6 different samples. This validation step highlighted the identification of already encountered structures without ambiguity. Moreover, it was also possible, for the first time, to achieve a Structural Elucidation Assisted by Software (SEAS)² for cases that require a medium level of NMR elucidation expertise. The new integrated compact NMR-based analytical platform dedicated to NPS paves the way to the elucidation of unknown drugs in a routine way for forensic, police and custom laboratories.

References:

¹Castaing-Cordier et al. *FSI* 2021

²Castaing-Cordier et al. 2022 (submitted)



3 Jun

Abstract no: KN006

**Jonas Malmborg***National Forensic Centre, Sweden*

| KEYNOTE

The forensic comparison of mineral oils

The CEN methodology for oil spill identification is developing a 3rd edition, now moving from guideline to standard. The expert body responsible for the methodology is the Bonn Agreement Oil Spill Id Network (OSINet). OSINet includes 43 laboratories from all over the world, but as these mainly are research institutes, military laboratories, or universities, the forensic community is largely unaware of oil fingerprinting methodology. However, the method could be applied to forensic applications other than oil spills at sea, e.g. land-based oil spills, fuel theft, weapons grease, lubricants in sexual offenses, or arson cases. The purpose of this contribution is to increase the forensic community awareness of the well-developed, applicable oil fingerprinting methodology.

The methodology relies on a tiered analytical approach using GC/FID and GC/MS including semi-quantitative diagnostic ratios. Ratios between the peak heights of compounds selected by their diversity in chemical composition in petroleum products are considered to be diagnostic for oil correlation. The method specifies ca. 25 such ratios to be examined for each type of oil, except for the highly refined lubricating oil type where only 10 suitable ratios have been defined. The methodology also contains a visual tool to detect weathering of the oil samples, e.g. evaporation of low-boiling compounds or microbial degradation. The talk will contain introduction to the methodology, basic criteria for setting up the method – i.e. sample prep, instrumentation and selected compounds used for fingerprinting depending on oil type. I will also show the weathering tool.



3 Jun

Abstract no: OP012



Fabienne Pfeiffer

| ORAL

School of Criminal Justice, University of Lausanne, Switzerland

Large-scale surveillance of hydrophobic contaminants in the Lake Geneva basin and investigation of pollution sources

Even though water is protected by various legislations, pollution by chemicals still occurs daily, as industrial chemicals, consumer products and pesticides find their way into natural waters. The presence of these chemicals, even in low concentrations, is of concern because of their high toxicity and their unknown long-term effects on aquatic life and human health. Thus, with the increase in human population and activities, water pollution has become an urgent security issue. By integrating traces caused by water pollution in an intelligence-led investigative approach, forensic science can aid authorities addressing this problem and support them in their decision-making.

Two large-scale surveys of chemical micropollutants in the Lake Geneva basin were conducted using a passive sampling-based approach. Contrary to current approaches, passive sampling provides high data comparability, sensitivity and temporal representativeness. In the present study PCB, PBDE and PAH were studied on over 30 sampling sites in Switzerland and France. Three relevant features (concentration, load and chemical profile of pollutants) were extracted. The results highlighted the rivers with the highest concentrations or loads. The chemical profiles, combined with knowledge of the geographical and historical context of the rivers, was used to investigate pollution sources. This methodology can be used to prioritize the surveillance on the most contaminated surface waters and to test hypotheses about pollution sources. The produced intelligence can support authorities in the investigation and trial of current pollutant sources, as well as in preventing current chemical releases from being continued.



3 Jun

Abstract no: OP023

**Naomi Reymond***School of Criminal Justice, University of Lausanne, Lausanne, Switzerland*

| ORAL

The use of passive samplers to monitor pesticides in rivers and to produce knowledge on contamination sources

Water pollutions, whether they are chemical, physical, or biological, have significant impacts on ecosystems and are of increasing importance in our society. In Europe, legal frameworks exist to protect the environment. For instance, the EU Water Framework Directive requires all member states to monitor and improve their water quality.

In Switzerland, regional environmental agencies detected chronic pesticides pollutions in several small water streams. In this work, this initial information was used to implement a monitoring campaign in one of the impacted rivers to produce further knowledge on the extent of the problem and possible contamination sources.

A passive sampling-based approach was implemented for 9 months in two sites to continuously collect contaminants released by human activities and improve the understanding of the problem. More than 40 pesticides, accumulated on polar samplers, were analyzed using LC-MS/MS. Performance reference compounds spiked on co-deployed nonpolar samplers were analyzed by GC-MS/MS and used to take the impact of water velocity into account. The second site was additionally monitored by active sampling to compare the results of the two methods.

Passive sampling allowed obtaining the time-weighted average concentration of target compounds at the two sites. The combination of qualitative and quantitative data collected by passive sampling allowed to further evaluate water quality, compare contaminations between sampling sites and gain spatio-temporal information about pesticides in a river of interest. Deploying samplers in additional sites would be useful to further investigate the origin of the contaminants in this river.



3 Jun

Abstract no: OP041

**Olli Laine**

| ORAL

National Bureau of Investigation, Vantaa, Finland

Development of a likelihood ratio-based comparison method for oil spill identification

A likelihood ratio (LR)-based comparison method was developed for oil spill identification. A score-based approach was selected for LR calculation by using a Bayesian network. In oil spill identification a comparison method is needed to connect oil spill samples to potential source samples. Spill samples are typically collected from waterborne oil spills. Spill and source samples are analysed by gas chromatography with flame ionisation detection (GC-FID) and mass spectrometry (GC-MS) by using methods defined in an international standard. A scoring system was established for GC-FID and GC-MS data to estimate similarity of the samples compared. The system includes parameters originating from sample components identified by both analytical techniques. Parameters for quality of analytical data are also included in scoring. LR values are calculated for comparison pairs based on scoring. The score-based approach for LR calculation developed here is planned to be applied later to other forensic comparison studies.



2 Jun

Abstract no: KN003

**Hans Önnnerud***Swedish Defence Research Agency (FOI)***| KEYNOTE**

Homemade explosives – a multifaceted detection challenge

Homemade explosives (HMEs) are commonly encountered in bomb attacks. Ordinary consumer chemicals can be precursors to HMEs. They can be maliciously used to manufacture HMEs that can be weaponised into an Improvised Explosive Device. Since HMEs can consist of a variety of different mixtures, they are a challenge from an analysis and detection standpoint. The European precursor regulation is important and obstructs the synthesis of HMEs by limiting the access to certain consumer chemicals. Nonetheless, more and improved countermeasures are needed. Better detection capabilities of precursors and explosives are of help to the forensic community. To understand this ever-changing threat, it is important to increase the knowledge on how and which precursors that can be transformed into working explosives. Over the years, European research efforts have studied various tools for disruption of different timeline phases: examples include the inhibition of precursors, detection systems for localisation of bomb factories, better forensic methods for hindering an upcoming attack, and ways to assess type and weight of used explosives quickly after an attack. The different phases of the timeline offers opportunities to counter illicit activities each and one with its own difficulties. Collaboration is a key activity for researchers in order to improve or develop new, sophisticated techniques that can be useful in forensic investigations. From a few historical, closed projects up to currently active projects, a summary of achievements will be outlined, where one focus is on analysis and detection of precursors and explosives across the timeline of the plot.



2 Jun

Abstract no: OP026

**Anne-Flore Prior****| ORAL**

School of Criminal Justice, University of Lausanne, Lausanne, Switzerland; Royal Military Academy, Brussels, Belgium

Application of ultra-portable NIR technology to hydrogen peroxide precursor and peroxide-based explosives

Hydrogen peroxide is an essential precursor for the synthesis of peroxide-based explosives. Its detection is an issue for on-site technologies, and its quantification is time-consuming in the laboratory. Portable Raman is generally used for field analysis, and its powerful laser generates fluorescence, which hampers the detection process. To overcome this problem, ultra-portable NIR technology has been tested on different concentrations of hydrogen peroxide. The portability and speed of the analysis allows easy deployment of this instrumentation on site. However, a sampling step is required for liquid specimens.

Ultra-portable NIR technology can successfully detect hydrogen peroxide within a liquid solution, with no risk of false positive known so far. More importantly, it shows convincing results regarding its quantification. By using a chemometric calibration method, a predictive model has been created and validated. It allows for a quasi-instantaneous determination of the concentration of hydrogen peroxide in a solution with reasonably low prediction error for unknown samples. This provides first-responders a relevant measurement of the specimen they are handling.

For field analysis of possible peroxide-based explosives, portable Raman has the main disadvantage of having a powerful laser as illumination source. To avoid problems with energy-sensitive materials, a lower intensity and therefore a longer analysis time is required. In this perspective, ultra-portable NIR analysis has been tested as it is fast, contactless, non-destructive and does not present a risk with energetic materials.



2 Jun

Abstract no: OP027

**Rick S. van den Hurk**

| ORAL

University of Amsterdam, Amsterdam, the Netherlands; Centre for Analytical Sciences Amsterdam (CASA), Amsterdam, the Netherlands

Characterization and comparison of smokeless powders by on-line two-dimensional liquid chromatography

Smokeless powders (SPs) are one of the most commonly used propellants for ammunition but can also be abused as energetic material in improvised explosive devices such as pipe bombs. SPs comprise nitrocellulose (NC) and additives. Therefore, the characterization of both NC and the additives is of significant forensic importance. Typically, the classification and chemical profiling of smokeless powders is based on the analysis of the additives. In this study, information regarding the NC component was combined with the chemical analysis of the additives using two-dimensional liquid chromatography (2D-LC). The system combines size-exclusion chromatography (SEC) and reversed-phase liquid chromatography (RPLC) in an on-line heart-cut 2D-LC configuration. In the first dimension, the NC is separated from the additives and characterized by its molecular-weight distribution (MWD). The additives are then transferred to the second-dimension separation using a novel analyte-transfer system. In the second dimension, the additives are separated to obtain a detailed profile of the low-molecular-mass compounds in the SP. With this approach, the MWD of the NC and the composition of the additives in smokeless powders have been obtained within an hour. A discrimination power (DP) of 72.63% was obtained when studying exclusively the NC MWD. Combined with the additive profile, an overall DP of 99.86% was obtained using 2D-LC. This novel combination enables detailed forensic comparison of intact SPs. Compared to previous methods, no extensive sample preparation is required, making the developed method less labor-intensive.



2 Jun

Abstract no: OP028

**Arian C. van Asten****| ORAL**

van 't Hoff Institute for Molecular Sciences, Faculty of Science, University of Amsterdam, the Netherlands; Co van Ledden Hulsebosch Center, Amsterdam Center for Forensic Science and Medicine, University of Amsterdam, the Netherlands

Chemical attribution of the Homemade Explosive ETN

In a joint effort, forensic explosive experts from the USA (URI) and the Netherlands (NFI, TNO and the UvA) conducted an extensive study into the chemical attribution of the organic explosive ETN (erythritol tetranitrate) [1-2]. This nitrate ester is increasingly encountered in forensic explosive casework due to the unrestricted access to the precursor erythritol (primarily used as low-calorie sugar alternative in foods) and the possibility to synthesize it in a domestic setting (homemade explosive, HME). An extensive set of ETN samples was synthesized using different erythritol sources and variable reaction schemes (i.e. the nitrate salt and mixed acid protocol) and conditions. These samples were subsequently characterized using LC-MS and IRMS. With LC-MS partially nitrated impurities can be analyzed at trace level. With custom-made standards accurate quantitation of these trace impurities is feasible which can assist in batch differentiation. The absolute levels provide information with respect to the clean-up procedure applied after synthesis. Using IRMS a detailed light element isotopic signature (d_2H , $d_{13}C$, $d_{15}N$ and $d_{18}O$) of the ETN samples and associated raw materials was established. IRMS, although laborious, not only showed great potential for ETN batch differentiation but also allowed experts to investigate possible links between ETN and the precursors used for its synthesis.

K. Bezemer, et al., Forensic Science International, 307(2020)110102

K. Bezemer, et al., Forensic Science International, 313(2020)110344



2 Jun

Abstract no: OP029



Petra Hehet

| ORAL

Bavarian State Criminal Police Office, Forensic Science Institute, Munich, Germany; Ludwig Maximilian University of Munich, Department of Chemistry, Munich, Germany

Determination of triacetone triperoxide (TATP) using passive samplers in combination with GC-MS and GC-PCI-MS/MS methods

Aims: Forensic identification of peroxide explosive TATP in pre-blast and post-blast residues, including on-field investigations of possible production sites, demands for practicable and sensitive diagnostic methods. This work presents a concept suitable for laboratory as well as on-site sampling and detection of TATP residues in liquid (aqueous TATP synthesis waste) and gas phase.

Methods: TATP enrichment from aqueous and gas phase was achieved using different passive samplers, polydimethylsiloxane (PDMS) sampling rods and activated carbon sampling tubes (ACST). Quantitative GC-MS/MS analysis of extracts was performed with ^{13}C -TATP as internal standard and qualitative analysis was based on a field-portable GC-MS system.

Results: TATP showed a remarkable stability in aqueous solutions. A successful extraction from the aqueous waste of a TATP synthesis was demonstrated using PDMS sampling rods, and gas phase monitoring was successfully performed with two different passive samplers, even at some distance outside the production room. A field-portable GC-MS system has been shown to deliver fast and on-site detection of TATP from PDMS sampling rods. In addition, a quantitative GC-PCI-MS/MS method for analysis of liquid extracts, either originating from passive samplers or from other extraction procedures, has been established.

Conclusion: A new strategy for TATP enrichment and detection from aqueous and gas phase has been developed. Sampling and measurement protocols for on-site analysis using PDMS sampling rods in combination with a GC-MS instrument, or alternatively for highly sensitive identification with a laboratory-based GC-PCI-MS/MS system have been shown to work.



2 Jun

Abstract no: OP031



Blake N. G. Kesic

| ORAL

Forensic Science Research Group, Northumbria University, United Kingdom

Enhancing smokeless powder profiling: development and assessment of different semi-quantitative GC-MS strategies

Smokeless powders (SLPs) are commonly encountered in the investigation of firearm- and explosive-related crimes and their chemical analysis is valuable for a number of purposes, including origin attribution and evidence association. Due to its widespread use in forensic labs, GC-MS is a promising technique in this regard and, indeed, a number of methods have been published in the past. Many SLP compounds, however, are challenging to analyse with GC-MS, and, so far, very little information has been reported regarding its analytical and source-discrimination performances, casting doubts on its actual use beyond qualitative approaches. In this work, an exhaustive study has been performed and the most sensitive parameters for the analysis of SLPs in GC-MS, such as injection solvent, injection temperature and liner type, have comprehensively been evaluated using a full factorial design. This led to the development of a series of optimal methods, which have further been validated and assessed for their use in routine and semi-quantitative profiling applications. Results showed that, perhaps against common beliefs, the use of methanol as the injection solvent, coupled with a high injection temperature and a glasswool-containing liner, generally led to the best LoDs and LoQs, within- and between-day repeatability, and discrimination powers in classification and comparison modes. These conditions, therefore, were also found to be the most promising for the development of next-generation SLP profiling approaches, as well as advancing current possibilities in the field. as well as advancing current possibilities in the field.



30 May

Abstract no: KN004

**Maurice Aalders****| KEYNOTE***AmsterdamUMC, University of Amsterdam; Co van Ledden Hulsebosch Center, the Netherlands*

The Progress and Promise of Forensic Chemical Imaging

The term chemical imaging is used for many analytical techniques that are able to spatially map their extracted chemical information. These include mass spectrometry imaging, spectral remittance- and fluorescence imaging, Raman imaging and XRF. This presentation will focus specifically on optical chemical imaging, as the fast, non-destructive and non-contact characteristics of HSI mark its suitability as an analytical tool for forensic science. The technique has rapidly evolved over the last decade into tools that can be easily used in forensic laboratory and field practice for the detection, analysis and real-time classification of traces. The principles, instrumentation and analytical techniques involved in hyperspectral chemical imaging will be discussed. Further recent developments in HSI technology that motivate forensic science applications, e.g. the development of portable and high-speed image acquisition systems will be described and reported forensic scientific applications, particularly concerning body fluids, will be discussed. Challenges are addressed, such as influences of substrates on trace analysis in casework and implementation of AI in spectral analysis, concluding with a summary of possible future applications.



30 May

Abstract no: OP032



Leisa Nichols-Drew

De Montfort University, Leicester

| ORAL

Fingermark development and visualisation methodologies on 'vegan' and Covid-19 preventive leather substrates

Leather exhibits (purses, belts, phone cases) are frequently encountered in investigations of diverse criminal offences (homicide, sexually motivated, acquisitive) and both natural and civilian mass disasters. Their recovery from the incident scene can be pivotal to identification of persons who have handled them. This process may be hindered by the complexity of leather surfaces due to variations in permeability, porosity, colour, texture and animal origin. The challenge is heightened by the United Nations 17 Sustainable Development Goals and COP26, which highlight environmental concerns over the sustainability of fashion textiles and their production, including genuine and synthetic leather. This has resulted in an increasing array of fungi-, bacteria-, and plant-based 'vegan' alternatives.

Here we present, our initial investigation using innovative Zeiss Smart Zoom dark light digital microscopy and scanning electron microscopy, to determine the topographic and cross-sectional analysis of these novel substrates, as well as footwear leather substrates with a unique Covid-19 preventive surface coating. Subsequently, latent fingermarks on these novel substrates and conventional surfaces, were visualized using development methodologies, including powder suspension and cyanoacrylate fuming / BY40 exposure followed by fluorescence imaging. Identifiable fingermarks (aged for 28 days) were successfully obtained and statistical analysis of these will be discussed.

This research will be of the utmost interest to practitioners within chemical development laboratories, undertaking fingermark examinations on leather, in furthering the knowledge of this challenging substrate.



30 May

Abstract no: OP033

**Ana Moraleda Merlo***Ecole des Sciences Criminelles*

| ORAL

Lipid composition of Natural and Groomed fingerprints using GC/MS

The lipids present in fingerprint residues play an important role for some detection techniques. Many different lipid species are found in sebaceous secretions and their qualitative and quantitative composition significantly varies between individuals (inter-variability) as well as for a given donor (intra-variability). Despite previous works dedicated to the composition of secretion residues, knowledge about the extent of this variability remains incomplete.

Several studies have focused on the lipid composition of fingerprints, mostly using groomed (sebum-rich) marks combined with GC/MS. Since the composition of sebum-rich marks may differ significantly from the natural marks left by individuals, it appears crucial to compare both compositions. Increasing fundamental data about natural lipid composition might help developing and improving fingerprint detection techniques.

Groomed and natural fingerprints from several donors were left on office paper, using controlled transfer conditions. The fingerprints were then analysed using GC/MS. As a result, we confirmed that groomed fingerprints contain quantitatively more lipids than natural fingerprints. Using a hierarchical cluster classification model based on the abundance of squalene, followed by cholesterol, different types of donors were determined: good, medium and bad. The reproducibility of this classification in natural and groomed fingerprints and the other analysis periods was also studied.

A successful identification of lipid compounds from fingerprints yielded results that might significantly help to expand fundamental knowledge about lipid targets of some fingerprint detection techniques such as physical developer.



30 May

Abstract no: OP034

**Annemieke van Dam**

| ORAL

Amsterdam UMC, University of Amsterdam, Biomedical Engineering & Physics, The Netherlands

Towards the implementation of immunolabeling for fingermark development in a forensic laboratory – an overview

Most of the techniques that can be used to develop latent fingermarks target a large group of chemical components, such as lipids, proteins and amino acids. In case of a smudged, partial or somewhat distorted fingermarks, the sequential use of a redeveloping technique might result in an improved visibility of the ridge pattern. An excellent technique that can be used to detect specific chemical components in fingermarks is immunolabeling. Here, antibodies are used to target specific biomarkers (antigens) that are present in the chemical fingermark, revealing an increased level of second and third level details. An important advantage of immunolabeling is that the method can be applied in sequence with other detection techniques. In case of a poorly developed fingermark, a partial or smeared mark, difficult substrates or old marks, immunolabeling can still be applied to enhance and increase the visibility of the fingermarks. The method has been tested extensively in our research lab and the next step has been taken to implement the method in forensic practise. We will present the results of a collaboration between the Dutch police and the Amsterdam University Medical Centers. Additionally, we will present an overview of the use of immunolabeling for fingermark development, discussing the possibilities and limitations of the method, and which steps are needed to implement this method in forensic practice.



31 May

Abstract no: KN005



Tatiana Trejos

West Virginia University

| KEYNOTE

Analysis and Interpretation of Organic and Inorganic Gunshot Residues: Lessons Learned from a Large Population Study

This presentation reports the occurrence of compounds related to organic and inorganic gunshot residue (OGSR & IGSR) in various populations using diverse analytical techniques (LIBS, electrochemistry, SEM-EDS, and LC-MS/MS). Standard carbon adhesive stubs were used to collect over 3,200 hand's residues from individuals from various populations. Background samples were collected from volunteers who had not fired a weapon for 24-hours, including different exposure risks to sources that mimic GSR. The shooter's groups fired pistols and revolvers of leaded ammunition, lead-free ammunition, and mixed ammunition. Also, GSR persistence after activities was evaluated on a shooter's subgroup.

Descriptive statistics and a categorical method were used to evaluate the prevalence of compounds of interest, define thresholds, and estimate performance rates when the techniques are used alone and in combination approaches. Additionally, Neural Networks were used for deep learning of underlying patterns in the groups. Then, likelihood ratios (LR) were calculated from the probabilistic outputs of machine learning to assess the weight of the evidence. These results highlight the potential to distinguish complex groups such as bystanders and high-risk individuals (to a degree) versus low-risk and shooter populations. This was possible because combining IGSR and OGSR information yields higher confidence in classifications and provides enhanced evidentiary value to GSR evidence, with low rates of misleading evidence (RoME <1%). The extensive collection of over 100,000 data files allowed probabilistic models to assess IGSR/OGSR evidence, opening new avenues to interpret gunshot residues.



31 May

Abstract no: OP035



Matteo D. Gallidabino

| ORAL

Forensic Science Research Group, Northumbria University, United Kingdom

In silico profiling: a novel machine learning approach to address complex source-level problems in GSR analysis

GSR is a chemical trace that commonly assists law-enforcement authorities in the investigation of gun crimes, but its use at source level, whilst helpful (e.g., origin attribution and evidence association), is still challenging. The main problem here is the complexity of the mechanisms involved in GSR formation. In order to advance from this situation, a novel in-silico approach, called quantitative profile-profile relationship modelling (QPPR), has been developed. This is based on the application of machine learning techniques to model the discharge process and predict the pre-discharge chemical profiles of selected ammunition components from those of the respective post-discharge GSR. In particular, the approach was optimised and successfully tested for the prediction of GC-MS profiles of smokeless powders from those of the respective organic GSRs. Results showed a high degree of similarity between predicted and experimentally measured profiles (media correlation = 0.982) after adequate combination of 14 machine learning techniques. Evaluation of association performances, for the comparisons between predicted-predicted and predicted-measured profiles, showed classification accuracies of 92.9% and 80.0%, respectively, in extrapolation mode and of 91.7% and 88.3%, respectively, in interpolation mode. These values were close to those obtained after direct comparison of the measured smokeless powder profiles with one another (accuracy = 98.6%), demonstrating excellent potential to correctly associate same-source samples in different forensic scenarios. The benefits are countless and may even extend to the analysis of other GSR fractions or to other forensic fields.



31 May

Abstract no: OP036



Timo Matzen

| ORAL

Forensic big data analysis group, Netherlands Forensic Institute

Objectifying evidence evaluation for gunshot residue comparisons using machine learning on criminal case data

Comparative gunshot residue analysis addresses relevant forensic questions such as 'did suspect X fire shot Y?'. More formally, it weighs the evidence for hypotheses of the form H1: gunshot residue particles found on suspect's hands are from the same source as the gunshot residue particles found on the crime scene and H2: two sets of particles are from different sources. Currently, experts perform this analysis by evaluating the elemental composition of the particles using their knowledge and experience. The aim of this study is to construct a likelihood-ratio (LR) system based on representative data. Such an LR system can support the expert by making the interpretation of the results of electron microscopy analysis more empirically grounded. In this study we chose statistical models from the machine learning literature as candidates to construct this system, as these models have been shown to work well for large and high-dimensional datasets. Using a subsequent calibration step ensured that the system outputs well-calibrated LRs. The development of the system is based on casework data, which makes the data representative, while the performance was tested on an independent dataset of cartridge cases. The results show that the system performs well on both datasets. We discuss future work needed before the method can be implemented in casework.



31 May

Abstract no: OP037

**Amalia Stamouli**

| ORAL

Netherlands Forensic Institute (NFI), Gunshot Residue Group, The Netherland

Survey of gunshot residue prevalence on the hands of individuals from various population groups in and outside Europe

The results of a study which was conducted by 32 participating forensic laboratories, mainly from Europe will be presented. In this EU-funded study the prevalence of the most common types of Gunshot Residue (GSR) particles was investigated in various subpopulations. Specimens were collected from the hands of more than 1300 persons using carbon stubs. Subsequently the stubs were analysed for the presence of PbBaSb particles using scanning electron microscopy coupled to energy dispersive X-ray analysis (SEM/EDS). An in-depth statistical evaluation of the obtained results was performed to estimate the prevalence of gunshot residue in specific sub-groups as well as in the general population. A customized logit model was applied on the present data set in order to identify important population characteristics and differences between the various subgroups. The observed variability of the results due to laboratory, country and sample effects was found to be significant indicating that these parameters should be taken into account in the interpretation of the results in casework.

Stamouli et al. (2021) Survey of gunshot residue prevalence on the hands of individuals from various population groups in and outside Europe *Forensic Chemistry*, 23: 100308



31 May

Abstract no: OP038

**Bart Nys**

| ORAL

Nationaal Instituut voor Criminalistiek en Criminologie – NICC/INCC

The use of machine learning technology for the automatic characterisation of gunshot residue particles

The detection of microscopic GSR particles with SEM/EDX depends heavily on automation. A programmed procedure for the automatic classification of detected particles according to pre-determined rules is used. A manual review step is usually required. Although the analysis runs overnight, a human operator is still needed at the side of the instrument. A second shortcoming is that precise knowledge of the particles of interest is required in order to set up the rules.

New developments in ammunition design show the use of a growing number of diverse chemical elements in order to avoid (heavy) metal pollution by the primers. This in itself will make rule-based detection of GSR much more difficult and the process of manual review more laborious and lengthy.

One approach to these problems is Artificial Intelligence, enabling the system to 'learn by example'. Instead of defining a fixed rule set, the system learns the characteristics of particles of interest by example and stores them in a model. The system later classifies the group of particles found on a sample by comparing them to the set of models.

In this feasibility study we demonstrate the use of such a system using various munition types. The raw spectra of the particles were used to train an Artificial Neural Network (ANN) using a federated learning technique. This technology uses a web application and cloud storage to design and train an ANN which is optimised for the application. The models can be downloaded and used to locally characterise test data. This approach ensures that the ANN is automatically designed and optimised and requires no programming or extensive AI knowledge of the forensic user/expert.



31 May

Abstract no: OP040

**Briana Capistran**

| ORAL

National Institute of Standards and Technology, Gaithersburg, United States

Application of GC QuickProbe as a screening tool for forensic fire debris analysis

Ignitable liquid residue (ILR) analysis is one of the most commonly requested trace evidence analyses in forensic laboratories. Gas chromatography-mass spectrometry (GC-MS) is the current standard for ILR identifications in fire debris samples. Though effective, GC-MS requires time-consuming sample preparation procedures and analysis methods. Thus, the use of screening tools could decrease analysis times, especially for negative samples. A newly developed technology, GC QuickProbe™, allows for rapid (< 90 sec) chromatographic analysis of samples, with possibilities of minimal sample preparation. The utility of this screening method has been demonstrated with many forensic samples; however, the use of QuickProbe™ for fire debris analysis remains to be investigated.

This presentation demonstrates one of the first applications of QuickProbe™ to ILR analysis. A temperature program and sampling protocol were developed specifically for fire debris samples. Method parameters (i.e., initial temperature, hold times, ramp rates) were optimized to achieve maximum resolution, especially for highly volatile compounds. Using this method, ignitable liquids of various classes were analyzed, and major compounds in each liquid were identified. To further assess the utility of QuickProbe™ for ILR analysis, mock burn samples were collected and analyzed to assess the ability to identify major IL compounds in the presence of substrate interferences. Current work involves the investigation of solid phase microextraction (SPME) as a sample introduction method to further decrease analysis times. Based on these results, the QuickProbe™ technology shows promise as a screening tool for ILR analysis.



31 May

Abstract no: OP042



Leo Peschier

| ORAL

Netherlands Forensic Institute, The Hague, The Netherlands

Gasoline comparison in fire debris analysis: A case-study illustrating complications and prospects

The presence of ignitable liquid traces in fire debris may not only be used as evidence for arson, but it may also help to identify the arsonist. If a container with gasoline is found that might be the source of the gasoline in the debris, and the container can be linked to a suspect, the question to be answered is whether the gasoline in the debris and the gasoline in the container share a common source. Attempts to develop gasoline comparison methods for this purpose date back to 1987, but a generally accepted method still does not exist. This can be attributed to complications arising from alterations of the gasoline composition in the fire debris due to evaporation, and to complications arising from interactions with materials in the fire debris. In this contribution we will present methods for gasoline comparison that have been developed at the Netherlands Forensic Institute, using a case study as an example where gasoline from a fire debris sample is compared to liquid gasoline. The methods comprise a sample preparation method using a Likens-Nickerson distillation-extraction, data-evaluation methods using differences in the composition of specific gasoline component classes, and a data-evaluation method that calculates likelihood-ratios based on integrated peak areas of 60 gasoline components. A guideline in the development of these methods was to minimize susceptibility to the effects of evaporation and matrix interactions. It was found that knowledge about these effects and using this knowledge to design intelligent data-processing methods is key to the development of better gasoline comparison methods.



31 May

Abstract no: OP043

**Denis Werner****| ORAL**

University of Lausanne, Ecole des Sciences Criminelles | School of Criminal Justice, Switzerland.; University of Derby, College of Science and Engineering, School of Human Sciences, United Kingdom

Source inference of gasoline traces: study of the combined contribution of molecular and isotopic compositions

The unusual presence of ignitable liquid is an indication of arson. Under certain circumstances, a link between a trace of ignitable liquid (e.g., gasoline) extracted from a fire debris and a potential source or another trace can be established. Such association through comparison remains, however, extremely challenging in cases where the specimen has undergone evaporation or contains pyrolysis and combustion products. This study explored the benefits of the combined contribution of molecular and isotopic compositions for the discrimination of gasoline traces from different sources in fire debris.

Fifty gasoline samples were collected from local gas stations in order to carry out laboratory and semi-operational tests. Molecular and isotopic profiles of undeteriorated and evaporated gasoline were compared to the chemical signature of gasoline traces extracted from unburned matrices (weathered specimens) and fire debris. Multivariate statistical treatment of the analytical results was undertaken applying Multiblock methods. These chemometric tools allow merging the datasets resulting from molecular and isotopic analyses for common source inference purposes in the context of gasoline traces.

This research highlights the contribution of carbon isotopic composition when analysing traces of gasoline, in particular its added value, its limits, and its complementarity with respect to the molecular composition. It provides a better understanding of the differences between profiles of liquid gasoline (neat or evaporated) and traces of weathered gasoline or traces extracted from fire debris. Finally, it provides new insights in the quest for source inference of gasoline traces.



31 May

Abstract no: OP044



Insaf Ben Terdayet

| ORAL

Laboratoire central de la Préfecture de Police, Paris, France

Study of the influence of matrix on the source inference process of ignitable liquids by a chemometric approach

Identifying the perpetrator of arson is a real challenge of criminal investigation since the physical traces associating a perpetrator with this type of crime scene are often destroyed. If an ignitable liquid was used to start the fire, and its residual presence can be detected, a source inference approach with other ignitable liquids is likely to provide investigative support. Source inference is a process of association, a method that consists of evaluating the possible common source between two unknown ignitable liquids, in particular between a liquid found at the arson site and a liquid found in an external source. This determination is based on the comparison of the chemical composition of the ignitable liquids being investigated. This comparison can be straightforward when the ignitable liquid is in its liquid form, pure or even partially altered. However, the samples received in the laboratory for analysis consist mainly of solid materials in which liquid residues are absorbed. While previous work has shown that it is possible to link two weathered or unaltered ignitable liquids sharing a common source by source inference thanks to similarity calculation algorithm, it remains difficult to extend this to ignitable liquid residues in fire debris. In this work, we propose to study the matrix contribution to the problem of source inference using previously developed multivariate chemometric methods. The choice of matrices focused on clothing, specimens were prepared in the laboratory with these fabrics and 11 gasoline samples from different petrol stations. The results show that it is possible to link gasoline samples contained on unaltered clothing with their sources.



1 Jun

Abstract no: OP045



Oleh Posilskyi

| ORAL

Kyiv Scientific Research Institute of Forensic Expertise, Kyiv, Ukraine

Establishing the absolute time for the issuing of documents

Establishing the absolute time of documents is a popular type of research that allows detecting falsification of a document in a categorical form, based on the discrepancy between the date specified in the document and the actual time of its production.

The Kyiv Scientific Research Institute of Forensic Expertise has developed a unique method of establishing the absolute execution time:

- records and signatures made with a ballpoint pen;
- imprints of seals and stamps made with stamp inks;
- printed texts made in inkjet printers.

The essence of this technique is to study the specified dyes of the details of documents and determine the kinetics of their temporal changes by changes in the qualitative and quantitative content of components using chromatographic and spectral methods of analysis.

A comprehensive study of the details of the document, taking into account the capabilities of all available other methods related to the described one, especially taking into account the order of applying various details in the document, allows determining, with an accuracy of up to a month, the period of execution of the document.

The influence of external aggressive factors on the document leads to a change in the components of the dyes of its requisites, but depending on the degree of such influence, it does not always prevent the use of the described methods to determine changes in the chemical composition of dyes over time.

The study to establish the absolute time of the details of documents is always preceded by a multi-stage process of the document's studying, which includes identifying signs of the presence of an external influence on the document and its fragments.



1 Jun

Abstract no: OP048

**Marc A. Van Bochove**

| ORAL

Netherlands Forensic Institute, Chemical Identifications, The Hague, Netherlands

Finding traces of lubricant in sexual assault cases

In sexual assault cases chances are that no DNA of the perpetrator is found due to the use of a condom. In situations like this, finding traces of lubricant from a condom could at least aid in the confirmation of a victim's statement that sexual intercourse took place. The analysis for DNA will usually get priority over the analysis for lubricants. This complicates the finding of traces of lubricants in two ways. First, the swabs used for sampling the victim will usually undergo the DNA-isolation process before a chemical analysis for lubricants can be performed. When the same swab used for DNA-sampling has to be used for the analysis of lubricants after DNA-isolation, it is not clear what the influence of the DNA-isolation process is on the lubricant traces on the swab. Secondly, the swab best suitable for DNA-sampling is not necessarily the best swab for a chemical analysis.

In this study we compared the chemical cleanliness of the nylon flocked swab used for DNA-sampling in the Netherlands with other available swabs and followed traces of a polydimethylsiloxane (PDMS) lubricant with spermicide on a swab throughout the DNA-isolation process. Analyses have been performed using GC-MS, GC-FID and LC-MS. This preliminary study aims in advising on the use of a separate chemically clean swab for sampling of lubricant traces when possible and, if a separate swab is not available, in which steps of the DNA-isolation process chances are best to still find traces of a PDMS-based lubricant.



1 Jun

Abstract no: OP049

**Jaap Van Der Weerd**

| ORAL

Netherlands Forensic Institute (NFI), The Hague, The Netherlands

Initial validation experiments of the SHUTTLE Toolkit

SHUTTLE aims to solve two major issues in forensic trace evidence investigation. First, current microscopic analysis are subjective and require a high level of expertise and training of examiners. SHUTTLE will render analyses more objective and scientific by automation of microscopy. Second, trace evidence analyses are time consuming and hence expensive. This limits the number of cases in which analyses can be carried out by forensic laboratories to fight against crime. SHUTTLE can assist in reducing workload, but will not replace the forensic examiner.

During the SHUTTLE project, complete automated microscopy systems have been developed (the 'toolkits'), consisting of high-throughput microscopic instrumentation, image processing and AI algorithms, and databases.

After installation of the toolkits in laboratories all over Europe, the developed toolkits are evaluated. In the current presentation, we will detail a number of tests that have been carried out. These will include the search for glass fragments in dust samples, the search for target fibres in tape liftings, the search for blood on tape lifts of dark clothing and the use of the image processing and AI capabilities of the toolkits to automatically classify traces on tape lifts.

The current contribution will focus on validation experiments. A more technical introduction to the toolkits will be provided during the workshop organised by the SHUTTLE consortium.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 786913.



1 Jun

Abstract no: OP193

**Pietro Maida***Raggruppamento Carabinieri Investigazioni Scientifiche-Messina, Italy*

| ORAL

Portable crime scene device: use of microNIR for rapid screening and quick response

When an investigator is faced with a crime scene, there is the need to be able to freeze the scene in such a way to be able to acquire the more informations is possible to reconstruct the real sequence of the events.

For this reason, handle portable instruments are essential since they allow rapid analysis to be carried out on site without altering the crime scene in order to direct the investigations rapidly and on the right direction. This is possible thanks to the development of robust and validated methods, built on miniaturized platforms, able to guarantee reliable analyses directly at the crime scene. Some of these devices are extremely simple since they require minimal instrumental training, low-cost analysis and small amount of sample, thus ensuring the repeatability of the analyses, a suspect's fundamental right. Among these, the tool that best fits to these purposes is the microNir-chemometrics approach which is spreading in the forensic, food, pharmaceutical and medical fields thanks to its high versatility and simplicity.

The aim of this work is to describe the analytical methods used in our forensic laboratories to obtain useful information from this instrumentation for investigative purposes.

Particularly, the versatility of this on-site device in the study of matrices of forensic interest, such as narcotics, has been studied. The data obtained were processed using chemometric software to obtain a statistical model usable on site for a quick response on the crime scene.



3 Jun

Abstract no: OP039



Virginie Redouté Minzière

| ORAL

University of Lausanne, School of Criminal Justice, Switzerland

Transfer and persistence of inorganic and organic gunshot residues

Following the discharge of a firearm, organic and inorganic gunshot residues (I and OGSR) can be transferred to the shooter, potential bystanders, the target, and surrounding surfaces. The collection of these residues can occur several minutes to several hours after the shot(s). Thus, to extract useful information from GSR, it is important to understand where the residues transfer, in which quantity, and if they persist over time. Such information is crucial to identify which areas are relevant for GSR collection.

This work aims at collecting combined information on the transfer and persistence of both I and OGSR. The residues were collected using carbon adhesive stubs 30 minutes ($t = 0.5h$) after the discharge of a firearm, on the hands, forearms, face, and in the nose of four shooters. Both I and OGSR were analysed in sequence by first extracting OGSR and analysing them with ultra-high performance liquid chromatography tandem mass spectrometry (UHPLC-MS/MS). Then, IGSR were analysed using scanning electron microscopy coupled with energy dispersive X-ray spectroscopy (SEM/EDS).

The obtained data allowed to evaluate how GSR are transferred and persist on the different targeted areas, and evaluate more particularly:

- the correlation on the observed quantities of I and OGSR on the different areas,
- the extent of variability in the quantities observed between different shooters,

Preliminary results showed that the highest concentrations of GSR are obtained on the hands of shooters, large variations were also observed between shooters. The results will be compared to prevalence data on the targeted areas to evaluate GSR relevance in a forensic specific context.



3 Jun

Abstract no: OP046

**Jaap Van der Weerd***Netherlands Forensic Institute*

| ORAL

Phosphorescent sand as a model system in glass transfer studies

Contents: Phosphorescent sand is presented as a model system for glass particles. We will present the phosphorescent material, the camera system developed to analyse these particles, and evaluate whether the behaviour of phosphorescent sand is comparable to glass particles. Finally, we will detail the experiments carried out to explore the behaviour of these samples in a number of laboratory based tests.

Background: Experiments with the proposed model system are intended to gain information on glass traces on the activity level. Activities during or after a crime or other incident may cause traces to be shed and transferred to a recipient. Information on such activities can often be derived from additional information, such as the number of traces, their distribution and their morphology. For this, the forensic expert requires a detailed knowledge on the behaviour of glass particles. Such knowledge can be based on transfer studies. In these studies, glass items or traces are submitted to controlled activities, and the fate of the traces is studied afterwards.

Transfer studies can be carried out using ordinary glass particles. However, recovery and analysis of glass particles with routine methodology is time consuming. The proposed model system based on phosphorescent particles makes detection and counting of particles straightforward. In addition, particles can be detected without recovery from the receptor, which allows the study of subsequent transfer steps in a single experiment.



3 Jun

Abstract no: OP050

**Virginie Galais****| ORAL***Leverhulme Research Centre for Forensic Science, University of Dundee, UK*

Interdisciplinary approach to identifying the effect of washing garments in the transfer and persistence of fibres

Clothes are an integral part of our daily lives and fibres are probably one of the most common trace materials. Washing garments is also a routine task to keep them clean and socially presentable. This presentation will discuss how repetitive washing may affect the transfer and persistence of fibres for different textiles, filling a knowledge gap in forensic science by evaluating the impact of given activities.

5 donor garments (red, 100 % cotton) were repetitively washed over 50 times with 1350 transfer experiments being carried out and photographed. An automated fibre counting protocol was developed to rapidly process the images and determine the number of target fibres retrieved in each experiment.

The results will show a decrease in the number of fibres being transferred to the recipient swatch despite seeing a constant level of fibres being recovered from the filtered wastewater. Loose fibres are also found to remain present in the washing for a prolonged time even after many subsequent wash cycles, in the wastewater but also by transfer between the washing machine and the control garments (white 100 % cotton). A comparison between mass produced and garments containing post-industrial or consumer (recycled) cotton will finally be discussed.



3 Jun

Abstract no: OP051



Victoria Lau

| ORAL

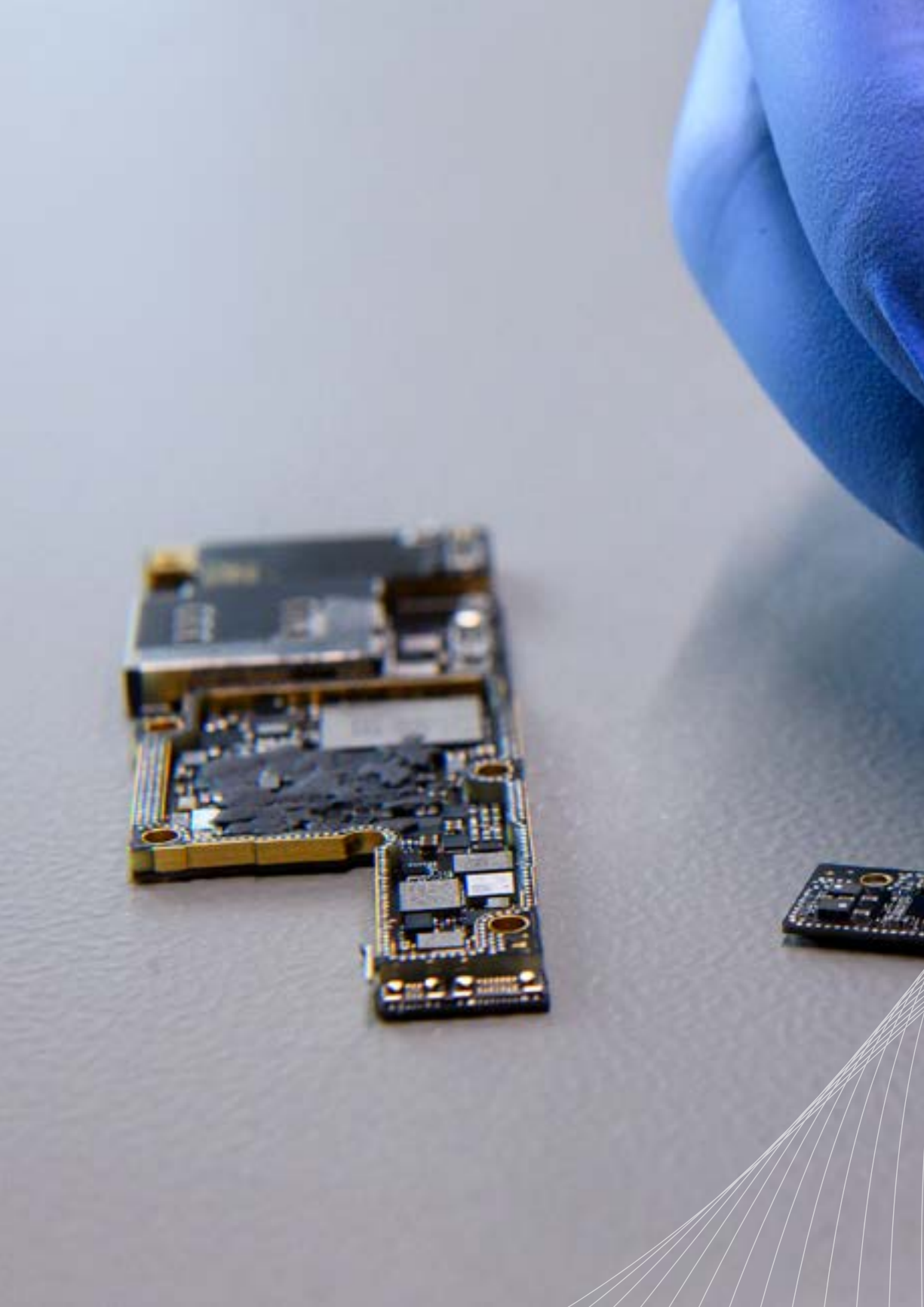
Centre for Forensic Science, University of Technology Sydney, Sydney, Australia

Revisiting the fundamentals of transfer and persistence to improve the evaluation of forensic traces

Recent challenges faced by forensic science have re-emphasised the need to improve our ability to evaluate the meaning of forensic traces in investigative operations and the judicial system. The value of microtraces often remains unclear to the non-specialist, including jury, and of relatively poor cost-benefit to the manager. This situation has implications for the criminal justice system. For this reason, there is a need to shift research focus from the minutiae of analytical problems addressing the donor of a trace (source-level), to furthering our understanding of the fundamentals of microtraces, especially their transfer and persistence.

Taking textile fibres as an exemplar microtrace type, this presentation describes ongoing collaborative research addressing this situation. Choreographed contact experiments with human subjects were conducted, followed by a study of the effects of physical activity on persistence of the transferred fibres at intervals up to 4 hours. Decay curves showed initial rapid loss of target fibres, followed by apparent exponential decay. Length distribution exhibited a shift towards shorter fibres with time. Zonal distribution of target fibres was greatest in upper regions of T-shirts and sleeves of hooded sweatshirts.

The overall goal is to propose a knowledge-based system (KBS) for microtraces. Such a system would allow forensic scientists to use results of previous research and casework to support interpretation and evaluation, whilst adding to the repository of information contained in the KBS. It is believed such a system can improve the evaluation of microtraces in casework, ultimately improving the reliability of forensic evidence.





**DIGITAL
EVIDENCE**



2 Jun

Abstract no: KN007



Niclas Appleby

| KEYNOTE

Swedish National Forensic Centre – NFC, Information Technology, Linköping, Sweden

Using AI and automatic image analysis as an investigative tool

AI and automatic image analysis algorithms have seen a rapid development in recent years. This has led to increased opportunities to use algorithms as an aid in police work. Even though biometric techniques such as face recognition do not give as reliable results as e.g. fingerprint and DNA these still have great potential to streamline the investigative work. Used correctly, there are great benefits to be gained in the work with analysing digital evidence.

By using an automatic image analysis tool a method has been developed, at the Swedish National Forensic Centre – NFC, within an EU funded project, that enables the use of automatic image analysis of large amounts of video data. In a pilot study this method has been used in real case work and great benefits have been identified such as reduced time required for analysis, better quality of analysis results and improved working environment for analysts.

During the development of the method several obstacles have been identified, addressed and overcome for a successful implementation. For instance, there is great need for legal judgment and adjustments have been made to the method when balancing integrity aspects against the needs of the police to streamline their work processes. Furthermore, the method needs to be validated in order to minimize the risk for errors and operating personnel need to be trained to be able to interpret results from the automatic systems. Finally, AI knowledge needs to be built up within the organization in order to be able to quickly take care of new innovations and utilize new technologies.



3 Jun

Abstract no: KN025



Katrin Franke

| KEYNOTE

Centre for Cyber and Information Security / Norwegian University of Science and Technology (NTNU CCIS)

Reliability of Artificial Intelligence in Forensic Sciences

A critical question when utilising artificial-intelligent systems to assist forensic investigations is whether one can trust the outcomes of machine processing. In other words, is the processing of the machine reliable?

Studying the application of artificial-intelligent methods in forensic sciences has several reasons: the most important is that such approaches provide a powerful toolset for representing human expert knowledge and implementing machine recognition and reasoning abilities. The concepts of machine learning and computational intelligence play a key role. They allow for technologies that help overcome the limitation of human capabilities, e.g. search through terra byte of electronic data. Another reason for studying artificial-intelligent methods is the criticism that testimony may lack a scientific basis or that artificial intelligence operates unethically.

This talk shares insights from more than 20 years of research and development on computational forensics methods and their applications in analysing physical and digital evidence.

We show that the total reliability of a computational system is affected by the reliability of several underlying processes such as data acquisition, preprocessing, feature encoding, model training, and classification. We argue that one should consider reliability at the earliest possible processing step. One shall also implement rigorous audit trials to ensure transparency and reproducibility of automated data processing.

Finally, we present a techno-legal framework for the reliability validation of forensic processes that utilise Artificial Intelligence, and we provide a possible way to implement it practically.



2 Jun

Abstract no: **OP052**



Mohamed Belahcen

French Gendarmerie

| **ORAL**

Authorship Identification in Web Forums

With the growing volumes of data, especially on social media and web forums, the correct identification of authors on Internet forums is a task that has great value for cyber investigations. It may help identify different accounts used by the same natural person. In this case, the person may be using multiple avatars to, for example, convey one idea or sell a product and other accounts to reinforce the value of his/her opinion or product. For investigators, this information may help understand the target avatar dynamics and establish investigative tactics.

Stylometry is a technique based on statistics of the text to detect particular writing styles specific to each person and that is hard to disguise fully. Advances in computer science and especially in natural language processing, have made the methods much more cost-effective and prone to be automatically applied to large datasets. The techniques may be as simple as counting the average number of words per sentence and the length of these words, or as complex as accessing the semantics of the given texts through sentence embeddings.

We propose a method and a framework for authorship identification in web forums. The suggested model is a combination of both linguistic features and embeddings to identify specific writing styles. The model is based on cosine similarity and yield an average accuracy of up to 99.4% when using 200 forum comments or posts per author. The framework also shows specific similarities in writing styles whether they are lexical or syntactic.



2 Jun

Abstract no: **OP056**



Zeno Geradts

Netherlands Forensic Institute; University of Amsterdam

| ORAL

Multidisciplinary Deepfake detection methods with artificial intelligence

Artificial intelligence, and especially deep learning, has made it easier to make a deep fake of voice or video. The wide range of deep fake software has made it much easier to make a deep fake that is realistic. Issues arise in court when the claim is made that the video is a deep fake, especially if the chain of evidence is not clear, such as videos uploaded on social media.

In this presentation, an overview is given of methods for making deep fake videos, as well as methods for detecting those. Many methods for detecting deepfakes are available, ranging from manual detection by visual artifacts, such as artifacts in video sequence itself, to eyes, mouth, or any other feature described in best practice guides. Also, the way someone speaks and pronounces words and makes sentences is of interest in analyzing. The comparison of for instance lipreading with the voice is one of the features of how it is synchronized. Often, in literature, methods for detecting deepfakes are based on deep learning methods themselves.

Classic methods used in forensic science, such as PRNU (Photo Non Response Uniformity), which is a kind of fingerprint of the sensor, can be of value for detecting a deep fake, though also these PRNU patterns can be forged or filtered out. Other methods of interest might be using the heart beat detection in video based on veins in the faces of the person in the video, though this is often filtered out in compression. For court, it is important to explain why a video is likely a deep fake or an original, so research should focus on the combination. For this reason, forensic deepfake detection needs a multidisciplinary approach.



2 Jun

Abstract no: **OP057**



Timothy Bollé

University of Lausanne, Lausanne, Switzerland

| ORAL

Short String Similarity of Pseudonyms in the context Forensic Intelligence

This research concentrates on how approximate matching of pseudonyms created by criminals can be used to produce forensic intelligence and find non-obvious links between high volume crimes. Perpetrators can easily switch to different online accounts or platforms, effectively changing their digital identity and the traces of their activities. As a result, exact comparison of digital traces is a limitation for link discovery in online fraud investigations. To overcome this limitation and to avoid linkage blindness, it is necessary to use near similarity comparison of distinctive digital traces.

Various algorithms, including token-based and edit-based methods, can be used to compute string similarity. This work examines how these methods perform on short strings and how they can be used to produce sound and actionable intelligence in online frauds investigations. In particular, we examine how various forms of similarities can be detected and their significance in terms of intelligence. The results presented in this work are drawn from real world cases.

An integral part of this work is to study the decision making process of evaluating the links found using near similarity computations. An aspect of this process involves different levels of evaluation such as the performance of the algorithms, their explainability and a scientific interpretation of their outputs, taking into consideration the context and the knowledge of the case. The approaches proposed in this work can be applied to other types of digital traces in different kinds of investigations.



3 Jun

Abstract no: **OP053**



Gaëtan Michelet

University of lausanne – school of criminal science, lausanne, switzerland

| ORAL

Automation for digital forensic investigations: definition, categorization, and literature review

Due to an increasing number of digital devices and diversity of data that must be analyzed, digital forensics labs suffer from backlogs. To address this problem, one possible solution is the increased use of automation.

Over the last years, several studies have been published with respect to automation and digital forensic investigation. However, none of these publications provided a clear definition on what it means to automate aspects of investigations. Literature so far has focused on definitions of automation in general, or just some key elements related to automation.

In addition to the definition, another missing element is a way to categorize the automation methods / procedures in establish a common language; there can be significant differences in automation, i.e., the techniques used, or the number of processes automated by a method can vary a lot. Consequently, a categorization schema can be useful to understand their impact on the investigation.

We present a definition for the automation in the context of the digital forensic investigation, and a schema that can help categorizing existing and the future automation techniques. This work also summarizes the state-of-the-art of automation with respect to the digital forensic investigation. In summary, the article proposes a new definition, a new categorization model and addresses the following questions: What has already been done? What are the current trends? What are the different challenges? What should be done next?



3 Jun

Abstract no: **OP054**



Abiodun Abdullahi Solanke

CIRSFID-AlmaAI, University of Bologna, Italy

| **ORAL**

Digital Forensics AI: Evaluation, Standardization, and Optimization of Evidence Mining Techniques

It is vital to distinguish the term "Digital Forensics AI" from the notion of "AI Forensics" to lay an appropriate foundation for this work. These colloquial words have been used to refer to the application of AI to digital forensics. However, in this work, we make preliminary differentiation between the two. As defined in Baggili and Behzadan, AI Forensics refers to "scientific and legal tools, techniques, and protocols for the extraction, collection, analysis, and reporting of digital evidence pertaining to failures in AI-enabled systems." Whereas, Digital Forensics AI, as we conceive it, refers to a broader concept that encompasses the models, methods, evaluation, standards, optimization, interpretability, and understandability of artificial intelligence techniques (or, more broadly, AI-enabled tools) used in the digital forensics domain.

The presentation of this concept is intended as a springboard for a more generic formalization of this domain, either as a sub-field or as an integral part of the existing framework.

We discuss performance evaluation and forensic decision evaluation. Additionally, we present a likelihood ratio table that is compatible with standard forensic science decision reports and AI accuracy measurements in this study.

On standardization, we touch on estimation of error rates (including its publication), forensic datasets, oversimplification of science for understandability in a judicial proceeding, transfer learning, and pre-trained corpus for forensics purposes.

Lastly, we discuss several optimization techniques used in conventional AI models that can be useful for DF-AI, in terms of scalability, interpretability and timeliness



3 Jun

Abstract no: OP055



Lukas Hardi

| ORAL

Central Office for Information Technology in the Security Sector, Research Unit Digital Forensics, Munich, Germany

Forensic Investigations in a Smart City – The Role of Data Science and Artificial Intelligence

The ongoing digitalization of our daily life causes challenges for forensic investigations. Whereas in the past individual, independent investigations of single items were sufficient, in the future holistic examinations of whole systems will become increasingly necessary in order to answer the relevant questions in an investigation process. One example of the complexity and dimension of systems for which digital forensic methodologies need to be developed are Smart Cities. The intelligent connection of individual segments of a city via a wide variety of communication channels results in a large and complex network with many sources of information and a significant amount of data processing. This interconnection requires the development and application of innovative forensic approaches for securing and analyzing the data. The presentation will introduce the role of data science and artificial intelligence in forensic investigations in the context of Smart Cities. After a general introduction to the topic, opportunities and challenges are presented using the example of the interconnection of energy supply, mobility and buildings in a Smart City. Employing concrete use cases, the focus is on a fundamental analysis of the type and extent of data created, processed and stored as well as on an introduction of selected methods for forensic extraction of this data. Finally, a discussion on the relevance of the derived information leads over to an outlook on further use cases and developments in this area of research.



2 Jun

Abstract no: **OP058**



Abdul Boztas

| **ORAL**

Netherlands Forensic Institute Digital Technology and Biometrics, The Hague, Netherlands

App Analyses and Reference Database Solution

Since a couple of years, apps have become a very important part of people's daily lives. Apps are used for various purposes, such as shopping, communicating, arranging banking, dating, etc.

There are currently millions of apps available on the app stores. Most apps automatically collect data of daily activities for different purposes. This kind of information can be potentially very valuable in a forensic investigation, and therefore these relevant traces must be detected and used for forensic purposes. However, commercial forensic tools currently only support a limited number of popular apps, such as WhatsApp and Facebook. Consequently, relevant traces can be missed during an investigation.

In this study, we investigate a new approach for detecting and analyzing files that are created and modified by app usage on mobile devices. We first determine which files are modified or created while using the app. We then analyze the contents of these files. Finally, all this information is stored in a database so that static investigations can be done by using the gathered information stored in the database to determine a relation between stored data by apps and user activity.

We have developed a new tool, called Argus that can detect and analyze files on a mobile phone that are created or touched while using an app. Our software stores information of apps in a database so that this information can later be used by forensic investigators.



2 Jun

Abstract no: OP059



Daniel Camara

French Gendarmerie

| ORAL

Automatic Generation of Parsers for Web Forums

For criminal investigations and intelligence, collecting and organizing open-source information is of paramount importance. However, each market and forum presents the information in different ways; for example, the vendor's name, product, price, are rarely in the same place on the page. In general, this requires the creation of specific parsers capable of correctly identifying each site's important information. This task is time-consuming and needs to be carefully done, as all the other future data treatments rely on it. The problem is even bigger if we consider the dark web, where the average lifetime of sites is four months. Automating the data extraction process would increase the speed investigators may have access to the data and improve the capacity to treat different sites.

This paper presents the work we have conducted on the automatic creation of parsers for web forums and markets. A web wrapper is a tool that extracts information from semi-structured data, such as html pages, guided by the structure inside the page. We have created a semi-automatic wrapper that creates a list of possibly interesting fields, based on the analysis of the repetitive inner structures of the page. All generated structures create a repetitive schema that can be detected and analyzed.

The method proposes fields and requests the validation of an agent over their pertinency. After this validation, the wrapper can be used to organize the collected information from the target website. Not only the proposed process decreases the required time to generate a parser, going from hours/days to seconds, but also it decreases the technical skills required to create efficient webpage parsers.



2 Jun

Abstract no: **OP060**



Johnny Bengtsson

Swedish National Forensic Centre; Linköping University

| ORAL

Payment card fraud analysis and tool for making new conclusions

The purpose of a payment card forensic examination may vary, but it colloquially refers to as 1) the determination of its genuineness, and additionally also that written magnetic magnetic stripe data complies with the human readable embossed, laser-engraved or printed information, or 2) the comparison of the magnetic stripe data read-out with e.g. online financial transactions, cash registers, credit card dumps, or data retrieved from in rarely seen magnetic stripe skimmer devices.

In order to support criminal investigations, the Swedish National Forensic Centre (NFC) has taken a step further by the development and implementation of manual and fully automated procedures to retrieve, interpret and analyse payment card chip data, in accordance to the global EMV contact payment (smartcard) and contactless (RFID) payment standards.

The payment card data itself is structured into one or more payment applications that complies with any of the payment card schemes, e.g. Visa, Mastercard, American Express, or proprietary ones. Such applications not only contain magnetic stripe data equivalent information, but a numerous of data related to the individual payment card and its cardholder; transaction activities, information regarding e.g. authentication, risk management, cardholder verification, and occasionally also a transaction log, all valuable to investigations where payment cards or payment wearables are present.

Moreover, read-outs, data interpretation and analyses are done with the fully automated NFC developed analysis tool `ffpemv2`, which also supports analysis of payment wearables in a various extent.

Keywords: payment cards, EMV, criminal investigation, card fraud



2 Jun

Abstract no: **OP061**



Marie Morelato

Centre for Forensic Science, University of Technology Sydney, Australia

| ORAL

The use of Internet traces to detect and monitor online illicit markets

The Internet has created new ways to trade commodities as well as to exchange information. Online platforms operating in the legal economy have impacted business models, customers, and vendors. This development has been mirrored in the illicit trade. Through the analysis of marketplaces, forums and review websites publicly available on the web (internet traces) in combination with traditional market descriptors, forensic science can help monitor illicit markets and provide knowledge about the activity that produced them.

The objective of this presentation is to describe how the detection and monitoring of these online sources can inform on the nature and evolution of the online drug and doping product market (i.e. type of products over time) as well as the structure of the market.

Results from several studies covering the detection of online shops on the web, as well as online forums and search engine queries will be presented. As illicit drug products, including doping substances, are physical objects, digital, physical, and chemical traces should be combined to produce a comprehensive market picture. Results from test purchases will be presented. Indeed, the physical/chemical analysis of the products can help to test the hypotheses inferred from online indicators and link online activities with physical locations.

All these studies confirm that internet traces are a valuable and complementary source of information that can be used to understand illicit drug and doping substance markets. In addition, they may help monitor the emergence of new threats. It is suggested that such approaches should be adopted more systematically in forensic science.



31 May

Abstract no: **OP062**



Patrick De Smet

NICC/INCC, Brussels, Belgium

| ORAL

Analysis of external digital context data and its use in digital image authentication workflows

Within the area of digital multi-media forensics large amounts of research has been conducted on the use of advanced signal processing methods in order to determine if certain image files may have been edited or manipulated. In the specific case of questioned imagery being submitted or available alongside an evidence storage processing container or context, a detailed analysis of this context should however also be carried out. In this presentation we review and propose several file and operating system digital forensics methods and a few recently in-house developed tools that can or should be embedded within an effective investigative image authentication workflow for which an additional digital forensics context is available. In other words, this presentation will argue and demonstrate that although many avenues for research on authentication issues remain to be pursued further, following up on and investing in “basic” digital forensics methods that could be used during storage media data extraction and analysis stages, may still remain crucially important. As such this presentation could also be seen as being positioned at the intersection of the activities of two ENFSI Working Groups, namely FITWG (Forensic IT) and DIWG (Digital Imaging). This presentation thus aims to reach out to and stimulate further collaboration between both of these groups’ members, as well as the larger scientific community and any other interested industrial parties or providers of relevant tools.



31 May

Abstract no: **OP063**



Till Sieberth

| **ORAL**

3D Zentrum Zurich, Institute of Forensic Medicine, University of Zurich, Switzerland

Confrontation Identification through Virtual Reality Technology: A Technical Setup

Virtual Reality (VR) within the forensic community is currently used for forensic training purposes. Furthermore, in connection with efficient and user friendly 3D documentation methods, VR visualisations can also be used for investigative purposes. As also persons can be documented in 3D, confrontation identifications using VR appears for be a feasible approach. The procedure of placing several persons in a room with a one-way-mirror, with a witness on the other side has practical disadvantages. The primary concern implicates the witness and persons in the line-up could come face-to-face prior to the lineup. Image confrontation using printed paper only partially resolved this problem, as features such as body stature cannot be perceived properly.

Therefore, we propose VR technology to advance this method. In this first trial we tested the setup and feasibility. A total of 14 subjects were 3D documented using the multi-camera device "Photobox". The generated 3D models were then visualized using common VR equipment, and separately, image confrontations were printed. In total, ten confrontation image sets were created, with ten randomized trials, some also not including the disturber. Both, 3D and A4 printed image sets were identical. One of the subjects then disturbed a lecture, visible to all students. Following the lecture, the students were split in two groups with each group participating in either the VR or confrontation image procedure. The students then looked at the 3D models or images, and were asked to identify the correct person by naming the attached letter (A-H, or N/A).



31 May

Abstract no: **OP064**



Dilan Seckiner

| **ORAL**

Centre for Forensic Science, University of Technology Sydney, Ultimo, Australia; Institute of Forensic Medicine, University of Zurich, Switzerland

Forensic body and gait analysis: Development and testing of a forensic interpretation framework for morphometric data

CCTV cameras allow continuous monitoring of an area where footage can be obtained for later use, if criminal or other activity of interest occurs. Subsequently, a photo-comparative analysis of the footage and of a person/s (trace) may be required from a forensic specialist, if facial analysis is not possible. Such examination involves evaluation of the strength of evidence at both activity within the footage and features observed on the individual.

The aim of this study was to assess and improve the scientific approaches applicable to forensic body and gait analysis in both 2D and 3D, addressing the source level. A probabilistic logical approach was proposed with the application of a likelihood ratio to the research, and its applicability viewed to evaluate the strength of evidence.

The method included a morphometric assessment of 18 anthropometric measurements, 52 morphological features, of male/female volunteers. As a result, frequency statistics were obtained and features were observed as either common or distinct, after which the feature dependency and independency was explored. Statistical hypothesis testing was also completed for proof of concept and to test the model. These components were then applied to assess the strength of evidence between the trace and the reference materials, resulting in a likelihood ratio value within two models.

The forensic examination of materials, obtained from CCTV footage, ultimately aims at evaluating the strength of evidence at source and activity levels, and this strength is inferred from the trace. This study established a method of evaluating body and gait whilst being scientifically robust and highlighting its limitations.



31 May

Abstract no: **OP066**



Helena Bruyninckx

Royal Military Academy, Brussels, Belgium

| ORAL

UNCOVER: Development of an efficient steganalysis framework for uncovering hidden data in digital media

UNCOVER – a joint international initiative funded by the European Commission under the Horizon 2020 Research & Innovation program – was launched in 2021. This presentation outlines the main objectives, goals and foreseen outcomes of the project and provides an insight into its ongoing activities.

UNCOVER is end-user-driven and responds to the criminal use of information hiding techniques (steganography) in digital media such as images, video, audio and text files. Due to the widespread availability of steganographic programs, potential perpetrators can quickly select, adapt and combine information hiding tools for their criminal activities. Detection methods on the other hand are a major challenge for Law Enforcement Agencies. This is amplified by the increasing amount of digital evidence that LEAs and judicial partners have to handle.

UNCOVER aims to address these issues and will further develop steganographic tools leading to a tailored toolkit for LEAs. Therefore, UNCOVER will conduct a detailed analysis of existing steganographic methods, develop training and theoretical validation detectors. End-users play a key role throughout the project cycle: from the analysis of user requirements and tools development through evaluation. Through regular feedback cycles, UNCOVER will ensure that the developed solutions can be integrated into the daily criminal investigation pipeline of LEAs. Next to its research activities, UNCOVER has a strong training dimension and will establish a comprehensive train-the-trainers program for LEAs and forensic institutions, integrating all theoretical findings and solutions developed during the project.



1 Jun

Abstract no: **OP067**



Mikael DE MIRAS

IRCGN, Pontoise, France

| ORAL

Crime scene : from broad-based 3D modeling to VR experience

Accident or crime scenes 3D modeling by lasergrammetry or photogrammetry have been used for many years by IRCGN. In that respect, they are not only well controlled but have also proved their efficiency, particularly when it comes to manage a complex scene. However, a large-scale deployment of these techniques is limited by a number of factors : high prices of lasergrammetry equipments, overall complexity and time consumption required by photogrammetry.

Therefore, in order to mitigate these constraints and to widen the use of 3D modeling, a photogrammetry server has been set up. It performs an automatic 3D model or orthophotography from pictures taken and uploaded by police officers.

In addition to the democratization of 3D modeling, it is of the utmost interest to take advantage of 3D models into VR environments. Considering the benefits of VR as it is applied to the understanding of a whole scene, an attempt to incorporate a point cloud into a 3D environment has been made. The expected improvements related to visualization and handling of the various forensic traces justify to allocate permanent resources to this project.

This presentation first explains the choices and the arrangements made to facilitate the large-scaled modeling by photogrammetry, before approaching the possibilities offered by having a virtualized scene.



1 Jun

Abstract no: **OP068**



Katarina Iversen

Linköping University, Linköping, Sweden

| ORAL

Representing uncertainty of position estimations in crime scene visualizations

Visualizations of crime scenes based on 3D-models as a tool for freezing crime scenes and presenting evidence in court is emerging. New methods for doing so in a legally secure and efficient way are being developed. P3KA is a program developed at NFC that makes position estimations in 3D-models based on photos, which includes an uncertainty calculation.

Heat maps have been identified as one possible way to communicate uncertainty in crime scene visualizations. However, their meaning can be somewhat ambiguous. Thus, further studies regarding the use of heat maps as a way to represent uncertainties are needed. The objective of the current study was to explore if it is meaningful to show the uncertainty of an estimated position. It also aimed to study the implications of different uncertainty representations on the interpretation of uncertainty in crime scene visualizations.

A qualitative approach using close readings and interviews was applied, and a thematic analysis was conducted. The results indicate a perceived usefulness of crime scene visualizations, but the interpretations and the preferred uncertainty representations varied. However, representations where the most likely position was marked out were preferred.

In conclusion, heat maps can be used to represent uncertainty. In order for the representations to be meaningful they have to be accompanied by information and clearly show the most likely position within the uncertainty representation. The next step is to develop a framework for how to represent uncertainties using heat maps. Thus, leading the way for the use of uncertainty representations for position estimation in crime scene visualizations.



1 Jun

Abstract no: **OP069**



Jean-Luc Paillat

| **ORAL**

Laboratoire Central de la Préfecture de Police - Paris - France

Virtual reality at the service of the training of investigators, application on a real fire

The LCPP has been conducting full-scale fire tests for years. Some of these fires reproduce real apartments and are then used for training purposes for French police investigators. In 2021, a training scene composed of two volumes was not directly used for on-site investigation trainings as it has been done many times previously. Instead, the scene was completely digitized with 360 cameras, 3D scans, and 2D photos. A virtual training tool was then developed. It is composed of a full immersive environment created with the Unreal Engine video game platform, and a secondary web tool based on WebXR technology. Those tools allow for a full immersion in the scene with a virtual reality headset, to examine the damages and conduct investigations. The immersion is not limited to the observation of traces and clues on the walls or ceiling: investigators can interact with objects and observe each of their faces. Measurements can also be carried out on site like the depth of charring on wooden structures or flammable liquid vapors detection and an additional layer containing these data can be added on the virtual environment. Users can also remove objects from the scene to perform an analysis layer by layer as recommended in the NFPA 921. A complementary team analysis can be conducted after the solo immersive experience through the WebXR based application. About fifty investigators have already been trained with this tool and the results show that these technologies offer real possibilities in terms of training, by offering the feeling of actually being on site and providing the ability to conduct a complete investigation, eventually under the supervision of a qualified investigator.



31 May

Abstract no: **KN008**



Aya Fukami

Netherlands Forensic Institute; University of Amsterdam

| **KEYNOTE**

Modern mobile forensic techniques

As more security protection measures are implemented in modern smartphones, analyzing them for criminal investigations is becoming a challenging task. Today, multiple invasive techniques are often required to extract data from target smartphones in an unencrypted form. In this talk, I will discuss some modern mobile forensic techniques.



1 Jun

Abstract no: KN009



Manon Fischer

| KEYNOTE

School of Criminal Justice, University of Lausanne, Lausanne, Switzerland

Smart objects (IoT) as crime scene witnesses

Crime scene investigation requires the exploitation of crime related traces and testimonies. The volume and type of traces vary between scenes. For example, most traditional traces (DNA, fingermarks, etc.) are destroyed when considering a fire CSI.

The endless and exponential expansion of digital technology is a game changer in many fields of the forensic science. The digital traces themselves offer similarities with the traditional traces but may also embed other features such as ubiquity and timestamping.

While digital traces are pervasive, their processing is not always considered on CSI, or limited to well-known items (smartphones, computers, etc.). Paradoxically, exploitation of digital traces on a crime scene might provide insight about missing destroyed items, permit to refine the timeframe and even provide witness testimonies.

A case study based on smart objects, also called IoTs, within a fire scene investigation will be presented. This case illustrates how digital traces can complete traditional traces on CSI, providing accurate and temporal information about the event, even though most of the scene items, and thus common traditional traces, are destroyed and unexploitable.



30 May

Abstract no: OP070



Wauter Bosma

Netherlands Forensic Institute

| ORAL

A probabilistic approach to estimating cell service areas

In a criminal investigation, mobile phone records may be the only way to establish the suspect's location. For example, police have discovered that the phone used a cell tower and may ask whether it would have connected to this cell if it was at the crime scene. However, the service area of a cell is poorly defined and depends on many conditions related to the physical environment and the network, and it overlaps with neighboring cells. As a consequence, the information is often used for investigative guidance but analysts are struggling to present it accurately in court.

We present a method to automatically estimate the probability of a cell being selected by a phone. We used prepared cell phones to collect reference data under the same circumstances as data that are available in investigations. The reference data include the actual location of the device as well as properties of the connected cells and other cells in the area, such as geographic position and azimuth. We use these data to fit a statistical model to estimate the probability of connecting from a location to each of the nearby cells. Since the system outputs probabilities, we evaluate the system's calibration loss as well as accuracy. We argue that such probabilities may be used even though it is not feasible to take all factors into account that potentially affect the cell selection. A distinguishing feature is that the probabilities can be used to answer a range of forensic questions within the Likelihood Ratio framework, which facilitates more precise analyses by forensic experts and can potentially be used in the courtroom.



30 May

Abstract no: **OP073**



Luisa Bassi

| **ORAL**

Cantonal Police of Vaud, Lausanne, Switzerland; University of Lausanne – School of Criminal Justice, Lausanne, Switzerland

Bayesian evaluation of digital location evidence: case report of a homicide investigation

Digital traces are among the newest types of evidence used in forensic science. Interest in digital forensic science has grown rapidly in both research and practice, but there is a lack of studies on how to interpret this new kind of evidence. The framework of case assessment and interpretation is nowadays well used and accepted in more traditional forensic fields, such as fingerprints or DNA. Recent works in digital forensic science suggest the application of this interpretative methodology to digital evidence.

This communication aims to illustrate the use of digital evidence in the context of a homicide investigation in the county of Vaud, Switzerland. Traditional investigative information such as witness statements or CCTV left a temporal gap, during which investigators had no information about the activities and location of neither the victim nor the suspect of the case.

In order to fill this gap and help understanding the sequence of events, call detail records as well as other digital evidence extracted from the smartphones have been collected and analysed. The analysis of this data has allowed to gather information on the sequence of events. The bayesian framework has then been used to evaluate the available location data used in the reconstruction process of the movements of the smartphones of both victim and suspect during the time window of interest.



30 May

Abstract no: **OP079**



Hannes Spichiger

Université de Lausanne

| ORAL

Where your iPhone is not: issues with error and data visualisation in location-related evidence from iOS devices

Location-related evidence recovered from mobile devices has become a cornerstone of many investigations and criminal proceedings. The last known location of a mobile device is used as a basis to search for missing persons, to justify search warrants, and as evidence in court to show presence at a crime scene. Despite published studies clearly showing problems with the precision and reliability of such data, there is limited awareness of these problems among practitioners, tool manufacturers, and legal personnel who deal with this type of digital evidence. This lack of awareness increases the risk of false logic in digital forensic science, i.e., treating location-related evidence as facts rather than observations that require scientific interpretation.

Using data recovered from iPhones in simulated cases, this presentation discusses current issues with the way location-related evidence is typically treated by practitioners. This work proposes approaches to using location-related evidence in a more robust and reliable manner, and to presenting it in a way that reduces the risk of misinterpretation. Real world case examples are used to show that the discussed aspects can indeed lead to problems.



31 May

Abstract no: **OP071**



Kim de Bie

| **ORAL**

Netherlands Forensic Institute, The Hague, The Netherlands

Assessing evidence for shared ownership of two phones using a statistical model and call detail records

We present a method that uses call detail records (CDRs) to assess the strength of evidence that two phones were carried by the same person. For forensic purposes, we quantify the strength of evidence in terms of a likelihood ratio. In particular, we consider the hypothesis that the phones were carried by the same person (referred to as the prosecutor's hypothesis or H_p) versus the scenario that they were used independently (the defense hypothesis or H_d), and consider the likelihood of the cell registrations for each hypothesis. In a typical use case, one of the phones has unknown or questioned ownership. The other phone is attributed to an identified person (designated as the 'reference phone').

The CDRs show to which cell towers the phones connected, but not the exact locations from where they were used. Using a statistical model of the service area of a cell tower, we estimate the likelihood of the cell tower registrations if both phones are at the same location (H_p). The model also considers the time elapsed between cell tower registrations. Under H_d , any relation between the phones is coincidental. Therefore, we estimate the likelihood that the reference phone happened to be near the questioned phone from the reference phone's typical behavior. This typical behavior is derived from historic records of the reference phone. We show that our method is potentially better able to discriminate between the scenario of the phones being carried by the same individual versus the scenario that they were not than existing methods.



31 May

Abstract no: **OP074**



Jan Peter Van Zandwijk

| **ORAL**

Netherlands Forensic Institute, Department of digital and biometric traces, The Hague, The Netherlands

Have you been upstairs? On the accuracy of registrations of ascended and descended floors in iPhones

Having become an indispensable part of modern life, modern smartphones are found to contain many digital traces related to actions performed by its user in the physical world. In a criminal investigation, such traces can provide crucial information for scenario reconstruction and evaluation. A good understanding of the accuracy of such traces is a necessary prerequisite for using them responsibly.

For instance, the iPhone Health App registers number of steps and distances in specific timeperiods, the accuracy of which has been assessed in a previous study. The iPhone Health App also records information on number of floors ascended, which can also be very relevant information in a criminal investigation. In this study, we experimentally investigated the accuracy of traces on number of floors in iPhones. For this, seven test subjects ascended and descended floors of different heights with five different iPhones, where number of floors, walking speed and carrying location were varied.

Analysis of data shows that the iPhone Health App predominantly records information on floors when walking upstairs and virtually never when walking downstairs. iPhones contain other timestamped traces from which information on number of ascended and descended floors in specific periods can be derived. The number of registered floors is primarily determined by the height difference travelled. From our experiments and information in the Health App, it follows that a height difference of approximately 3 meters corresponds to the registration of one floor. Other factors, such as walking speed and carrying location of the phones only have a minor effect on the accuracy of registered information.



31 May

Abstract no: **OP075**



Matthieu Regnery

| ORAL

Ecole des Sciences Criminelles – Université de Lausanne

Meet the world of darkphones. A modern, encrypted and stealth communication network

Encrypted communications are becoming a standard to enhance privacy and address users concerns. A vast majority of consumer grade messaging applications are thus now implementing end-to-end encryption. Corporations, especially larger ones are adopting fleet management infrastructures to secure their employees mobile devices. Even more integrated solutions propose customized operating systems to completely secure hardware and software as well as server-side applications. At the end of this spectrum recent police operations uncovered criminal organisations designing and operating infrastructures to provide ultra-secure communications to organized crime groups.

We studied several of these solutions used or in still in use and had the opportunity to access and experience this type of network. In particular, we lived the take down of SkyECC from a customer perspective. Leveraging this immersion, we would like to bring definitions and classification based on security features and mode of operation. Especially, we will aim at defining the term “darkphone”, a more generic appellation of mobile solutions mimicking the darknet.

We will start with real life examples, uncovering the security mechanisms and the adoption arguments, then we will draw a generic definition for such solutions, and we will finish by discussing the necessary evolutions in forensic methods to address these new networks.



31 May

Abstract no: **OP076**



Mateus Polastro

Brazilian Federal Police

| ORAL

NuDetective 4.0: automatic detection of CSAM in Android phones

Possession of child sexual abuse material (CSAM) is a criminal offense in many countries. To detect this content, a forensic tool called NuDetective was developed in 2009. The tool can search for CSAM on digital media such as pen drives, computers, and hard drives. It uses nudity detection in images and a previously published own strategy to detect CSA videos, and searches for known hashes as well as suspicious file names.

With the development of technology and the increasing use of smartphones, the demand for CSAM screening on these devices has increased tremendously. Currently, about 70% of smartphones worldwide and in Europe are Android devices. Therefore, a new version 4.0 of the NuDetective tool was developed to detect CSAM in Android phones.

The tool installs an APK on the smartphone and allows it to search for images and videos that contain nudity, known hashes, and suspicious file names. It can also detect apps used to hide data on smartphones, password protect other apps, and store data in the cloud. The list of suspicious apps can be easily edited. The communication between the NuDetective APK and the desktop version is done through a Java Serializable Object and all the extensive processing is handled by the desktop version.

NuDetective has proven to be very effective in searches and seizures related to smartphones, as their contents are analyzed faster and with a low error rate. Since the results are displayed on the screen of the desktop version, it can also be successfully used on phones with partially damaged screens.

The NuDetective tool is free, available in five languages, and available only to law enforcement agencies.



31 May

Abstract no: **OP078**



Matthieu Regnery

Grayshift

| ORAL

The new challenges of seizures to maximize chance to recover data on locked encrypted devices

Apple iPhone 5s introduced late 2013 was the first smartphone implementing strong hardware encryption with mechanisms to prevent bruteforce even if the phone is compromised. iOS 12.3.2 in June 2019 added an extra layer of security, using a secure element in the authentication process. The impact of this update is huge as it slows down bruteforce attempts drastically, enforcing 10-15 min by attempts. Android is taking the same path et same challenges are arising.

Traditional forensic methods to extract data from this evidences are not possible anymore. In 2018, Grayshift started to offer a new solution capable to access this kind of phone data if this one is powered on and has been unlocked at least once. However, it changes completely the procedure to seize and examine the evidence. In some countries, the law or the justice may have to evolve to cope with these constraints and offer the best chances to investigators and citizens to solve cases.

In this talk we would like to start by defining the different states of phones and their implications in terms of data access, then develop on how to maximize chances of getting access to user data and the challenges associated and finally discuss the traces which can be left and how forensically sound it can be to access a live system. For this last part, we did several extractions of a system at different times, without any user interaction and then mapped the changes.



1 Jun

Abstract no: **OP072**



Marius Eggert

Bundeskriminalamt

| ORAL

Automating Fault-Injection Attacks to Extract Digital Evidence

Hardware attacks are becoming more and more relevant for police forensic investigations due to the increasing number of security features present in the system on chips used in modern devices. With attacks like voltage glitching or laser fault injection these protections can often be disabled during the boot process, therefore allowing access to the stored data. But before these types of attacks can be utilized in police casework, several solutions to various problems must be found. Data corruption and data loss is hardly considered in publications, so the evidence object may break. Also, a lot of manual effort is required to execute the attacks presented in the literature. Automation approaches are available but often limited to specific white or gray-box scenarios, which are not present in real live.

We present a framework design that aims to overcome some of these problems. It allows the definition of various attack scenarios such as side-channel analysis or fault injection attacks by coordinating the devices involved. Besides the interchangeability of modules, a lot of effort was put into parameter optimization, which is one big issue when utilizing complex attacks. While still improvable, the applicability of the approach was already confirmed by targeting several real-world chips, which will also be presented. Lastly, we showcase our latest research in the area of fault injection attacks and discuss the applicability of the results to mobile devices (e.g., smartphones).



1 Jun

Abstract no: **OP077**



Johnny Bengtsson

Swedish National Forensic Centre; Linköping University

| **ORAL**

Revisiting home automation forensic experiences for application on a building automation and control system (BACS)

Building automation and control systems (BACSs) as specified in ISO 16484, and commonly with integration of a supervisory control and data acquisition (SCADA) system, are nowadays commonly seen in newer real-estate development projects. Such server-based system are built upon numerous network-attached monitoring and control or data processing devices, such as remote terminal units (RTUs) and programmable logic controllers (PLCs), as well as data-generating or data-driven components such as sensors and actuators. Real-estate SCADA systems generally aim at maintenance planning, lighting, cost-related energy optimisation of the indoor environment, e.g. heating, ventilation and air conditioning (HVAC), but also directly and indirectly provide sensor information that may concern safety and security.

Previous projects within home automation forensics at the Swedish National Forensic Centre (NFC) have demonstrated the feasibility of generating timelines with timestamped sensor measurements and actuator states events, based on home automation controller extracted log files and databases. It was also concluded that the timeline events correlated well with the planned and conducted scenario based real-world activities. It has been proposed that such timelines may contribute well to a traditional crime scene investigation.

This work, with regards to the experiences from the home automation forensics domain, presents the outcome of an initial forensic study on a complex SCADA implemented BACS, and a proposal on how such BACS forensics concepts further can be developed and adapted for general field usage.

Keywords: digital forensics, BACS, SCADA, crime scene, data visualisation



1 Jun

Abstract no: OP080



Aart Spek

Nederlands Forensisch Instituut

| ORAL

Use of deciphered data from Tesla vehicles

In any Tesla, a central gateway module continuously logs vast amounts of data over the course of its lifetime. These data are used by Tesla for several reasons, such as improving (semi-) self-driving capabilities and trouble shooting. Although the data is periodically uploaded to Tesla's servers, the logs reside on a concealed but accessible SD-card. We learned that these logs contain far more signals, and over a much longer period of time, than a regular Event Data Recorder does. We reverse engineered the contents and validated our findings in experiments and by comparing to redundant data. Our main motivation for this endeavor was to be able to investigate accidents with Tesla vehicles without being dependent on the manufacturer. The presentation shall focus on the content of the vehicle logs and shall contain several examples where the data was used to better understand an accident. Some remarks will be given on how to access and decipher the logs and what precautions should be taken for the acquisition.





**DNA/FORENSIC
GENETICS**



1 Jun

Abstract no: OP081



Deborah A. Hughes

Deakin University, School LES, Geelong, Australia

| ORAL

An investigation into the substrate variables impacting DNA transfer, persistence, and recovery in forensic casework

During preliminary research, an array of non-porous substrate surfaces routinely encountered in crime scene settings were investigated for their affinity to encourage or discourage the transfer and adherence of DNA-containing biological materials.

It was discovered that observable impacts on the spread and deposition of touch and salivary deposits could be linked with minor changes in surface roughness and the physicochemical interactions, including hydrophobicity. Further, not only did the available surface free energy of the combined substrate/deposit interface influence the spread of the deposit, but the nature of the deposit was equally as impactful.

Continuing this research, the present study further investigates the substrate variables that impact the transfer of biological materials and its persistence after collection, with a strong focus on the fluid dynamics of deposits, evaluating the change in deposition behaviour across a particular surface roughness parameter. Findings from this research provides a better understanding of the importance of surface composition as a consideration for interrogating how forensically relevant deposits behave during transfer and persistence over time.



2 Jun

Abstract no: OP082



Maija Lepistö

National Bureau of Investigation, Forensic Laboratory (NBIFL), Vantaa, Finland

| ORAL

Validation of automated microscope slide scanner with DNN based image analysis software for detection of sperm cells

Forensic laboratories typically subject sexual assault samples for presumptive testing for semen, DNA profiling and light microscopic analysis of sperm cells. Light microscopy is laborious, time consuming and prone to human errors. In recent years automated scanning systems and AI based methods have been developed for the detection of sperm cells. Metasystems Metafer is an automated scanning system with a Sperm finder deep neural network (DNN) based imaging system.

We validated the Metasystems platform. The aim was to evaluate the sample specific sensitivity of Metasystems compared to light microscopy and to determine the amount of images a forensic expert needs to review.

116 microscope slides were collected from the casework samples. The experts examined the slides for the presence of sperm cells using a light microscope. After the light microscopy the samples were scanned and analyzed with the Metasystems. The Metasystems recognizes sperm cell like patterns which are saved as thumbnail images. The Sperm finder application sorts the thumbnail images based on their probability value.

Four slides which were determined as negative using light microscopy were determined as positive using Metasystems. These four samples were re-evaluated as positive using light microscopy. The sensitivity of the Metasystems scanner was 96,7% which met the set criteria. Based on the validation, guidelines were determined for the amount of thumbnail images an expert needs to review.

The Metasystems platform greatly reduces the hands-on time of a forensic expert and is more sensitive than the currently used method. The method has FINAS accreditation and is currently in use at the NBI.



1 Jun

Abstract no: KN011



Bas Kokshoorn

| KEYNOTE

Netherlands Forensic Institute, The Hague, The Netherlands; Amsterdam University of Applied Sciences, Amsterdam, The Netherlands

Reflections on 10 years of activity level reporting: where to from here?

A decade ago, questions put to DNA scientists at the Netherlands Forensic Institute (NFI) about the manner or time of transfer of body fluids or latent DNA traces would by default be answered as “We cannot determine, based on the traces alone, how or when a trace originated”. This situation is now dramatically different given the increasing knowledge on trace dynamics, with publications on DNA transfer, persistence, prevalence, and recovery (TPPR) becoming more abundant.

Reporting on forensic biology findings given activity level propositions was introduced at the NFI about 10 years ago. Building on the foundations laid in seminal papers from the former Forensic Science Service in the UK, a framework was developed and implemented in casework. Issues and obstacles encountered along the way are discussed. We will follow the process of acceptance by the Dutch courts, culminating in the delineation of ‘DNA activity level’ as a separate area of expertise by the Netherlands Register for Court Experts.

Casework experiences are shared and we discuss how those shaped research efforts into DNA TPPR. From these experiences we also outline current developments in the field and provide an outlook on areas that need to be explored further to strengthen the evaluation of forensic findings given case relevant propositions at the activity level.



2 Jun

Abstract no: KN010



Corina Benschop

Netherlands Forensic Institute

| KEYNOTE

Advancing the analysis, comparison and interpretation of DNA profiling data: What does the future hold for us?

The analysis, comparison and interpretation of DNA profiling data becomes more and more automated. The digital storage of data, methods for software development, bioinformatics, and artificial intelligence enable increased and efficient use of data. This leads to newly developed methods that impact the success rates in forensic DNA cases but also the laboratories' workflows.

This raises questions of how far can, and do we want, our processes be automated and data driven.

Will neural nets for DNA profile analysis outperform trained DNA analysts making use of threshold based approaches?

Is explainable artificial intelligence (XAI) and a machine learning approach for number of contributors (NOC) estimation a must have, or will there be no need to estimate the NOC with the latest advancements in probabilistic genotyping?

Should probabilistic genotyping systems model all types of artefacts or noise?

Will computer power or calculation time not be a limitation anymore?

Will CE remain the default for autosomal STR typing and will MPS based analysis be used for specific cases only?

How far can, will and do we want to automate the DNA analysis, interpretation, database searching and reporting for investigative leads?

Can we use data from historical cases to support reporting officers in current cases, or even provide automated suggestions for decisions in the interpretation process?

During this presentation, these questions will be discussed by means of literature, research data and/or recently developed methods or tools within the NFI, such as a U-net for DNA profile analysis, NOC XAI, DNASTatistX, Fast DNA ID-track, and a DNA decision support tool.



1 Jun

Abstract no: OP084



Jack B. Reither

| ORAL

*School of Life and Environmental Sciences, Deakin University, Geelong, Victoria, Australia;
Office of the Chief Forensic Scientist, Victoria Police Forensic Services Department, Macleod,
Victoria, Australia*

DNA transfer between worn clothing and flooring surfaces with known histories of use

DNA profiles of samples recovered from clothing are often attributed to a wearer, another person who contacted the clothing and/or their close associates. A potential scenario of interest may be whether DNA was transferred to clothing via contact with a surface unrelated to the activity of interest. DNA may also be transferred from the clothing to the surface it contacts. One such surface is flooring, on which clothing may be placed or come into contact during wearing. To investigate the transfer of DNA between clothing and flooring when different types of contact are applied, two scenarios were tested. In the first scenario, a set of previously worn clothing (shirt and trousers) was taken to a home occupied by unrelated individuals and placed on the floor ('passive'). In the second scenario, another set of clothing was worn, by the original wearer, who laid with their back on the floor, rolled to one side and back, and then stood up ('active'). Samples were collected from clothing and flooring where contact did and did not occur, and references taken from wearers, wearer co-habitants, and home occupants. DNA transfer was observed from clothing to flooring and from flooring to clothing in both active and passive situations, though greater in situations involving pressure and friction ('active'), and only where contact occurred. This study informs on the composition of DNA profiles that one may obtain from an item of clothing or flooring following contact, and will aid investigators when interpreting DNA evidence recovered in a domestic environment and the activities leading to its transfer and subsequent recovery.



1 Jun

Abstract no: OP087



Nick Laan

Netherlands Register of Court Experts

| ORAL

Standardizing the field of DNA Activity Level and assessing experts

In criminal cases, questions about DNA analysis have been shifting from Who is the donor of the DNA? towards How did it get on the crime scene? Consequently, experts in criminal cases are increasingly asked to report using activity level propositions. Courts are often unaware of the evidentiary value of activity level reporting and often find it difficult to assess the scientists' competencies. The NRGD contributed to a solution by demarcating DNA Activity Level as a field of expertise, thus guarantying, promoting and monitoring the quality of these experts. To demarcate DNA Activity level, international stakeholders, experts and scientists in this field, gathered at two expert meetings, organized by the NRGD. They discussed the feasibility of standardisation of DNA Activity Level reporting and defined the quality standards for experts. There was a general agreement that DNA Activity Level is a distinct field of expertise. Consequently, demarcation and standardisation of DNA Activity Level reporting has been completed and the NRGD has opened this field for registration in 2021. Currently, the first assessments have been completed resulting in multiple registered experts. The assessed experts obtained various points of improvement on their reporting, leading to an even higher quality of their written reports. With DNA Activity Level the courts are supported in assessing the evidentiary value of DNA reports on activity level, understanding its limitations and be able to formulate relevant questions. Finally, the standardisation of DNA Activity Level reporting will improve the expert's contribution to the criminal case and will lead to better informed decisions by the court.



2 Jun

Abstract no: OP083



Øyvind Bleka

| ORAL

Forensic Genetics Research Group, Oslo University Hospital, Oslo, Norway

An extended EuroForMix model to combine STR DNA mixture profiles from different kits

We have extended the EuroForMix genotyping model into a new tool called EFMrep, that can combine STR DNA profiles run with different multiplex kits. The tool includes a graphical user interface to ease the analysis for practitioners in real case work. Here, multiple family related unknowns can be specified in both hypotheses. In this study we used samples from the PROVEDIt dataset to show the benefit of combining samples with different properties, analysed with either the same or different multiplex kits. The tool is very useful for real case work since samples extracted from the same material can have different properties, especially when analysed with different multiplex kits. We illustrate this with a real casework example.



2 Jun

Abstract no: OP085



Mateusz Susik

| ORAL

Biotype GmbH, Dresden, Germany; Technische Universität Dresden, Faculty of Computer Science, Dresden, Germany

How does the choice of the optimization algorithm influence likelihood ratios in probabilistic genotyping

Recent studies on the comparison of probabilistic genotyping systems revealed that there exist differences in the resulting likelihood ratios [1,2]. Substantial differences might reduce trust in the available solutions, as a single ground-truth is expected. We provide a better understanding of the topic by isolating one of the possible causes for the difference: the underlying optimization algorithm. We compare a Monte Carlo method with maximum likelihood estimation when the same probabilistic model is used. The comparison is performed on mixtures coming from the ProvedIt dataset. We analyze in-depth the mixtures where the largest differences occurred and explain the reasons for the differences.

- [1] – Riman, S., Iyer, H., & Vallone, P. M. (2021). Examining performance and likelihood ratios for two likelihood ratio systems using the PROVEDIt dataset. In U. Qamar (Ed.), PLOS ONE (Vol. 16, Issue 9, p. e0256714). Public Library of Science (PLoS). <https://doi.org/10.1371/journal.pone.0256714>
- [2] – Cheng, K., Bleka, Ø., Gill, P., Curran, J., Bright, J., Taylor, D., & Buckleton, J. (2021). A comparison of likelihood ratios obtained from EuroForMix and STRmix™. In Journal of Forensic Sciences (Vol. 66, Issue 6, pp. 2138–2155). Wiley. <https://doi.org/10.1111/1556-4029.14886>



3 Jun

Abstract no: OP086



John Butler

| ORAL

U.S. National Institute of Standards and Technology, Special Programs Office

MVPs of Forensic DNA: Examining Some of the Most Valuable Publications in the Field

Thousands of publications in dozens of peer-reviewed journals exist on the topic of forensic DNA. This ever-growing body of scientific literature becomes increasingly challenging to monitor, much less incorporate into forensic laboratory training programs. For case-working forensic scientists, understanding which research publications are most informative would be helpful. This is one of the reasons that the INTERPOL reviews are prepared and shared every few years (e.g., [1]). DNA technical leaders and analysts can benefit from receiving regular updates on useful articles and creation of lists of valuable articles in specific areas of interest to forensic DNA casework. This presentation will introduce an effort to identify and describe some of the most valuable publications (MVPs) in the field. An initial MVP list assembled almost 500 informative publications in forensic DNA across 26 topic categories [2]. This list builds upon references cited in the July 2020 SWGDAM Training Guidelines [3] and efforts underway within the OSAC Biology Scientific Area Committee [4]. Information learned as part of the forthcoming triennial INTERPOL review on forensic biology and DNA will also be discussed. A common information knowledge base is expected to benefit forensic scientists, students, and stakeholders.

References

- [1] Butler JM, Willis S (2020) INTERPOL review of forensic biology and forensic DNA typing 2016-2019. *Forensic Sci. Int.: Synergy* 2:352-367.
- [2] See https://strbase.nist.gov/pub_pres/AAFS2021-W19-Handouts.pdf
- [3] SWGDAM Training Guidelines (2020). Available at <https://www.swgdam.org/publications>
- [4] See <https://www.nist.gov/osac/biology-scientific-area-committee>



3 Jun

Abstract no: KN012



Andreas Tillmar

| **KEYNOTE**

National Board of Forensic Medicine, Linköping, Sweden; Linköping University, Linköping, Sweden

Investigative Genetic Genealogy: Current Practice and Future Challenges

Investigative genetic genealogy (IGG, or forensic genetic genealogy, FGG) has emerged as a powerful forensic tool to generate leads for the identification of unknown perpetrators and unknown human remains. After its first appearance in 2018, IGG has successfully been used to solve hundreds of cold cases. IGG includes the use of large genotype data sets, typically including hundreds of thousands of single nucleotide polymorphisms (SNPs), in combination with commercial genealogy DNA databases to trace biological relatives of the unknown by matching segments of shared DNA. Although IGG, from a theoretical standpoint, is relatively easy to understand and apply, a number of obstacles (methodological, legal and ethical) exist when it comes to its practical application in law enforcement cases. This presentation will summarize and give an overview of the latest advances in the methods used for IGG. The presentation will also include a discussion on existing and future challenges and how these can be approached.



1 Jun

Abstract no: OP089



Eija Lapinkaski

National Bureau of Investigation Forensic Laboratory, Vantaa, Finland

| ORAL

Automated reporting of volume crime DNA samples yielding a non-comparable result

Year 2018 is turning into 2019. NBIFL DNA laboratory promises that all examinations of volume crime DNA samples (VC samples) are reported in 90 days – and the deadlines are crashing. Early 2019, the average time for examinations exceeds 100 days. At Christmas, the average turnaround time has exceeded 140 days, even though 4850 reports (11 600 samples) were churned out during the year. The majority of the samples are "touch DNA", often with a null result. Reporting these is laborious.

At fall 2019 the "AULA project" is set up. The goal is to create automated reporting for VC samples that yield a result non-comparable result. Already, VC samples were being processed in their own line of production. Following AULA, the quantification values of VC samples are given a cut-off limit. If there is less than 0,003ng/μl DNA in the sample, the analysis is stopped and a null result is reported. These cut-off null results, together with other null results from analyses of samples that continue to PCR, are sent each night automatically to the customer.

By the summer of 2020, automated reporting had lowered the average time of examination under the promised 90 days. Year 2020 totalled 8 100 reports (18 600 samples), of which 3 100 (6 100 samples) fell into the null category and resulted in an automated report. At Christmas time 2020, the average time for investigations had sunk to 70 days, a reduction of 50% from the year before. Another year later, at the end of 2021, the average time for investigations is still going down as the backlog is slowly melting away.

Later the automatic reporting has been expanded to serious crimes samples and environmental monitoring samples from CSI units.



1 Jun

Abstract no: OP092



Karin Hedberg

Senior Forensic Expert, The National Forensic Centre, Swedish Police Authority

| ORAL

Detection of multiple identities in the Swedish DNA database ensures correct identities in other governmental databases

The Swedish DNA database legislation gained legal force in 1999. After an amendment in 2006, the criteria for taking samples from individuals were widened. This has given the intended result; a growing national DNA database. In the past years, about 30,000 samples from individuals have been taken yearly. In 2021, about 170,000 individuals were included in the DNA database. A consequence of this growth is that the number of samples with unconfirmed and false identities increases. Therefore the National Forensic Centre (NFC) invests large resources to improve the quality of the personal information and to assure the correct identity of each DNA profile. However, DNA samples and fingerprints are not always collected at the same time, making it possible for suspects to use multiple identities. Multiple identities are detected when a new sample matches the DNA profile from an individual that is already included in the database but with a different identity. These individuals benefit from existing with multiple identities not only in the DNA and fingerprint databases and the databases for suspects and criminal records, but also in the Swedish population register. This presentation will describe how NFC and the International Affairs Division within the Police cooperate to provide the Swedish Tax Agency, the manager of the population register, with quality assured results from the DNA and fingerprint databases and with information about personal data which should be used in all the Swedish governmental databases. Through this cooperation, personal data in the population register and in the databases for suspects and criminal records can be corrected and merged into one identity.



1 Jun

Abstract no: OP093



Martin Slagter

Netherlands Forensic Institute

| ORAL

Development of the Fast DNA Identification Line (FDIL)

The need for faster turnaround times of DNA profiling results is essential to help solve crimes in the decisive investigation stage of a case. The Netherlands Forensic Institute (NFI) therefore has developed a fully automated DNA identification line that automatically: analyses a trace profile from raw profile data, checks for cross contamination during a certain time window, derives the main contributor from the trace, searches the trace against reference profiles within the case, searches the trace against reference profiles within the elimination databank and the DNA databank for criminal cases, creates a conclusion and finally creates a report which is automatically sent to the assigned police unit and public prosecution. For this project specific software (LabXS, WorkflowXS) was developed to track the samples real-time during the automated process and to make it possible to manually intervene when certain expected quality criteria are not met. For the cross contamination check the fast ID line automatically exports trace profiles to a database (ContaminationXS) that derives the main contributor of a trace and searches the profile against other profiles within a certain time window. For the automated report we have created software (ReportXS) that automatically fetches case data from the case management system and fills a template which is automatically exported to PDF. The Fast DNA Identification line makes it possible to report within three working days from the time of arrival of the traces in the laboratory. The developed system will be presented as some results of the first half year of usage.



1 Jun

Abstract no: OP094



Alexandre Poussard

| ORAL

French gendarmerie's forensic institute (IRCGN), gendarmerie nationale, Cergy-Pontoise, France

Evaluation of DNA methylation based age prediction models from buccal swabs and saliva samples using pyrosequencing data

In forensic genetics, the identification of an individual is often allowed through the comparison of unknown DNA profiles obtained in a case to databases or references. When no match occurs, investigators need new tools in order to obtain additional leads. The latest technical advances now allow the prediction of externally visible characteristics. In this sense, the age prediction of an individual through DNA methylation analysis remains one of the latest challenges. The prediction models have to account for the specific constraints of this field including tissue specificity and DNA availability (i.e. low DNA amounts, or low DNA quality). Lately, Jung and colleagues produced models from blood, saliva and buccal cells, using a single base extension sequencing method. Aiming to evaluate these models in our analytical conditions, saliva and buccal cell samples from 115 French individuals between 0 and 88 years old were collected and analyzed. After having determined the optimal analysis conditions, including the DNA quantity for bisulfite conversion (75ng), some differences were highlighted in the measured methylation rates between the two studies. Despite these discrepancies, the prediction performances remained very similar in our conditions (mean absolute error of 3.5 years, 3.9 years and 3.2 years respectively for the saliva, buccal swab and multi-tissue model), with limitations observed for the oldest and youngest individuals. Furthermore, we propose the use of a prediction interval regarding the error dispersion and the correct prediction rate at +/- 5y and +/-10y.

Keywords: forensic epigenetics, age prediction models, DNA methylation, pyrosequencing



1 Jun

Abstract no: OP098



Laurene Pottier

French Gendarmerie Forensic Institute, Pontoise, France

| ORAL

RapidHIT ID, fast DNA solution in french overseas territories: feedback on New Caledonia implementation

RapidHIT ID, fast DNA solution from ThermoFisher company, has been implemented by French Gendarmerie to provide DNA analysis solution in French overseas territories, where no close DNA lab is available and when a fast response is needed. After a technical validation performed on IRCGN's site in Pontoise (France), more tests were performed to check if French Gendarmerie encrypted network could be used to secure data exchange between the overseas territories and Pontoise. On October 2021, for the first time, the instrument was deployed in the local forensic unit in Noumea, 20,000 km away from Paris. After two weeks of training and final testing, the instrument was ready to be used by local forensic technicians on real casework samples. At the beginning of November, for its first use in real condition, the RapidHIT ID allowed to solve a housebreaking in only few days (compared to the several weeks required when the samples are shipped to Pontoise). As the instrument perform an analysis in 90 minutes, the samples eligible to the analysis can be treated in one or two days. Then, thanks to the secured network, a DNA expert in Pontoise can directly pick up the data on the instrument in Noumea and do the interpretation in the meantime. Moreover, a real-time assistance can be provided by Pontoise to Nouema if necessary by connecting itself directly on the instrument. Therefore, the RapidHIT ID instrument offers a real solution to save time for the territories far from a DNA laboratory.



1 Jun

Abstract no: OP099



Guro Dørum

Zurich Institute of Forensic Medicine, Switzerland

| ORAL

RNA-based Age Estimation from RNA-Seq data – Preliminary Results from the RNAGE Project

In the last decade, DNA methylation has been established as the method of choice for age prediction. However, the harsh bisulfite treatment and the requirement of high DNA inputs for DNA methylation analysis limits the use of this technique. In addition, there is no consensus on markers and methods yet.

RNA has gained a lot of attention within the forensic field in the last few years. RNAs are differentially expressed and there is evidence for a correlation with age. Since RNA can be co-extracted with DNA from the same piece of evidence, molecular RNA-based analysis seems to be a promising alternative for age prediction.

The EU-funded collaborative project “RNAGE” (RNA-based Age Estimation) aims to establish an RNA-based workflow for age prediction of unknown perpetrators from forensic trace material. We performed whole transcriptome and miRNome sequencing of blood and saliva samples collected from donors between 17 and 86 years of age, in order to identify potential RNA markers with statistical methods.

Here, we present preliminary results of a statistical model for age prediction based on whole transcriptome sequencing of blood samples. We discuss different approaches and problems encountered in the analysis of these RNA-Seq data.



1 Jun

Abstract no: **OP101**



Marie Morelato

Centre for Forensic Science, University of Technology Sydney, Australia

| **ORAL**

Utility of trace DNA: An analysis of historical casework data

The resurgence of the central role of the trace in forensic science allows this discipline to more fully exploit its broader problem-solving potential related to security and societal issues, by moving away from specialised analyses that focus on single facets or purposes. This, coupled with the increased use of biological traces for criminal investigations, has driven research to investigate the utility of trace DNA. This study aimed to present a holistic view of the utility of trace DNA by comparing its recovery rates from differing exhibit and crime types against the utility of the resultant links obtained.

The DNA profile recovery rates of six months (July-Dec 2019) of historical casework data from New South Wales, Australia, categorised by crime type and exhibit type, were assessed. A sub-set of this data was analysed for the utility of the links they provided to an investigation, where the resulting links were grouped into four categories; linking a person to a crime, links used for exclusion, corroboration of an alleged narrative or links that provide redundant information.

It was found that exhibit types with high DNA recovery rates did not necessarily have high utility. Clothing and fabric had the highest recovery rates, but had very low utility. Alternatively, firearms had a very low recovery rate but extremely high utility. These findings demonstrate the need for a model considering both DNA recovery rates and utility for different exhibit types to assist scene of crime officers and investigators in trace selection, as consideration of DNA recovery rates alone does not always result in the targeting of traces with high utility.



2 Jun

Abstract no: OP090



Jord H.A. Nagel

| ORAL

Can DNA-profiling provide intelligence information on criminal cooperation an organization, a case example

The comparison of DNA-profiles from traces and persons taken from different cases can help to link crime scenes and/or criminals with each other. In order to link these cases and/or persons with each other, it is often necessary to compare huge amounts of DNA-profiles. With the aid of automation, such as DNAXs, it is possible to compare a large number of DNA-profiles that have been obtained in different cases with a large number of DNA-profiles from traces and persons. The outcome of these comparisons can provide information and intelligence about criminal organizations and the possible contacts between certain individuals. Without automation, gathering intelligence via DNA-profiling data was till recently, severely limited to what a DNA-scientist could handle by hand. But with the implementation of automatic comparison software suits like DNAXs, the amount of DNA-profiling data can be greatly increased. Thus providing a much more in-depth intelligence gathering opportunity. But it also creates its own set of possibilities, challenges and requirements for the DNA-scientists, which we will discuss, via a case example.

Investigative DNA



2 Jun

Abstract no: OP091



Chiara Fantinato

| ORAL

Department of Forensic Sciences, Oslo University Hospital, Oslo, Norway ; Department of Forensic Medicine, Institute of Clinical Medicine, University of Oslo, Oslo, Norway

Detection of human DNA in the air

Humans constantly shed DNA into the environment. Large quantities of dead skin cells and fragments are released into the air and this constitutes a large proportion of indoor dust. DNA can be recovered from dust in sufficient amounts to yield STR genotypes. Human DNA was detected in environmental air DNA (eDNA) samples collected from indoor and outdoor settings with intense human traffic. Aerosol DNA may potentially be a useful source of information to aid human identification in a specific environment and may help in the activity level assessment of criminal cases. This study explored the feasibility of aerosol DNA for forensic applications. The possibility of collecting, isolating and analyzing human DNA from air was investigated. Air samples were collected from various indoor environments regularly attended by several individuals. The samples were collected using the AirPrep ACD220 electret filter air sampler and the DNA was recovered with the sampler-specific elution kit and with two alternative approaches. The methods employed to collect and extract human DNA from air are described, along with insights on the quality and quantity of human aerosol DNA that can be recovered from a typical indoor environment. The results of this study suggest the potential use of aerosol DNA as a novel investigative tool for forensic applications.



2 Jun

Abstract no: OP095



François-Xavier Laurent

International Criminal Police Organization – INTERPOL, DNA Unit, France

| ORAL

I-Familia: Identifying missing persons globally through family DNA kinship matching

Although other means of identification can be applied to missing person investigations, DNA is often extremely valuable to further support or refute potential associations. When reference DNA samples cannot be collected from personal items belonging to a missing person, identifications can be made indirectly using DNA from the missing person's relatives. The ranking of likelihood ratio (LR) values, which measure the fit of a missing person for any given pedigree, is often the first step in selecting candidates in a DNA database. Although implementing DNA kinship matching in a national environment is feasible, many challenges need to be resolved before applying this method to an international configuration. In June 2021, the International Criminal Police Organization INTERPOL launched I-Familia, a new DNA database aiming to facilitate the identification of missing persons globally through family DNA kinship matching. This straightforward method, based on calculations performed with the DNA matching software BONAPARTE, Worldwide allele frequencies and tailored cutoff \log_{10} LR thresholds, allows for the classification of potential candidates according to the strength of the DNA evidence and the predicted proportion of adventitious matches. This powerful method streamlines the decision-making process in missing person investigations and DVI processes, especially when there are low numbers of overlapping typed STRs. Intuitive interpretation tables and decision trees help strengthen international data comparison for the identification of reported missing individuals discovered outside their national borders, ultimately bringing closure to many families.



3 Jun

Abstract no: OP096



Siri Aili Fagerholm

The National Forensic Centre, Swedish Police Authority, Linköping, Sweden

| ORAL

Investigative genetic genealogy in criminal investigations – an update of ongoing work in Sweden

In June 2020, a double murder committed in 2004 was finally solved with the use of investigative genetic genealogy (IGG). This came to be the first criminal investigation in Sweden solved applying IGG. The work was a result of a successful cooperation between the National Forensic Centre (NFC), the National Board of Forensic Medicine (RMV), the Legal Affairs Department at the Swedish Police Authority (SPA) and the investigation team. In another, still ongoing case, involving identification of human remains, IGG was also used and investigative leads produced. Following the successful use of the method, the SPA aims for implementation of IGG to solve serious criminal cases, including identification of human remains. In the implementation process several considerations have been made and addressed including the establishment of national guidelines. Legal assessments have been made and a “prior consultation” with the Swedish Authority for Privacy Protection (IMY) performed. However, the findings in the consultation report from IMY were in contradiction to the findings made by SPA. Thus a revision of legal statutory and potentially also adjustments were found to be necessary. An update of the present legal situation will be given.



3 Jun

Abstract no: OP097



Daniel Kling

| ORAL

Department of Forensic Genetics and Forensic Toxicology, National Board of Forensic Medicine, Linköping, Sweden; Department of Forensic Sciences, Oslo University Hospital, Oslo, Norway

Investigative Genetic Genealogy – Errors and how to deal with them

Investigative genetic genealogy (IGG) is the process whereby dense sets of genetic markers are used to trace relatives of in criminal investigations. The term genealogy specifically relates to the use of methods where pedigrees are built based on genetic matches within public databases, e.g. GEDmatch or FamilyTree DNA. In addition, IGG involves searches in birth records, historic document and other publicly available meta data to finally circle in a suspect as the donor of an unidentified crime scene sample.

In this study, we focus on models to generate pedigree data, errors in the data as well as models to call shared DNA segments. In particular, we outline and compare how simulations can be used as a powerful and appropriate tool to investigate the reach and limits of IGG. We use publicly available genotypes from the 1000 Genomes and simulate data using different approaches and compare the outcome. Specifically, we focus on how errors affect the results and different strategies to mitigate the effects of errors, both in the approach whereby shared DNA segments are determined but also when generating the DNA profile used. As an example we illustrate that low pass whole genome sequencing data often generate an excess of homozygote genotypes and demonstrate different approaches to process the data for optimal searches in databases.



3 Jun

Abstract no: OP100




Adam Staadig

| ORAL

Department of Forensic Genetics and Forensic Toxicology, National Board of Forensic Medicine, Linköping, Sweden; Department of Biomedical and Clinical Sciences, Linköping University, Sweden

The power of unique molecular indices in an extensive SNP panel for confirming investigative genetic genealogy leads

Investigative genetic genealogy (IGG) is a rapidly emerging forensic tool that has given crucial investigative leads in a number of cold criminal cases and in identifications of human remains. An extended DNA profile is required for the IGG method which can be determined, preferably, by high density SNP microarrays or whole genome sequencing. The subsequent genealogy investigation hopefully results in a candidate suspect and traditional forensic STR typing is done to confirm the identification. However, certain DNA samples can be degraded and are therefore unsuitable for STR typing. Additionally, direct or appropriate reference samples may be missing and distant relatives might be required. We have tested the FORCE panel which consists of ~5400 forensically relevant SNPs including autosomal, X, Y, ancestry, phenotype and kinship informative SNPs. Due to the high number, and carefully selected SNPs the panel is well suited for distant kinships and other forensic applications. We have analyzed the FORCE panel with a QIAseq targeted DNA custom panel (QIAGEN) and have sequenced the DNA libraries on a MiSeq FGx (Verogen). The QIAseq assay includes unique molecular indices (UMI), which are short random nucleotide sequences that are enzymatically ligated to each template molecule prior amplification. This results in that, theoretically, each starting molecule has a unique UMI sequence and a consensus sequence can be created. We have tested the panel on both bone samples as well as high quality reference samples and have performed sensitivity and mixture studies. We have shown that the use of UMI decrease genotype errors and increases sensitivity and precision in the analysis.



**FORENSIC
MEDICINE AND
TOXICOLOGY**



31 May

Abstract no: KN013



Arjo J. Loeve

| KEYNOTE

Delft University of Technology, Faculty of Mechanical, Maritime and Materials Engineering (3mE), Department of BioMechanical Engineering (BMEchE), Delft, the Netherlands; Co van Ledden Hulsebosch Center of Forensic for Forensic Science and Medicine, Amsterdam, the Netherlands

Infant Head Injury by Shaking Trauma – a biomechanical engineering perspective

Head injuries in abusive situations are a major cause of infant morbidity and mortality. Their causes are topic of much debate and include various forms of violence such as blunt force impact, shaking and compression. Victims may show subdural haemorrhages, retinal haemorrhages and various degrees of encephalopathy, often with absent or inconsistent history, commonly with co-injuries indicative of abuse, such as fractures and bruises. Signs of direct impact to the head are lacking in a large proportion of the victims. It is unclear whether violent shaking without impact to the head may cause intracranial injuries, not the least because literature seems conflicting at first sight.

A series of literature reviews and two volunteers studies with instrumented shake-dolls were conducted to shed light on how various biomechanical studies on infant head injury by shaking trauma (IHI-ST) can be so seemingly contradictory. Results were put in a "7-Step model of IHI-ST", describing the transfer of kinematics (motion, velocities and accelerations) from the torso of an infant being shaken, via the neck to the skull and the internal anatomy, eventually resulting in injury.

Our recent findings suggest that various often-cited (both in scientific literature and court) studies on infant shaking and the relations between accelerations and injury made some understandable, but unfortunate simplifications. Hence, the possibly most harmful aspects of shaking kinematics were overlooked or ignored up to now. Furthermore, measured accelerations and velocities have often been compared to injury thresholds that are about very different kinematic situations and hence should not be used.



30 May

Abstract no: OP105



Puneet Setia

| ORAL

All India Institute of Medical Sciences, Jodhpur, India

Beclin protein analysis in human cadaveric brain and muscle tissues for estimation of post-mortem interval

Background: The most significant characteristic discovered during an autopsy is the post mortem interval (PMI). Decades of research have not yet provided an accurate PMI measurement method that can be used in all circumstances. The traditional approaches, which were based on physical discoveries such as algor mortis, rigor mortis, and decomposition changes, are very subjective and are influenced by a variety of circumstances. At the molecular level, forensic pathologists have noted modifications. Tissue autophagy is one of them, which happens gradually after death.

Methods: The present study was planned where we tried to find the utility of Beclin protein in the estimation of PMI. The current study was conducted on the brain (n=5) and muscle (n=5) tissues of human cadavers that were harvested at the time of medicolegal autopsy. Serial estimation of Beclin levels was performed at 0, 3, 6, and 9-hour intervals from the time of death by using the ELISA method at temperatures 20°C and 40°C.

Results: The result showed that at 40°C in the brain tissue the protein degrades for 6 hours and then increases up to 9 hours and at 20°C it remains almost stable till 6 hours and then increases up to 9 hours. The muscle tissue showed that at 40°C the protein degrades for 3 hours and then increases up to 9 hours and at 20°C it increases till 6 hours and then degrades up to 9 hours after death.

Conclusion: The current study reports for the first time in human cadaveric brain and muscle

tissue the correlation in the levels of autophagy protein Beclin with increasing time since death.

Keywords: Beclin, post mortem interval, autophagy, ELISA



30 May

Abstract no: OP108



Agatha Grela

University of West London, London, UK

| ORAL

Diclazepam metabolite interpretation

There has been a rise in cases involving designer benzodiazepines. Given their similarity in structures and metabolic pathways, their analysis within biological samples is challenging and presents many problems for forensic and toxicological analysis and interpretation. This is particularly relevant for the designer benzodiazepine diclazepam. Diclazepam is a structural derivative of diazepam and has not been approved for human consumption. There is a concern regarding a lack of data for the expected concentrations of diclazepam's metabolites, particularly when analysing blood samples. We will present the available data relating to this concern, including the known quantification of metabolites that have been encountered when detecting the diclazepam in biological samples. However, some distinct patterns relating to the expected proportions of metabolites were identified across these studies, suggesting that diclazepam may form metabolites of similar proportions across different subjects, which could lead to the identification of the original drug consumed, for example: diclazepam, or one of its three pharmaceutically active metabolites; delorazepam, lormetazepam, and lorazepam. Therefore, we will present data collected in our preliminary microsome studies further contributing to the knowledge on diclazepam metabolism and discuss how this can be applied in the interpretation of forensic and toxicological data.



30 May

Abstract no: OP109



Lata Gautam

| ORAL

Forensic and investigative Science Research Group, School of Life Sciences, Anglia Ruskin University, Cambridge, UK

Drinks spiking – Gaps in reporting and conviction

Drink spiking, chemical submission, date rape drugs, or drugging are some of the terms used in literature to name the covert administration of drugs or substances into drinks or food to incapacitate a person to commit sexual assaults, theft, pranks or abuse. This is not a new phenomenon as there were drinks spiking cases reported as early as 1903. Recently in the UK, there have been reports of increased drink spiking in house parties and cases of needling i.e. injection in clubs and bars. This latest news has added a new dimension to this crime although drink spiking is still a low reported and under researched topic.

In order to understand the nature and trend of drink spiking, we recently carried out two surveys: first survey focussed on men only (N= 69) and second survey focussed on general participants (N=91). In this presentation, we will share findings from these surveys, highlighting participants' knowledge, perception and experience, awareness of support system available, reporting rate and reasons for not reporting cases to the authorities, among others. We will also share some key insights and lessons from related previous research on spiked drinks analysis and Drug Facilitated Sexual Assault (DFSA) highlighting some useful recommendations to help police forensic science communities and general public to address key gaps on reporting and conviction.

Keywords: Drink spiking, chemical submission, date rape drugs, drugging, DFSA



30 May

Abstract no: OP110



Francesco Saverio Romolo
University of Bergamo, Italy

| ORAL

Forensic analysis of illegal pharmaceutical products, supplements and doping agents by Ion Beam Analysis (IBA)

Criminal organisations are trading illegal pharmaceutical products and supplements, threatening public health worldwide. Drugs for erectile dysfunction such as phosphodiesterase type 5 inhibitors are the most commonly counterfeited medicines in high-income Countries. Sildenafil is not only used in counterfeit Viagra® tablets but also in supplements. Another class of “lifestyle” products are anabolic steroids. Such illegal products, widely sold through e-shops, are manufactured with no quality standards, thus resulting in final products likely containing toxic contaminants and mismatching active ingredients and respective amounts declared on labels.

Their characterisation needs a comprehensive analytical approach not simply for forensic reasons but also for providing early warning for public health.

We studied these illegal products and authentic Viagra® tablets using traditional approaches based on chromatography coupled to mass spectrometry (MS) and accelerator-based nuclear analytical techniques, such as Ion Beam Analysis (IBA). Traditional MS and secondary ion mass spectrometry using primary ions with energies in the range of several MeV (MeV-SIMS) provided analysis of organic active compounds and organic impurities.

IBA measurements with an accelerated proton beam extracted in air allowed elemental analysis of the as-is material without sample preparation steps.

IBA in two different accelerator laboratories (Italy and Brazil) are compared and allow the evaluation of research plans for the possible future implementation of an inter-laboratory characterisation approach based on chromatography, mass spectrometry and IBA measurements of illegal products.



30 May

Abstract no: **OP113**



Ilkka Ojanperä

University of Helsinki, and Finnish Institute for Health and Welfare, Helsinki, Finland

| ORAL

Homicidal poisoning in Finland between 2000-2021 with special attention to a digoxin case

Disclosure of homicides committed by poisoning has always been one of the main goals of forensic toxicology. In Finland, post-mortem toxicology rate is as high as 12% of all deaths. The Finnish Institute for Health and Welfare (THL) maintains a national post-mortem toxicology database, in which the results of toxicological analyses and information from death certificates are collected. Between 2000 and 2021, a search of the post-mortem toxicology database for homicidal poisonings yielded 48 cases. Distribution of poisons used was as follows: combustion fumes (carbon monoxide and/or hydrogen cyanide) 33 cases, insulins 5 cases, other therapeutic drugs 8 cases (citalopram, digoxin, 2 x morphine, propofol, propoxyphene, temazepam, venlafaxine), illicit drugs 1 case (bromo-dragonfly), and ethylene glycol 1 case. The following case represents a category in which a member of the medical staff is found guilty of a homicide committed by poisoning. In September 2014, an 84-year-old woman suffering from memory disorder was found dead at her home. Investigation into the cause of death was initiated because the woman died in the middle of a property crime investigation in which the suspect was her male nurse, working for a private home nursing company he owned. Post-mortem toxicology disclosed a fatal concentration of digoxin in her blood; this crucial finding was only due to the fact that digoxin screening in older people was part of the laboratory routine. The motive of the murder was to obtain a considerable financial advantage and to conceal previous criminal offenses. The District Court and Court of Appeal sentenced the man to life imprisonment for murder and attempted murder.



30 May

Abstract no: **OP114**



Denise Guggenheimer

Rättsmedicinalverket; Karolinska Institutet

| **ORAL**

Homicidal poisoning in Sweden

In Sweden, around 100 homicides occur each year. The most common homicide methods are sharp force (41%), fire arms (31%), blunt force (15%) and strangulation/suffocation (7%). This leaves 6% to other methods, for example homicidal poisoning. Exactly how many cases of homicidal poisoning there are in Sweden each year is unknown, except for one study which found 34 cases from 1975 to 2008 (Homicide by poisoning, Finnberg et al.). In cases of homicidal poisoning there are usually no signs of external violence, and since most poisons leave no trace on the body, unnatural death may not be suspected initially. Even if unnatural death is suspected and the body undergoes medicolegal autopsy, some poisons are not detected in the routine toxicological screening and some poisons cannot be detected at all.

This is a descriptive and exploratory study of homicidal poisonings in Sweden 1995-2019. The aim of the study is to raise awareness of these types of cases, which may facilitate police work in future homicides. Questions concern number of cases, distribution of gender, age and geography of victims and perpetrators, the relationship between victims and perpetrator, motive of the crime and how many reach a judicial verdict. Another question of interest is which poisons were used and in how many cases poisoning was detected without prior suspicion.

So far we have identified 20 cases of homicidal poisoning. The victims comprised of 15 women and 5 men, 0 to 86 years old. The identified poisons were benzodiazepines, opiates, cyanide, pesticides, insulin and carbon monoxide. These are only preliminary findings and more extensive data will be presented at the conference.



30 May

Abstract no: OP116



Aline Gibson

University of Lausanne, School of Criminal Justice, Lausanne, Switzerland

| ORAL

Investigating the consumption of illicit drugs and anti-inflammatory drugs (NSAIDs) during the coronavirus 2020 period

Wastewater-based epidemiology is an indicator that was firstly proposed in 2001 by Daughton in order to assess social phenomenon and to measure illicit drug consumption. Over the next twenty years, the analysis of illicit drugs in wastewater has been gradually integrated into a forensic perspective, proving to be an excellent indicator in order to better understand the magnitude and trend of consumption.

The consumption, even if hidden or little exposed, of substances in a given population can be objectively measured by the metabolites of various target compounds that are excreted from the human body through urine and feces. The wastewater produced by a population is thus the transport vector for the metabolite, which in turn represent the traces of consumption. It is these traces that are searched for and measured by laboratory analysis. This vector of information is the witness of the consumption of the substances by the population that contributed to wastewater.

Wastewater samples were collected at the sewage treatment plants of one Swiss city, in 2020 during the coronavirus period. The samples were extracted and subsequently analysed by LC-MS/MS. The goal of this study is to determine whether any trends emerge from the various restriction phases imposed by the government.

Keywords: illicit drug consumption, wastewater analysis, coronavirus



31 May

Abstract no: OP103



John Gall

| ORAL

Department of Paediatrics, University of Melbourne; Victorian Forensic Paediatric Medical Service, Royal Children's Hospital and Monash Medical Centre; and Era Health, Melbourne, Australia

Abusive Head Trauma (AHT) – time for a reappraisal

Abusive head trauma (AHT) in children is not a recent concept but has been documented within the medical literature for over 160 years. It can occur in the presence of not only one or more of subdural haemorrhages, retinal haemorrhages and hypoxic – ischaemic encephalopathy but with the presence of both external and internal injuries about the head and body generally. The pathogenesis of AHT was once considered to be solely the result of shaking of an infant/child but has subsequently been modified to include impact; this mechanism resulting in tearing of the bridging veins to cause haemorrhages and being of such a force, in some cases, to cause axonal injury and the development of hypoxic-ischaemic encephalopathy. In the absence of finding a suitable biomechanical model, and the absence of direct human experimentation for obvious ethical reasons, the diagnosis of AHT has remained an hypothesis which has subsequently led to challenges to its validity in the courts over the past few decades. Recently, a Swedish systematic review (the SBU Report) of the 'triad' found that there was limited scientific evidence for its association with traumatic shaking. This report has been used as a basis for a recent appeal against a criminal conviction. The outcome of this appeal will be discussed particularly in relation to not only AHT but other areas of forensic medicine for which there is limited empirical research. It will also be suggested that the term, AHT, contributes to the ongoing controversy and that it is an inappropriate term for a diagnosis. A more general diagnostic term needs agreement, one that avoids all reference to either the mechanism or intent.



31 May

Abstract no: OP106



Céline Burnier

Ecole des Sciences Criminelles, Université de Lausanne

| ORAL

Challenges in forensic sciences – Condom evidence analysis: Case studies report

Rape and sexual assault cases are commonly assessed using medical evidence, DNA and/or physical trace evidence. There has been a noticeable increase in cases where no DNA was detected on forensic analysis of the internal intimate swabs. The use of a condom by the perpetrator is one possible explanation for the absence of DNA. However, evidence of condom traces is often overlooked, and currently there are no published or publicly-available protocols optimized for condom trace collection for use by practitioners. Routinely, samples are collected similarly to DNA trace, and the forensic analysis usually involves GC/MS analysis. Nevertheless, these current protocols may be inadequate for the full analysis this type of evidence.

ChemCentre in collaboration with the Sexual Assault Resource Centre and the Western Australia Police Force, has recently implemented advancements, in how to collect and analyse this type of evidence. With the procedure being tested using proficiency trials, its implementation has seen an increase in case numbers. Various case samples were processed, and gaps that affect the interpretation of the evidence highlighted within the current framework.

This presentation aims to present and address the challenges for the Clinical Forensic Physician and the Forensic Scientist from the point of condom evidence collection, through the analysis and the interpretation. Australian casework examples illustrating different issues in terms of sample collection, sample analysis and the interpretation of the evidence will be discussed. The presentation will cover topics including the sampling protocols, the nature of the investigation and the persistence of the residues.



31 May

Abstract no: OP112



Patrick Randolph-Quinney

Northumbria University, Newcastle upon Tyne, UK

| ORAL

Harnessing Thor's Hammer: Experimentally induced lightning trauma to human bone by high impulse current

Lightning fatality identification relies primarily on soft tissue traumatic pattern recognition, which would generally prohibit cause of death identification in cases of full skeletonisation. This study explores the effects of high impulse currents on human bone, simulating lightning-level intensities and characterising electrically induced micro-trauma through conventional thin-section histology and micro-focus X-ray computed tomography (μ XCT). An experimental system for high impulse current application was applied to bone extracted from donated human cadaveric remains. μ XCT was undertaken prior to and after current application. Histological sections were subsequently undertaken. μ XCT poorly resolved micro-trauma compared to conventional histology, the latter allowing for identification and classification of lightning-specific patterns of micro-trauma, which were qualitatively and . Statistical analyses demonstrated correlation between current intensity, extent and damage typology suggesting a multifaceted mechanism of trauma propagation – a combination of piezo-electrical, thermal and pressure induced alterations. This paper gives an overview of high impulse current trauma to human bone and discusses the possible mechanisms of trauma propagation in the light of both the strengths and limitations of this study. This is a multi-disciplinary project, which highlights how forensic scientists can work with physicists and engineers to explore a real-world problem, which is implicated in the deaths of many people annually and is especially important a time when global climate change is driving increases in the number and severity of thunderstorms and lightning strikes.



31 May

Abstract no: OP118



Akos Dobay

| ORAL

Zurich Institute of Forensic Medicine, University of Zurich, Switzerland

Machine learning techniques in forensic medicine

Machine learning can be seen as a statistical approach in the sense that the algorithms defining the models can learn from data. Traditionally, the gold standard in forensic science consisted of comparing a measurement with a reference value. Based on this comparison, the forensic scientist could draw a conclusion. With facilitated access to powerful computers and the constant developments in high-precision measuring devices, the amount of data available for a forensic investigation has also increased dramatically. To overcome this challenge, part of data analysis must be automated.

In other scientific fields, multiple machine learning procedures have already been developed to mine data and transform them into human-readable representation that can be interpreted more reliably. Unlike in some fields, though, forensic science faces an additional challenge: because the conclusions must support a judicial procedure, the methods used to produce the results have to be validated against the current gold standards. Additionally, not all experts are trained as forensic scientists.

Here, we present two studies where we implemented machine learning techniques to help with analyzing postmortem computed tomography imaging. In one study, we developed an automated method to classify rib fractures. The algorithm was trained on our internal database of postmortem computed tomography images collected from July 2017 to April 2018. In the second study, we developed an automated 3D segmentation algorithm able to extract the volumes corresponding to the heart, lungs, liver, kidney, and bladder, respectively on postmortem computed tomography images.



31 May

Abstract no: OP120



Jason Payne-James

| ORAL

Norfolk and Norwich University Hospitals NHS Foundation Trust, Norwich, United Kingdom

The Workload of a (new) Medical Examiner Service at an acute NHS hospital during the COVID-19 pandemic in the UK

Introduction A Medical Examiner (ME) system was introduced in England & Wales in 2019 to review deaths of patients not referred to the Coroner. The ME is intended to prevent scandals and avoidable deaths where previously the concerns of families and whistleblowers have been ignored. The Norfolk & Norwich University Hospital Medical Examiner Service (NNUH MES) was established in May 2019. The ME must consider for every death the following: What did the person die from? Does the case need to be notified to a Coroner? Have the bereaved or any medical staff have questions about the cause or circumstances of death or concerns about the care before death. The Coronavirus Act 2020 modified certification of death requirements.

Aims This study reviews the workload of the NNUH MES from June 2020 to May 2021.

Methods All reviews of deaths were recorded on the ME-1B form and data stored on a database from which data were extracted.

Results In the study period, there were 2856 deaths in the hospital. The NNUH MES reviewed 94.08% (2687) of in-patient deaths. 458 (17.9%) were referred to HM Coroner. 42% were completed with a 'Form 100A' (HM Coroner allows a Medical Certificate of Cause of Death to be issued without inquest), 55% had an inquest or post-mortem. 2394 (89%) bereaved families were spoken to by the NNUH MES.

Conclusions Despite the challenges of a new role, and a concurrent pandemic the new NNUH MES was able to adapt continue to develop and fulfil its primary functions whilst providing a valuable support service to hard pressed clinical teams, to the Registration Office and HM Coroner. It will become an essential part of the medicolegal investigation of death.

**1 Jun**Abstract no: **OP102****Iris Sluis***Maastricht University, Maastricht, The Netherlands***| ORAL**

A preliminary data-analysis of a four-year decomposition study with small-sized pig carcasses

Objective

Estimating the postmortem interval (PMI) is a challenging task for a forensic medical doctor, pathologist, anthropologist or entomologist, particularly when decomposition is advancing. Numerous studies have been carried out in the field of forensic taphonomy in other countries, especially in the United States. However, little has been done so far in Western Europe, especially with a focus on juvenile remains. Leading to a serious knowledge gap, making it impossible to base an estimation of the PMI on empirically obtained data specific for the region.

Methods

In order to obtain data on decomposition a research facility was created to study outdoor cadaver decomposition in the Netherlands by means of pigs as a proxy (*Sus scrofa domesticus*). Each season four cadavers were placed on the surface in wire cages (1x1cm, to deny larger scavengers access) for the period of four years. The rate of decomposition was scored based on an existing scorings index (Megyesi, M. e.a., 2005), external variables and insect activity were recorded.

Results

The results show clear seasonal differences in both speed and observed phases of decomposition. Furthermore, new insights were gained in the effect of external variables on the rate and extent of postmortem alterations.

Conclusion

Based on current data, it should be possible to estimate the PMI with a scorings index for juvenile remains in specific seasons. However, the results have to be considered to be a first step in a multiannual, international, and interdisciplinary research project.



1 Jun

Abstract no: OP104



Rebecka Teglind

| ORAL

Department of Oncology-Pathology, Karolinska Institute, Sweden

Analysis of ^{14}C , ^{13}C in Bones to Facilitate Identification of Unknown Human Remains

Dead victim identification constitutes an important task for forensic professionals including forensic pathologists, anthropologists, and odontologists both in the daily casework, and in mass disasters. If there are no clues as to the identity of the deceased, the age, sex, and origin represent particularly important information to limit the search for possible matching persons. Analysis of increased levels of ^{14}C , so-called bomb-pulse radiocarbon, in tooth enamel, which has not exchanged carbon since its formation, allows for precise birth dating of individuals. If a find only consists of bones, which constantly turns over carbon, such analysis can only tell if the person was alive, or not, after 1955, when the ^{14}C levels started to increase in the atmosphere. However, the levels of ^{14}C in bones will show different levels depending on the time window of exposure during the bomb-curve, and probably on the individuals age during exposure. We therefore decided to analyze ^{14}C in bones from well-characterized deceased subjects to find out if the date of birth and date of death can be estimated by mathematical modeling. To this end, we used a pre-analytical extraction protocol to obtain three fractions, the carbonate, collagen and lipid fractions, which were then analyzed separately. We have found that the lipid fraction consistently shows more recent ^{14}C levels than the collagen and carbonate fractions. Hence, it might be possible to estimate the year of death from the lipid fraction ^{14}C levels using simple calculation of lag times. Our preliminary results show that the carbon turnover is similar in different bone types.



1 Jun

Abstract no: OP111



Eugénia Cunha

| ORAL

Instituto Nacional de Medicina Legal e Ciências Forenses, Portugal and Universidade de Coimbra

Forensic anthropology experience versus Academic background: the needed difficult balance to achieve

It is well known that theory guides, while the experience decides. How does this work in the field of forensic anthropology, where the backgrounds continue to be asymmetric? Do different academic backgrounds lead to other decisions in the expertises? Can an expert with no valuable experience in the field make the right decision? In this presentation, we will present and discuss cases to illustrate these different situations. The aim is to make the audience think about how they would act. When facing diastases in the skull, what inference do you usually make? Would that be enough to talk about possible asphyxia when there is an evident fracture in the styloid processes? What do you do when there is an apparent discrepancy in the age intervals provided by the age indicators? Which one do you follow? Regarding PMI estimation, how often do you provide our opinion? What about the final report? Do you indicate the references? Pictures? Are you categorical? How often do you feel the need to update your knowledge? These will be some of the questions we want to raise and discuss with this communication



1 Jun

Abstract no: **OP115**



Leah Wilk

| **ORAL**

Department of Biomedical Engineering and Physics, Amsterdam UMC Location AMC, University of Amsterdam, The Netherlands; Co van Ledden Hulsebosch Center, University of Amsterdam, The Netherlands

Individualised and non-contact postmortem interval estimation: combining thermal 3D imaging and numerical thermodynamics

The postmortem interval (PMI) plays a key role in forensic investigations, as it aids in the reconstruction of the timeline of events. Currently, this information is provided by an empirical model (Henssge's nomogram) describing postmortem body cooling. However, this model is subject to three significant limitations. First, the underlying experiments were conducted under standardized conditions, restricting applicability of the model to a specific subset of forensic cases. Second, in order to broaden this suitable subset, qualitative correction factors were introduced, rendering this approach subjective. Third, use of this model requires an invasive measurement of the victim's core (rectal) temperature, risking contamination and destruction of other traces. Consequently, there is an urgent need to develop a non-subjective, widely applicable, and preferably non-invasive method for PMI estimation. To address this need, we developed a thermodynamic finite-difference algorithm, providing a rigorous method to simulate postmortem body temperatures. By combining this algorithm with photogrammetry and skin thermometry, we achieve accurate and non-invasive PMI estimation for bodies of arbitrary shape and posture. Moreover, using thermal imaging, this approach even allows non-contact PMI estimation. Finally, we extended the method's applicability to cases where thermodynamic input parameters (e.g., ambient temperature) are unknown, by combining it with surrogate-model-based parameter optimization. Crucially, we validated this approach on deceased human bodies (both in the lab and at real crime scenes), and achieved the lowest PMI estimation errors to date ($0.18\text{h} \pm 0.77\text{h}$).



1 Jun

Abstract no: OP119



Tamara Gelderman

Maastricht University, Maastricht, the Netherlands

| ORAL

The time of death in Dutch court; using the Daubert criteria to evaluate methods to estimate the PMI used in court

When a capital crime is committed the post-mortem interval (PMI) is of particular importance in investigating a suspect's alibi in court. A forensic expert can use different methods to estimate the PMI. This research focuses on who is considered an expert in court and whether the methods used to estimate the PMI are reliable. As part of this study, the methods that can be used to estimate the PMI in court were subjected to the Daubert criteria.

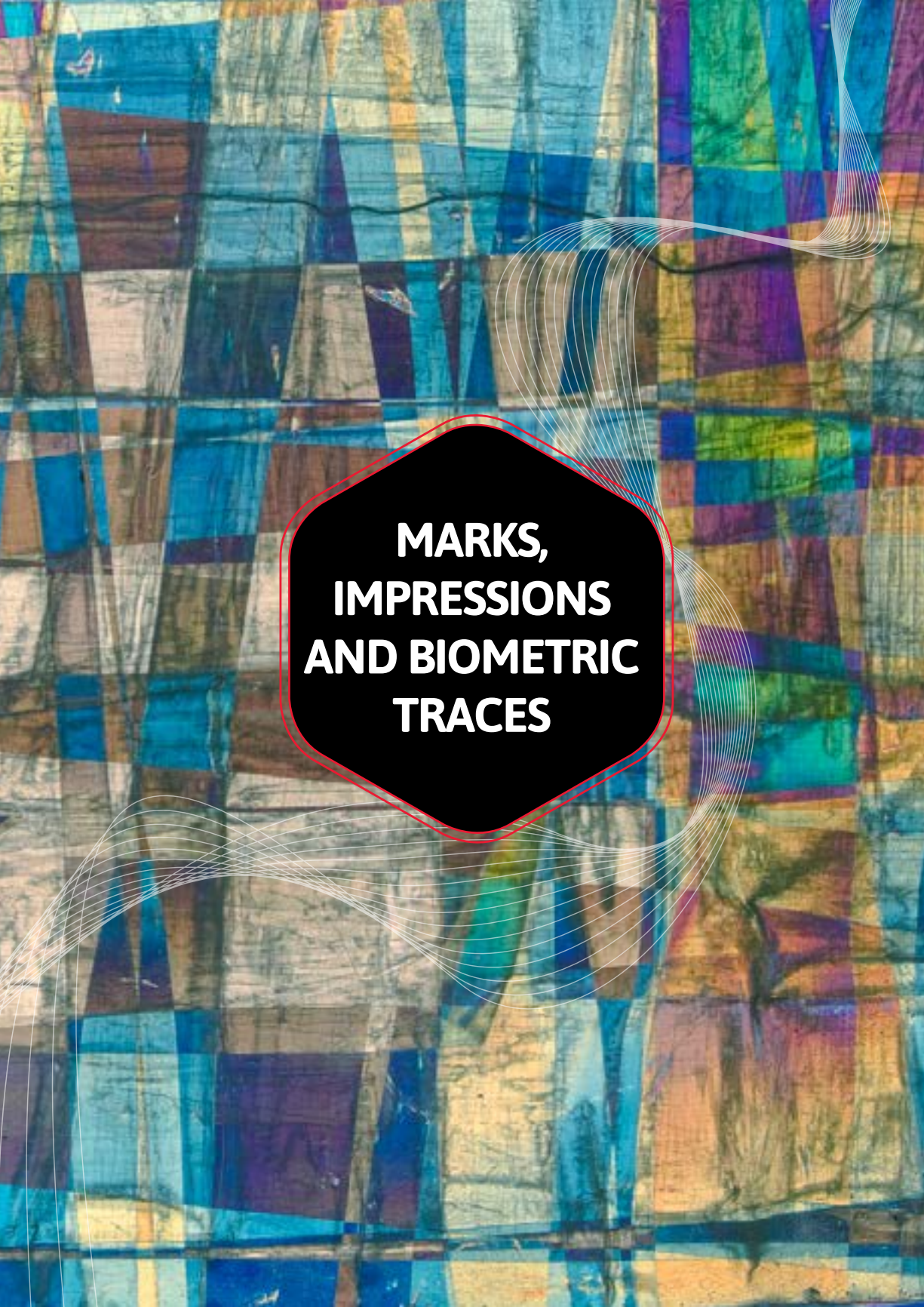
Two studies were performed, one concerning the Dutch jurisprudence of criminal case law and one literature study. Within the Dutch databank 'rechtspraak.nl' criminal law cases were searched using the following term: 'Tijdstip van overlijden' (Time of death, TOD).

The literature study was conducted to investigate if the methods used in court meet the Daubert criteria and focused on nine methods. The found articles were reviewed to establish if one or more of the Daubert criteria were met.

Ninety-four judicial cases were included and multiple experts and methods of estimating the PMI were found. Of the nine methods, only algor mortis and entomology meet all of the Daubert criteria and are both nationally and internationally accepted.

In this study an effort was made to make judges more aware of the limitations and implications of application of methods that are used to estimate the post-mortem interval for TOD determination. A method must meet all the Daubert criteria before it can be deemed scientifically reliable and only scientifically reliable methods should be permissible in court. The methods are only useful when applied by the right forensic expert and in the right manner. Unfortunately, this was not always the case.





**MARKS,
IMPRESSIONS
AND BIOMETRIC
TRACES**

Body and Gait



30 May

Abstract no: **OP121**



Lilly Dan

| ORAL

Leverhulme Research Centre for Forensic Science, University of Dundee, Scotland

The persistence of knuckle creases through finger flexion for the identification of perpetrators from digital images

As part of the multifactorial assessment from digital images of the hand, the assessment of the features of knuckle creases has been used to assist in the identification of perpetrators captured in images depicting child sexual abuse. Despite being a characteristic of the hand commonly used in the comparison between perpetrator and suspect images, further research regarding the impact of finger flexion on the accuracy and reliability of the comparison of knuckle creases is required.

The primary aim of the presented research was to assess human variation of the dorsal knuckle creases associated with the proximal interphalangeal joint (PIP) joint and the impact of finger flexion on their appearance in digital images. The collection of knuckle crease images, at different points of flexion, was facilitated through an app-based Citizen Science project, Knuckle Down ID. A manual image quality assessment framework was created, and a proposed method of knuckle crease classification was adapted to assess images taken on smartphone devices. Repeatability testing of the methodologies was conducted using expert and non-expert observers.

This presentation will discuss the results relating to the outcomes of the accuracy and repeatability assessment of the proposed method and the impact of finger flexion on the assessment of knuckle creases of the PIP joint, allowing examiners to understand its reliability in its use as a biometric in forensic investigations.



2 Jun

Abstract no: **OP122**



Kent Nord

The National Forensic Centre, Swedish Police Authority, Linköping, Sweden

| ORAL

Age determination of ballpoint pen ink using HPLC-DAD/FLD

Age determination of ballpoint pen inks can be crucial when investigating document suspected to be forged. A method has been developed that can be used to investigate if ballpoint text has been written newly or in accordance to date. The method includes sampling, extraction, and analyze by high pressure liquid chromatography (HPLC) together with a diode-array detector (DAD) in-line with a fluorescence detector (FLD). The method embraces common constituents in ballpoint pen ink, 2-phenoxyethanol (PE) and Crystal Violet (CV) and demethylated equivalents of CV.

Solutions with different concentrations of PE and CV were analyzed. Freshly written ballpoint text, six month or younger, and ballpoint text with age two years or more were analyzed during 12 weeks and evaluated with aging plots together with von Neumann's trend test. Finally, the method was used in quality assurance tests arranged by EDWEG.

Measured calibration curves did not deviate more than 10% from constructed calibration curves. For CV were both LOD and LOQ determined to be 67 ppb. LOD and LOQ for PE were determined to be 1.4 ppb respectively 4.7 ppb. PE decreased over time as expected for freshly written ballpoint text. Ageing plots showed minor or no distinguishable trends for older ballpoint text. Von Neumann values indicated the presence or absence of trends. The quality assurance tests passed with satisfying results.

The talk will contain a short introduction to how ballpoint pen inks are composed and ages. There will be a description of the analytical procedure and statistical methods used, exemplified with pictures, chromatograms and aging plots. The talk ends with results and discussion. Questions?



2 Jun

Abstract no: OP124



Tomasz Dzedzic

Institute of Forensic Research, Krakow, Poland

| ORAL

Best Practice Manual for Forensic Examination of Digitally Captured Signatures (STEFA G8 Project)

Digitally captured signatures (DCS; aka biometric or dynamic signatures) have recently been gaining popularity as a means of authenticating electronic documents such as PDF files. Based on technology that enables the sampling of writing movements, they take the form of a series of points with typically four basic data channels recorded: x and y coordinates, force/pressure and time. As a result their time and pressure related features are expressed in absolute values, which contrasts them from the conventional (pen-and-paper) signatures and poses a challenge for forensic handwriting experts, who need to shift from qualitative to quantitative examination.

In order to face this challenge, the European Network of Forensic Handwriting Experts (ENFHEx), a Working Group of ENFSI, found it necessary to define rules of good practice for forensic examination of DCS. In the years 2018–2020, a research project called STEFA G8 was carried out, which resulted in the development of a relevant appendix to the Best Practice Manual for Forensic Examination of Handwriting^[1].

In addition, two experimental research were conducted during the project. One of them showed that the writing behaviour when signing on an electronic device is not fundamentally different from that on paper, and thus comparing DCS and conventional samples is justified. The other indicated that different combinations of hardware and software used to capture handwriting may differ in the ways in which some signature features are coded, and therefore data may need to be scaled and normalised before examination.

^[1] <https://enfsi.eu/docfile/best-practice-manual-for-the-forensic-examination-of-handwriting-version-02/>



2 Jun

Abstract no: OP125



Ciara Devlin

University of Technology Sydney, Australia

| ORAL

The potential of using the profiles of fraudulent identity documents to assist in intelligence-led policing

The manufacture and use of fraudulent identity documents is an enabler for the activities and movements of organised crime groups. Despite the prolific nature of this crime problem, policing methods have largely focussed on identifying singular instances of fraud. The visual profiling and comparison of fraudulent identity document profiles to uncover links between groups and individuals is rarely considered. A forensic intelligence model for the systematic comparison of the visual profiles of fraudulent identity documents was first proposed in Europe, and since its inception it has assisted in identifying organised crime networks and terrorist cells. Despite this success, no such method has yet been considered for implementation within Australia, and very little is known about the Australian fraudulent identity document climate. This study will analyse the phenomenon of fraudulent identity documents in Australia and determine if there is any organisation behind their manufacture and distribution. Fraudulent Australian driver licences were obtained from the NSWPF and have been visually profiled and compared. Although this early research is a proof of concept, of the 43 documents in the training set, 88% were linked to at least one other document, and four series were identified. These results suggest that the fraudulent document market in Australia may be organised. It is hypothesised that as the number of documents examined increases so too will the number of links and series identified. This research has the potential to provide knowledge about the organisation of criminal activities, and will enable a comparison of the Australian and European document fraud climates.



2 Jun

Abstract no: **OP126**



Fanny Guillet

| ORAL

National Forensic Police Department, Scientific Police Laboratory, Lyon, France

“Forenscrip” : a database of digital handwriting samples for forensic analyses

Currently, French Forensic Document Examiners (FDE) observations and evaluations are based on experience and training. This forensic field suffers from a lack of quantitative data and objective analyses. The project “Forenscrip” aims at creating a database of handwriting samples recorded in ecological conditions, with inkpen and paper fixed on a digitizing tablet. Clustering and classification analyses will determine which handwriting variables (spatial, temporal, kinematics, and/or dynamics) can inform on biological (e.g., age, gender, manual laterality, height and weight) and sociocultural (e.g., level of education, professional category) characteristics of the writer, with an associated probability. To this end, we will perform two steps: first, creating the text and the items to be written and second, collecting and analyzing the written production with advanced statistical tools. The first step is nearly completed: we have studied all forensic examinations conducted in 2019 and 2020 to determine the most frequently occurring words in these documents. Preliminary results revealed that most cases handled by the FDE were threatening letters and anonymous letters, handwritten on a white paper with a black pen. The results from the word occurrence analysis performed on these types of letters, as well as the selected texts and items resulting from this first step will be presented in this conference. We argue that such a database will be useful for determining the value of observations in future examinations, as well as for informing on the characteristics of the writer.

Face Recognition



30 May

Abstract no: OP127



Erica Hedberg

| ORAL

Forensic Image Biometrics, Department of Information Technology, National Forensic Centre, Swedish Police Authority, Linköping, Sweden

Automated facial recognition method implemented at NFC, Sweden

In May 2021, the Swedish National Forensic Centre (NFC) implemented a new method that includes automated facial recognition (AFR). The purpose of this method is to help criminal investigations where a suspect is caught on camera, but the identity of the suspect is unknown to the investigation. Using this method, a picture of the suspect's face is searched against the Swedish national "mug shot" database in the ABIS system. This database includes persons that are suspects or convicts in relation to criminal investigations.

This method combines automated facial recognition and manual analysis performed by forensic experts. When a search is performed, the AFR system provides a candidate list of persons showing similarities with the unidentified depicted suspect. The system presents them in a descending order with the person having the highest similarity score at first place. The candidate list is then manually examined by forensic experts, trained in the forensic discipline of comparing faces in images. The forensic experts decide if there is a potential candidate or not to report to the criminal investigation.

The method involves no evaluative report on the strength of the match between the depicted suspect and the reported potential candidate. Thus, if the investigation needs that kind of evidence in court, it is recommended that a subsequent evaluative forensic image comparison is carried out.

Here, the aim, methodology and the impact of this new method will be explained and illustrated.

Face Recognition



30 May

Abstract no: OP128



Maëlig Jacquet

University of Lausanne, School of Criminal Justice

| ORAL

Interpretation of scores from automatic face recognition systems for court purposes

Forensic face recognition has become a ubiquitous investigative tool, but its reliability in court still suffers from the lack of methodological standardization and empirical validation, notably when using automatic systems. Although the use of such systems increased drastically, it still requires more empirical studies based on adequate forensic data (surveillance footage or identity documents) to become a reliable method for court purposes. A recognized method used for interpreting forensic evidence is the assignment of a likelihood ratio, which represents the strength of the forensic observations with respect to two mutually exclusive propositions. This research proposes a score-based LR computation (SLR) model using matching scores generated by an open source (FaceNet) and a commercial system (MorphoFace Expert, Idemia). To use data that best match actual forensic casework constraints, we built a forensic database from CCTV (closed circuit television) footage, identity documents, photographs from online sources and mugshots of 34 volunteers. In collaboration with cantonal police forces in Switzerland, we constituted a background dataset composed of genuine mugshot images. In this presentation, we detail the workflow of our SLR computation model and highlight the approaches and algorithms that best fit forensic evaluative purposes. We then show examples of misleading SLR and seek to identify elements of images quality that may have an undesirable impact on the systems performance.

Face Recognition



30 May

Abstract no: OP129



Johanna Tuvskog

Swedish National Forensic Centre, Linköping, Sweden

| ORAL

Validating a score-to-LR model from an automated facial recognition software

When performing forensic facial image comparisons at the Swedish National Forensic Centre (NFC), a likelihood ratio (LR) interval is estimated based on the likelihood of the findings under two competing hypotheses. These comparisons are manually performed by forensic experts, and the evaluation of the results includes subjective decisions based on the training and experience of the examiners. There are many uncertainties in facial images like image quality and pose angle, and a general lack for statistics on faces and facial features due to their non-classifiable nature.

With the aim to further assist the decision-making, we have used an automated facial recognition (AFR) software to develop a statistical score-to-LR model to be used in conjunction with the manual examination. The model was built from similarity scores provided by the AFR system using authentic criminalistics data from the Swedish mugshot database. Five statistical models were trained and validated following a recommended framework.

Based on the results from the development stage, the Gaussian (G) model was selected as baseline and the Skewed Gaussian (SG) model as the model to perform further validation on. The SG model performed better or equal than the baseline model on all validation criteria. For the generalization, datasets with different image quality were used, for which the SG passed the criteria on images with high quality but not on medium and low quality.

For future work we plan to train and validate separate models on gender, as well as on images with lower quality. We also need to establish how to weight the model-derived and manual LR estimates together.



1 Jun

Abstract no: KN014



Erwin Mattijssen

| KEYNOTE

Netherlands Forensic Institute, The Hague, The Netherlands

Forensic judgments and computer-based methods: Validity, reliability and bias

For most feature-based forensic disciplines there is insufficient knowledge to assess the validity and reliability of the examiners' judgments. Furthermore, these judgments are prone to be biased by task-irrelevant information. Because of these two aspects, examiners' judgments are increasingly challenged [1,2].

Several avenues are proposed to strengthen the forensic disciplines. One is to invest in empirical studies to provide insight in the validity and reliability of examiners' judgments. Another is to assess possible sources of bias in forensic casework and to apply cognitive and behavioral insights to set up procedures to minimize the effects of task-irrelevant information. While these two approaches focus on the examiners' judgment another approach would be to invest in the development and implementation of computer-based methods.

In recent years, significant efforts have been spent on these three avenues of research. The outcomes of these studies provide us with more insight in the performance of examiners and with guidelines to effectively minimize the negative effects of bias. The ongoing development of computer-based methods enable with the possibility to apply these in practice. This raises the practical question on how to combine the judgments of examiners with the outcomes of computer-based methods.

I will present recent insights on examiners' judgments and computer-based methods, while discussing options to combine them.

References:

- [1] PCAST (2016) Forensic science in criminal courts: Ensuring scientific validity of feature-comparison methods.
- [2] NAS (2009) Strengthening forensic science in the united states: A path forward. The National Academies Press.

Firearms and Tools



1 Jun

Abstract no: **OP131**



Erwin Mattijssen

| ORAL

Netherlands Forensic Institute, The Hague, The Netherlands; Radboud University Nijmegen, Behavioural Science Institute, Nijmegen, The Netherlands

Bias in forensic peer review

To ensure the quality of forensic examinations, peer review procedures, where a second examiner reviews the work of a first examiner, have been an accepted standard for a long time. Different types of peer review are used in practice, often applied without a clear empirical justification of the actual value in a forensic setting [1]. Similar to initial examination, forensic peer review is often the result of human judgment and thus subjective and prone to bias.

We studied the occurrence of bias in forensic peer review [2]. To do so, we looked at how often there was a discussion about the evidential strength to be reported between the first examiner and the peer reviewing examiner. We compared the proportion of discussions between a non-blind and a blind peer review procedure. In the non-blind procedure the peer reviewing examiner saw the interpretation of the first examiner and in the blind procedure they first needed to provide an independent interpretation.

The odds of discussion between examiners about the evidential strength of a comparison were approximately five times larger (95%-CI [3.06, 8.50]) in the blind than in the non-blind procedure, with disagreement about the interpretation in 42.3% and 12.5% of the comparisons, respectively. Our results support the hypothesis that bias occurs during non-blind forensic peer review.

Although this study was performed with firearm examiners, the outcomes are also useful for other forensic feature comparison disciplines.

References:

1. Ballantyne, K.N., et al. (2017) *Forensic Science International*, 277, 66-76.
2. Mattijssen, E.J.A.T., et al. (2020) *Science & Justice*, 60(4), 337-346.



1 Jun

Abstract no: **OP132**



Stefan Schaufelbühl

| ORAL

School of Criminal Justice, University of Lausanne, Lausanne, Switzerland

Current state of the art of the forensic investigation of 3D-printed firearms

The Liberator became the first 3D-printed polymer firearm to attract wide attention after Cody Wilson released its blueprints in May. Since then, countless new designs of 3D-printed firearms, which are praised to be more reliable, have been created and made publicly available on the Web. The rapid pace of this development poses new challenges to forensic investigations and unveils new areas of investigation regarding 3D-printed firearms. Therefore, more forensic studies are needed to keep up with this trend and to assess the situation.

This presentation showcases the results of a series of experimental shooting campaigns, undertaken mostly with Liberators as well as other more recent models of 3D-printed firearms. It also presents the analysis of the traces generated by the printing process or by the discharge. The objective of these experiments was to assess whether the findings from previous studies could be extended to Liberators produced under different conditions and to other 3D-printed firearms.

These sets of experiments showed that 3D-printed firearms are indeed functional but suffer different levels of damage after the discharge. This leads to the production of different types of traces on the firearms, the elements of ammunition and in the environment. These findings may be used to infer the use of a 3D-printed firearm on a scene of investigation. Further analysis of these traces allows for the reconstruction and identification of the firearms, as well as to draw a link between the firearm itself and printing equipment or conditions. This information can initially be used for investigative purposes and later for comparison once reference material is available.



1 Jun

Abstract no: OP134



Nabanita Basu

Forensic Data Science Laboratory, Aston University

| ORAL

Feature-based calculation of likelihood ratios for forensic comparison of fired cartridge cases

Morrison's keynote presentation described a paradigm shift in evaluation of forensic evidence in which methods based on human perception and subjective judgement are replaced by methods based on relevant data, quantitative measurements, and statistical models that calculate likelihood ratios and that are empirically validated under casework conditions. In this presentation we provide an example of the application of the new paradigm to forensic comparison of fired cartridge cases, a common task in forensic firearm examination, a branch of forensic science in which the new paradigm has so far made almost no progress. We describe the building of a database of 3D digital images of the bases of fired cartridge cases, and the development and validation of feature-extraction techniques and feature-based statistical models for calculating likelihood ratios. We focus particularly on the problem of feature extraction, i.e., what are the best features to extract and what region of the base of a fired cartridge case is it best to extract the features from? The features are automatically extracted from the firing-pin impression, the breech-face region, and the whole region of interest (including flowback), using various functional-data-analysis techniques including central moments, Legendre moments, and Zernike moments. The statistical modelling process makes use of methods commonly used in human-supervised-automatic approaches to forensic voice comparison, and the validation makes use of protocols, metrics, and graphics commonly used in human-supervised-automatic approaches to forensic voice comparison.



1 Jun

Abstract no: OP135



Jens Ulander

| ORAL

Swedish Police Authority, Forensic Section, Stockholm Police Region

Forensic intelligence in gun shooting violence in Stockholm Region

Sweden, and especially Stockholm, has been affected in recent years by shootings which had resulted in a huge number of murders and many severely injured in terms of population. In 2018 a project started with the New Jersey police among others. They had had similar development but managed to get change in their work against gun violence. During 2021 the police management decided on a forensic increase in ambition to meet the problem from a forensic perspective. The work with the New Jersey police ended up with three principles and one method.

- Treat all weapons as murder weapons
- Treat all shooting cases as a serious crime
- Follow the weapon
- And the method is speed in analyses to be operationally relevant for the investigation.

The importance of obtaining forensic information at an early stage is the goal for this increase in ambition. Previously, the results came late in the investigation but through an early assessment the goal is to get information as early as possible.



1 Jun

Abstract no: **OP143**



Matthieu Glardon

University of Bern, Institute of Legal Medicine

| ORAL

When $1 \neq 1$, a case and literature review of atypical multiple projectiles

Outside of the realm of automatic firearms and shotshells, there is an assumption that the number of projectiles matches the number of times the perpetrator pulled the trigger of the firearm. This assumption does not always hold true, be it through little known weapon systems, malfunctions or particular wound ballistics phenomena. The aim of the presentation is to give an insight into rare events that nonetheless came to light during the analysis of forensic cases. Through experimental high-speed imaging, case and literature review, the relevant conditions, traces and interpretative pitfalls those rare events could lead to are presented and discussed.



2 Jun

Abstract no: **OP130**



Matthias Weber

| **ORAL**

*Institute for Forensic Sciences, Landeskriminalamt Nordrhein-Westfalen (LKA NRW),
Düsseldorf, Germany*

Advances in Tool Marks Examinations of Human Tissue

The examination of tool marks is used to analyze human tissue like bone and cartilage after sharp force trauma for almost 90 years. Nevertheless, until today the method is not widespread in the field. One reason of the generally low level of awareness may be due to the lack of a uniform approach. In addition, there is a shortage of substantial research regarding the securing of marks and manufacturing of test marks.

Following the hypothesis that the same elastic material properties are the basis for a comparable marks pattern we measured the Young's Modulus of human costal cartilage of 12 bodies and 6 potential test materials in (bio)mechanical tests. The elastic moduli of all tested materials were found to be significantly lower than those of human cartilage.

Furthermore, by determining the cross-correlation coefficients of the signatures of known matches (KM) and known non-matches (KNM) of cut marks generated in the test materials, we found that 7% agarose achieved the best differentiation of KM and KNM.

In addition, we compared various cleaning methods for cut marks in cartilage and repeated (triple) casting yielded the best results. Furthermore, a comparative analysis of the point-like artifacts (dots) on casts of cut marks in cartilage with histologic images led to the identification of the dots as result of casting material penetrating the lacunae of the cartilage tissue. Experiments to avoid these dots by fixing the cartilage were unsuccessful.

Our study provides valuable practical insights with respect to the preparation and securing of tool marks on human tissue and to the comparative examination. We demonstrate the use of these findings in two case studies.



2 Jun

Abstract no: **OP138**



Ophélie Devaux

| **ORAL**

Institut de Recherche Criminelle de la Gendarmerie Nationale, Cergy-Pontoise, France

Toolmarks Image Retrieval Using Deep Learning conventional Neural Network

Toolmarks examination is an integral part of forensic science. Indeed, tools are commonly used in crime scenes such as burglaries, thefts or violent interactions. The purpose of the comparative examination process of toolmarks used in criminal investigations is to determine if an evidence mark was made by a suspected tool and to bring criminal investigations closer by comparing toolmarks evidence. To date, no automated system exists. The toolmarks comparisons are actually realized manually obliging experts to limit their examination at local level. The present study proposes a fast and accurate method for toolmarks recognition. This is based on the combination of deep learning conventional neural network, namely transfer learning model, with a k-nearest neighbor classifier. The proposed algorithm demonstrated an outstanding performance for toolmarks image comparison.

Key words: Toolmarks, Deep learning, Image recognition, Transfer learning.

- [1] Biasotti A., Murdock J., The scientific basis of firearms and toolmark identification, Chapter 23, Section 23-2,3, Modern Scientific Evidence: The Law and Science of Expert Testimony, Vol. 2, pp.131-151, 1997.
- [2] Pan S.J., Yang Q., A Survey on Transfer Learning. IEEE Transactions on Knowledge and Data Engineering, Vol. 22, N° 10, pp. 1345-1359, 2010.



2 Jun

Abstract no: OP139



Koen Herlaar

| ORAL

Netherlands Forensic Institute, The Hague, The Netherlands

Towards virtual striation marks for comparing knives to cartilage trauma caused by stabbing

Worldwide, stabbing plays a large role in homicide cases. One of the forensic possibilities in these cases is comparing the striation marks in costal cartilage to a suspected knife. Currently this is done by physically creating test marks, executing test stabs in costal-cartilage-simulating material, and visually comparing them to those in the costal cartilage.

Especially for the interpretation, there is a lack of knowledge on the rate of occurrence of specific striation patterns caused by random knives. However, filling a reference database with test marks of knives is labour-intensive due to the fact that various parameters, such as the angle of attack, influence the exact configuration of striation patterns, resulting in a high number of required test marks for each knife.

To overcome this challenge and to improve objectivity and robustness we are aiming at a new method using virtual striation marks. If the influence of relevant parameters is known, virtual striation patterns can be calculated by the computer instead of labour-intensive manhours. This will open up a realistic road towards a reference database with virtual striation mark patterns of knives. This presentation will show the approach that is taken to study this influence which comprises: 1) creating "known controlled irregularities" on micron level into knives using focussed ion beam milling. 2) executing test stabs in costal-cartilage-simulating material while varying the parameters of interest. 3) reverse-engineering of the influence of the parameters. Furthermore the results on the influence of the parameters knife blade shape, angle of attack and axial rotation angle will be shown.



2 Jun

Abstract no: OP140



Koen Herlaar

Netherlands Forensic Institute, The Hague, The Netherlands

| ORAL

Using the Congruent Matching Cells algorithm for comparing fracture surfaces of broken knives and screwdrivers

Visual comparison of fracture surfaces to examine a possible link between two broken objects is common practice for a toolmark expert. As in other fields of visual comparison, such as cartridge cases and fingermarks, the question has risen whether it is possible to use computer algorithms to compare the marks and to determine the strength of the evidence. By using computer algorithms, the value of the evidence can be based upon data instead of knowledge and experience.

A proof of concept study has been done by breaking 10 identical screwdrivers and 10 identical knives in the same manner. The resulting fracture surfaces are digitized by scanning them with a 3D optical measurement system with a lateral resolution of 1.8 μm and a vertical resolution of 0.1 μm . The digital fracture surfaces are compared using the Congruent Matching Cells (CMC) algorithm, developed by Chu, Chen, Tong and others for comparing breech face and firing pin impression marks in cartridge cases.

The study shows a clear separation in resulting CMC scores between the Known Matches (fracture surfaces from the same origin) and the Known Non Matches (fracture surfaces from different origin). In the Known Matches CMC scores ranging from 60% to 100% were obtained, while the CMC scores in the Known Non Matches ranged from 2% to 10%.

This presentation will show the results as well as future steps that are necessary to transform the CMC score into a likelihood ratio to express the value of the evidence. Furthermore, the presentation will show that it is necessary to make choices in the design of such a computer based system. Depending on the choices made, the value of the evidence will be different.



2 Jun

Abstract no: **OP142**



Leisa Nichols-Drew

De Montfort University, Leicester

| ORAL

What's the point? An investigation of clothing severance damage involving conventional and novel knives

Since 2010, there has been a substantial increase in offences involving sharp or bladed implements reported in the United Kingdom; in the year ending June 2021, the Office of National Statistics recorded 46,937 knife-enabled crimes. According to the 2020 Home Office Homicide Index, kitchen knives contribute to the majority of street based and residential stabbing related incidents.

Here we present a preliminary study involving penetration of a range of upper and lower clothing garments (jumper, t-shirt, skirt, jeans) with novel and conventional knives. Sharp force trauma on the target surfaces was analysed for 300 downward stabbing motions using 5 types of blade. There is a clear correlation between knife tip shape and fabric severance damage. Qualitatively, rounded tipped (less-lethal) knives failed to penetrate clothing, whereas conventional knives with pointed tips produced the greatest damage. Interestingly, a sheep's foot knife caused trauma similar to that observed from screwdriver penetration. SEM images reveal quantitative insights.

In a subsequent study designed more closely to mimic a stabbing, fabric substrates were placed over tissue simulants prior to the knife impacts. Further work has compared the observed knife damage with that from other penetrating tools encountered at crime scenes, including scissors, chisels and screwdrivers.

The immediate significance of the outcomes in terms of criminal investigations involving textile damage evidence will be discussed. Future benefits in terms of crime reduction and injury prevention in bladed weapon crimes will be considered, based on smarter design of functional knives with diminished utility as weapons.



3 Jun

Abstract no: OP133



Valerio Causin

Università di Padova

| ORAL

Determination of the orientation of guns at the time of shooting through the morphology of marks on the cartridge case

Knowledge of the position and orientation of the firearm at the time of firing can be of fundamental help for the reconstruction of controversial events. For example, it may help to discriminate between suicide, homicide or accident, or between attempted murder versus accidental discharge, or also yield information for distinguishing between legitimate defense and voluntary homicide.

In order to elucidate the dynamics of firing of a weapon, the analysis of ballistic markings is very important.

In this work, the markings on the cartridge cases shot with different kinds of handguns, aiming at three different spatial orientations (vertical upwards, horizontal or vertical downwards) were studied.

Rimfire and centerfire weapons, and both revolvers and semi-automatic handguns were used.

The correlation between shape and size of the markings of firing pin, ejector and extractor as a function of the orientation of shooting will be discussed for the different weapon types.

The effect of pressure exerted by the primer will be also be considered.

This work shows that indeed cartridge case markings carry a rich deal of information on the dynamics of shooting, albeit with different degrees of detail for different types of weapons.

Firearms and Tools



3 Jun

Abstract no: OP136



Maria Ledin

The National Forensic Centre, Swedish Police Authority

| ORAL

Heat seal examinations – Part 1: Methods

During the last few years it has been increasingly popular in Sweden, as well as other countries, to use vacuum sealers and other sealing devices to seal bags containing e.g. drugs and weapons. The seals are made by a heating element often covered by a PTFE coated glass fabric strip. The heat seals typically contain details that can be compared with a specific heat sealing device or with other sealed bags found in different locations.

As a response to the increasing influx of requests for these types of comparisons, we have developed procedures for examining and comparing the heat seals. Since the plastic bags used are often transparent, the seals can be examined directly using transmitted light, but we have found it valuable to use a traditional, but improved, tool mark approach. This poster will show how we do this step-by-step, including casting, double-casting and comparison microscopy. We will also share some tips about where to find detailed parts of the seals, how to illuminate the casts and how to improve the production of test seals.



3 Jun

Abstract no: **OP137**



Viktor Andersson

The National Forensic Centre, Swedish Police Authority

| ORAL

Heat seal examinations – Part 2: Observations

During the last few years it has been increasingly popular to use vacuum sealers and other sealing devices to seal bags containing e.g. drugs and weapons. The seals are made by a heating element often covered by a PTFE coated glass fabric strip. The heat seals typically contain details that can be compared with a specific heat sealing device or with other sealed bags found in different locations. The increasing influx of requests for investigation of heat seals emphasises the need for more information and knowledge about seals and sealing devices.

This poster will show that seals with a wide range of appearances are made by different sealing devices. Some of the characteristics arise from the manufacture of sealing devices and their parts. One such example is the occurrence of small “bumps” in between the weave of the glass fabric strip. We believe that the “bumps” are a result of trapped bubbles in the gaps between the warp and weft of the glass fabric strip. In a pilot project the occurrence of such “bumps” was recorded in test seals from 42 vacuum sealers in recent cases. The amount and distribution of bumps differed noticeably between the seals, even when they were produced by the same make and model of sealing device. Over time, as a sealing device is used, other details will appear and disappear, which will be also be shown in this poster. Since there are so many characteristics from the sealing device that can be reproduced in the heat seals, there is a potential for strong conclusions.



3 Jun

Abstract no: **OP141**



Erwin Mattijssen

| **ORAL**

Netherlands Forensic Institute, The Hague, The Netherlands; Radboud University Nijmegen, Behavioural Science Institute, Nijmegen, The Netherlands

Validity and reliability of forensic firearm examiners and a computer-based method

Forensic firearm examiners provide judgments about the source of bullets and cartridge cases. Courts of law rely on these judgments to decide about a person's innocence or guilt. These examiner judgments are challenged [1,2] because they are not based on empirical research.

We studied the validity and reliability of the source judgments and degree-of-support judgments of 77 firearm examiners and compared these judgments to the outcomes of a computer-based method [3]. Our study showed that the validity and reliability of the source judgments were quite high, but that examiners are not infallible. The examiners seem to be slightly less proficient than the computer-based method at identifying same-source comparisons correctly, while they are better at identifying different-source comparisons. The degree of support judgments were not well-calibrated and showed signs of overconfidence – as is also seen in other expert populations [4].

Future studies could 1) focus on the comparison of the judgments of experienced examiners to those of novices to study if the examiners' performance and overconfidence is a result of acquired experience, and 2) on the merits of performance feedback to calibrate judgments.

References:

1. NAS (2009) *Strengthening forensic science in the united states: A path forward*
2. PCAST (2016) *Forensic science in criminal courts: Ensuring scientific validity of feature-comparison methods*
3. Mattijssen, E.J.A.T., et al. (2020). *Validity and reliability of forensic firearm examiners. Forensic Science International*, 307, 110112
4. O'Hagan, A., et al. (2006). *The elicitation of probabilities. In Uncertain judgements: Eliciting experts' probabilities (pp. 61-96)*



1 Jun

Abstract no: KN015



Nicole Richetelli

Noblis, Inc

| KEYNOTE

Forensic Footwear Evidence: Stepping Forward

Footwear evidence holds tremendous forensic value, owing to its ability to inform linkages between victims, suspects, and scenes. Naturally, the strength of these linkages is a function of the perceived clarity, quality and rarity of class, subclass, and randomly acquired characteristics (RACs), which are the fundamental outsole features used to formulate source associations. In order to reach a conclusion when performing a footwear comparison, forensic examiners must assign value to the observed similarities and differences that exist between questioned crime scene and test impressions. Embedded within this process is an evaluation of the random association between unrelated shoes as a function of both class and acquired characteristics. To date, weight of evidence within this space has been largely informed by the training and subjective casework experience accumulated by an examiner over the life of his or her career. In an effort to support the foundational validity of this evidence assessment and ultimate conclusion, recent research leveraged a large-scale empirical dataset of 72,306 RACs collected from 1,300 outsoles in order to i.) quantify the chance association of RACs on unrelated shoes and ii.) characterize the spatial distribution of these features on outsoles using spatial statistics. This presentation will discuss the results of these research efforts and the path forward for aiding forensic footwear examiners in their evaluation of weight of evidence by providing an empirical basis upon which these assessments can be informed.



1 Jun

Abstract no: **OP144**



Malou Den Harder

| ORAL

École des sciences criminelles, university of Lausanne, Switzerland

Footwear impressions in blood: possible variations for the same source

To evaluate a comparison of a footwear impression in blood with a possible source, it is essential to consider the range of variations that may occur for such a mark originating from the alleged source. The aim of this work is to investigate such variability based on the study of bloody footwear impressions resulting from experiments carried out with three different pairs of shoes. Leuco crystal violet (LCV) was chosen as the enhancement method of the marks. The results show that, even if the general pattern and design remain recognizable, the footwear marks in blood display an important variability, especially concerning small elements such as acquired characteristics. It is difficult to define precise limits of the variability, but the experiments have allowed its documentation. It has been possible to identify several recurrent phenomena concerning the behavior of the blood. Moreover, the material of the outsole has been found to have an influence on the general appearance of the impressions. For operational applications, footwear impressions of the known shoes as references should be established in blood in order to understand the behavior of their outsoles, and to be able to compare them to the impressions found on the scene. The experiments also demonstrated the importance of considering the images of the impressions taken before the application of the chemical treatment and not only the ones taken afterwards. Finally, if possible, the examination of the footwear impressions should be based on several marks and not only one, since they often are complementary.

Footwear and Garment



1 Jun

Abstract no: OP145



Edward Adach

| ORAL

Forensic Identification Services, Toronto Police Service, Toronto, Ontario, Canada

Footwear mark composite

Partial footwear marks are a reality and often do not provide the investigative lead of a make/model of shoe. In a Toronto homicide case, the bloodletting scene provided only jig-saw like pieces of the murderer's footwear.

These pieces were gathered and rearranged by the forensic footwear mark specialist in collaboration with the forensic police artist. A composite was created providing a tangible lead for the homicide investigators. This composite was dubbed the "Frankenfoot" by colleagues.

In an attempt to identify the make/model, the composite was submitted to the Royal Canadian Mounted Police (RCMP) for a SICAR database search. This shoeprint was unknown in North America.

The composite was subsequently submitted to the Swiss police. Their database search provided a photograph of remarkable likeness to the composite. However, the make/model information was not available.

The Swiss sole was then submitted to the European Network of Forensic Science Institutes (ENFSI), Expert Working Group Marks. The query was answered by a footwear mark specialist in Germany. A clearer sole image of the Swiss sole was provided, along with an image of the upper, and the shoe was identified as a "Landrover".

This European connection was relevant to the case, seeing that the persons of interest were originally from Greece and fled to Greece during the homicide investigation.

Both persons of interested were subsequently convicted of 1st degree murder in 2018.

All possible efforts should be made by the forensic specialist to maximize the potential of gathered evidence.



1 Jun

Abstract no: **OP146**



Julien Pasquier

| ORAL

Forensic Service, Police Neuchâteloise, Neuchâtel, Switzerland

The development and deployment of a footwear marks database in Western Switzerland: a forensic intelligence success

For decades, the management of footwear marks has been a subject of questioning for the forensic services. In the literature, the problem of footwear marks databases is generally approached from the angle of the technological and algorithmic question. However, no universally accepted solution has been proposed so far.

For several years in Western Switzerland, an inter-police working group has been examining the issue of exchanging marks and references between services. Its work resulted in a database developed in-house and now in operation. This tool makes it possible to interconnect the data of forensic services with each other as well as with criminal analysis and intelligence systems. From this point of view, this tool brings real benefit to series detection.

This project does not exploit any particular technological advances but is nevertheless seen as a success, both from users and management point of views. This presentation will highlight some of the factors that have led to the development and implementation of a successful footwear marks database connecting several police services.



1 Jun

Abstract no: OP265



Regina Eckardt

Federal Criminal Police Office, Wiesbaden, Germany

| ORAL

Training of Artificial Intelligence in the field of automatic shoe print retrieval

The presented subproject of “KIForPol” aims to develop an AI to automatically match shoe prints to reference pictures of shoe models.

The basis for the training of an AI is a valid and realistic data set in means of quality and quantity. Over the past three years, shoeprints from real crime scenes and self-made shoeprints were collected and prepared for training. The presentation addresses how this data was collected, which difficulties were encountered and which factors affect the quality of the training data set. The current status of the development of the AI as well as an outlook to future activities will be presented.



1 Jun

Abstract no: **OP266**



Michael Gorn

| **ORAL**

Federal Bureau of Investigation, Quantico, United States

Using a burned shoe to reconstruct a multi-fatality vehicle accident

In November 2016, a collision occurred between two vehicles near Lander, Wyoming. A forensic reconstruction was undertaken in order to identify the driver of the vehicle at fault. The FBI Laboratory in Quantico, Virginia was asked to; 1, determine the brand, model and size of a partially burned shoe located in the passenger compartment of the suspect vehicle and 2, compare the burned shoe to CCTV images of the occupants of the vehicle. This lecture will go over in detail how the examinations were conducted, information provided by the shoe manufacturer and trial testimony.

Friction Ridge Skin



31 May

Abstract no: KN016



Henry Swofford

| **KEYNOTE**

Henry Swofford, Principal Forensic Analyst, HJS Consulting, LLC, Washington, D.C., USA

Toward Computational Algorithms in Forensic Fingerprint Examination: Navigating a Path Forward

Over the years, scholars have called for the implementation of statistical methods and probabilistic models in many pattern evidence disciplines—including forensic fingerprint examination—to strengthen its rigor and improve our capacity to interpret partial and degraded evidence in a more systematic and examiner-independent manner. Computational algorithms are often a means to this end. Once an aspirational vision for the future, now we find ourselves surrounded by a proliferation of innovative tools allowing for this vision to manifest as today's reality. As these tools have become more accessible in recent years, we must consider how to effectively leverage them across the forensic science enterprise and strengthen the value of forensic evidence that our criminal justice systems rely. One challenge is the issue of the validation of these tools to demonstrate their fitness for operational use. Another is the implementation of these technologies operationally, which is a complex task that will require us (1) to account for complicated sociopsychological dynamics between human and machine interactions, (2) to be sensitive to the unique needs and diverse perspectives of criminal justice stakeholders, and (3) to provide the foundations for these technologies to be implemented in a responsible and practical manner within a quality management system. This presentation will explore the salient challenges to the widespread adoption of computational algorithms, reflect on recent experience leading the implementation of a computational algorithm for fingerprint examination in a federal laboratory in the U.S., and propose a strategy for navigating these issues moving forward.

Friction Ridge Skin



31 May

Abstract no: **OP152**



Aldo Mattei

RaCIS Carabinieri, RIS of Messina, Messina, Italy

| **ORAL**

Error rates & collaborative exercises in friction ridge examination: getting rid of misinterpretations

The evaluation of the performance of latent print comparison is usually focused on the error rates. What are the different types of errors and what is their impact to the criminal justice system? This lecture will describe the aforementioned aspects, whilst enlightening how error rates are calculated. Red flags will be disclosed to the audience and future corrective actions will be proposed. Moreover, interesting outcomes of the last three collaborative exercises carried out within the ENFSI Fingerprint WG (EFP-WG) will be presented, thus demonstrating how the critical review of the results could improve the quality of the daily activities.

Friction Ridge Skin



31 May

Abstract no: OP154



Caroline Gibb

| ORAL

University of Twente, Enschede, Netherlands; The Netherlands Forensic Institute, The Hague, Netherlands

Exploring the frequency of 'open fields' in friction ridge skin

Automated Fingerprint Identification Systems (AFIS) encode fingerprints (known individual reference sets) and fingermarks (partial impressions recovered from crime scenes), based on a couple of minutiae types, generally speaking, ridge endings and bifurcations. Current searching limitations of an AFIS mean that a trained examiner will perceptually process a substantial amount more data than the current system is capable of. Areas of friction ridge skin (fingers, palms, soles) that display no minutia, are defined as open fields. Open fields are not considered by the current AFIS technologies due to the absence of minutiae. In addition, they are rarely considered as holding any evidential strength by friction ridge examiners and tend to be given less weight during analysis and interpretation, largely due to the historical point (minutia) counting system, and the obvious absence of minutiae to count. They are also poorly defined. The purpose of this study was to empirically explore the frequency of open fields in an attempt to better define them. An open field heuristic was developed and applied to a dataset containing 2000 images. These images were further divided into the following respective pattern types: arch, left loop, right loop, whorl, tented arch. Based on this heuristic, the 10 largest open fields were plotted and categorised. In this presentation, we share the key findings, including the limitations of the results based on the developed heuristic, and offer future directions for further research.



31 May

Abstract no: OP155



Bethany Growns

University of Exeter

| ORAL

Human factors in forensic science: selecting forensic trainees based on natural skill

Forensic science plays a critical role in the criminal justice system – it is thus important to ensure forensic scientists are trained and selected using the most valid and reliable tools. In this presentation, we present the results of two experimental studies that investigate natural skill in visual comparison – a task regularly completed in forensic feature-comparison disciplines where examiners compare to provide judgments about the source of the evidence. Forensic examiners develop extremely accurate performance in this task after many years of training and experience. However, it may be possible to also recruit new trainees on the basis of natural ability in this task.

Across two studies, we examined natural skill in four different visual comparison tasks (i.e., fingerprints, faces, firearms, and a novel artificial comparison task) to investigate the overlap or independence of performance in each task. We found that performance on each task significantly correlated with one another (but not three other measures of discriminant validity), and loaded onto one factor in principal components analyses. These results suggest that there is a natural and variable ability to compare different visual stimuli where some individuals naturally outperform others and suggest visual comparison is a skill that occurs naturally in the general population without forensic science training or experience. These results have exciting implications for testing and developing programs and tools to select and recruit potential forensic examiners by selecting top performers based on inherent ability.

Friction Ridge Skin



31 May

Abstract no: OP158



Bethany Grows

University of Exeter

| ORAL

What makes an expert an expert?: psychological mechanisms and training in forensic feature-comparison expertise

Human factors play an important role in forensic science but relatively little is known about the psychological mechanisms that underpin forensic feature-comparison expertise. What makes an expert an expert, and how do experts make decisions? Critically, understanding this could lead to the development of novel training programmes as understanding how forensic scientists make accurate judgements is critical to improving professional performance.

In this presentation, we will provide an overview of the psychological mechanisms underpinning forensic feature-comparison expertise and present the results of an effective training programme drawn from this research, with focus on one particular mechanism: statistical learning. This is an innate ability that all human decision-makers possess to learn how rare or common things are in the environment. This ability is important in forensic science as statistical information is important in assessing the likelihood of the comparison results if two evidence samples (e.g., fingerprints) are from the same or different sources—e.g., rare fingerprint minutiae provides better diagnostic information supporting a higher likelihood ratio than common minutiae.

Our research has shown that fingerprint and document examiners have better domain-specific statistical learning. We expanded this research to develop a training programme to train decision-makers to focus on rare fingerprint features and found that it improved both novice and fingerprint examiners' fingerprint comparison performance. We will discuss the importance of utilising empirically-based training and selection in the quest to improve reliability and validity in forensic science.



1 Jun

Abstract no: OP149



Lumikki Clover Ree

| ORAL

Comparison of carbon and iron oxide powder suspension formulations

Powder suspensions are a fingerprint development technique that have been shown to be efficient on difficult substrates such as adhesive tapes and wetted or aged fingerprints. In Australia, NSW, only carbon-based suspensions are currently used operationally, however success using an iron oxide formulation shows promise as a suitable alternative.

An optimised iron-oxide formulation was first developed by testing different combinations of iron-oxide powders and surfactant solutions. General observations found that thinner surfactants and lower powder weights produced more effective formulations, as well as improving ease of use. Two iron-oxide powder and surfactant combinations were selected for use in the comparison stage.

Those formulations were then compared with a pre-mixed carbon-based formulation (Wet Powder™). This comparison showed that the effectiveness of each formulation is heavily dependent on substrate type and all formulations had issues with background development. Iron oxide powder suspensions were a highly effective fingerprint development technique, notably on plastic surfaces. A nanopowder iron-oxide formulation performed comparably to Wet Powder™, however the latter was shown to produce more consistent results, especially on adhesive tapes. Further research will determine if these formulations are viable for casework in Australian and international climate. Similarly, the interactions between suspensions, fingerprint residues and substrates should be explored further to ensure the most appropriate development method is used at all times.



1 Jun

Abstract no: OP150



Scott Chadwick

Centre for Forensic Science, University of Technology Sydney

| ORAL

Comparison of Near Infra-red powders on Australian Polymer Banknotes

Fingerprint powders remain one of the most common techniques for fingermark detection. However, powder efficiency and contrast can be hindered when applied to highly patterned backgrounds such as polymer banknotes. Recently a number of powders have been developed that are luminescent in the Near Infra-Red (NIR) region and have been shown to be effective at producing high contrast fingermarks on difficult surfaces. This study explores the comparison between two commercially available NIR powders (fpNatural 1 & fpNatural 2) and in-house developed powder Universal powder, which has the ability to luminesce in both the visible and NIR regions. In addition to evaluating the powders, a comparison of different excitation light sources was also explored.

Fingermarks from 10 donors were deposited onto uncirculated \$10 Australia polymer banknotes and aged for a period up to one month. Marks were split and developed with each powder and imaged under their optimal conditions using a modified DSLR camera. Images were then digitally stitched back together to be evaluated by three independent assessors.

Evaluation of the results found that all powders were able to reduce background interference from the polymer banknote when viewed in the NIR region. Additionally the Polilight proved to be a suitable alternative to the Crime-lite for visualisation of fpNatural1 and fpNatural 2. This study highlights the value that visualising in the NIR region has for fingermark detection on difficult substrates such as polymer banknotes, and the potential applications NIR powders have for the fingermark discipline.



1 Jun

Abstract no: **OP151**



Pawel Korzeniewski

The National Forensic Centre, Swedish Police Authority

| **ORAL**

Developing fingermarks on the adhesive side of dark electrical tape: Cyanoacrylate/Basic Yellow 40 or Powder Suspension?

The Fingermark Visualisation Manual published by the Centre for Applied Science and Technology is among the most important guidelines in fingermark development. During the accreditation work at the Swedish National Forensic Centre, it was noted that Cyanoacrylate/Basic Yellow 40 (CA/BY40) was recommended for development of fingermarks on the adhesive side of electrical tape. This was in complete opposition to the previous routines, where white powder suspension (PS) would be used. No publication comparing the two methods could be found, and it was therefore decided to investigate this.

The study compared CA/BY40 to PS for development of fingermarks on the adhesive side of electrical tape. 256 fingermarks were deposited in a factorial experimental design. It involved 3 ageing times, 8 donors, 2 replicates, 2 fingers and 2 methods. Each fingermark was examined by two persons using an 11-level Likert scale, and analysed by a multifactor ANOVA.

The development achieved by PS was far superior compared to CA/BY40. This was observed across all ageing times and factors investigated. Interestingly, fingermarks from the lowest performing donor among the PS data were graded very similarly to the fingermarks from the highest performing donor from the CA/BY40 data.

The tape for a fourth ageing time was accidentally developed by CA prior to PS. That series was removed from the analysis, but the tapes were still treated with PS and examined. The performance of PS was strongly negatively influenced by exposure to CA vapour. This suggests that application of PS after CA on the adhesive side of electrical tape may not be optimal.



1 Jun

Abstract no: OP153



Helen Earwaker

University of Portsmouth, Portsmouth, United Kingdom

| ORAL

Exploring the effectiveness of a fingerprint powder batch acceptance protocol: interdisciplinary considerations

There is an increased move to ensure quality, transparency and consistency of crime scene investigation processes. Fingerprint powders have been identified as an area of potentially problematic variation across the landscape of forensic provision in the UK. The Defence Science and Technology Laboratory has developed a draft protocol for fingerprint powder batch acceptance to ensure that subsequent batches of fingerprint powder are comparable to the original batch upon which comprehensive validation has been carried out. The present study looked to establish the effectiveness of the DSTL batch testing protocol in terms of sensitivity and specificity through a controlled study using powder of known provenance.

A series of fingerprint powder samples of known ground truth were selected. For each of these powders a match, close non match and non match sample was prepared. Samples were labelled to specify either an original batch of the powder or a new batch of the same powder, when, in fact, the new batch powder was either a match, a close non match or a non match to the original powder. Participants were provided with the powders and the DSTL draft batch testing protocol and asked to carry out batch testing as per the protocol. Data was analysed to establish the sensitivity and specificity of the batch testing protocol and to qualitatively examine the process from a human factors perspective.

The results of this study will be presented in terms of the implications for powder batch acceptance in practice. Ergonomic, human factor and behavioural science aspects of the process will be discussed within the context of fingermark quality assessment and comparative judgement.

Friction Ridge Skin



2 Jun

Abstract no: **OP147**



Francesco Zampa

| ORAL

RaCIS - Carabinieri Scientific Investigation Service (R.I.S.), Parma - Italy

A pan-European training for fingerprint visualization? It could work!

The ENFSI Memorandum of Understanding encourages co-operation between its members and other international organisations in the development of new scientific methods and procedures, standards of practice, training and quality assurance. ENFSI wishes to promote consistent and reliable scientific evidence through the whole forensic process from scene of incident to court. It is the policy of ENFSI that all members shall have achieved or be taking steps towards ISO/IEC 17025 accreditation. The vision of ENFSI is to ensure that the quality of development and delivery of forensic science throughout Europe is at the forefront of the world.

An EU funded project (STEFA Monopoly Project 2016, Work Package G4) established and provided high qualified professional training to the staff working in the fingerprint visualisation laboratories of ENFSI member institutes. Such pan-European training may drive up standardised operating procedures, achieving consistency across European countries. In doing so it may also meet the requirements of ISO/IEC 17025 in relation to staff competence and ongoing education.

The purpose of this lecture is to provide a brief outline of the outcomes of the G4 Work Package. The importance of the training activities will be stressed, as well as all the organizational issues that may occur when arranging this kind of events. In addition, the possibility to establish a summer school will be discussed.

Friction Ridge Skin



2 Jun

Abstract no: **OP148**



John Riemen

Police of the Netherlands, Zoetermeer, The Netherlands

| ORAL

AFIS user knowledge exchange across borders – working together to implement best practice systems

Across the globe fingerprint examiners utilise an Automated Fingerprint Identification System (AFIS) to verify the identity of individuals, and to search crime-related impressions against the reference database. There are several providers that supply biometric systems to law enforcement agencies. Traditionally these systems are search systems only and have a limited workflow to support forensic processes in best practice approaches. System specifications vary greatly between agencies, each with a different interface, software packages, capabilities, and interoperability. In 2019 the EU IAI held their first AFIS Masterclass. It brought together managers, users, and biometric representatives to discuss different AFIS setups, approaches, and developments. Notably, some agencies have successfully set up a system that supports the forensic process in scientific best practice approaches and have implemented streamlined workflow processes that support the reduction and prevention of bias and error. (e.g. the removal of contextual information, blind verification). Some agencies are at the forefront of investigating lights out latent processing. From the forensic perspective, it's important the community explores what best practice AFIS processing looks like so agencies can enhance current practice. In this presentation, we will discuss the purpose of AFIS in the criminal justice system and the importance of ensuring forensic casework follows best practice approaches. We will benchmark the AFIS of the Police of the Netherlands, which incorporates functionalities that reflect aspects of scientific best practice.



2 Jun

Abstract no: **OP156**



Francesco Zampa

| ORAL

RaCIS - Carabinieri Scientific Investigation Service (R.I.S.), Parma - Italy

The EU funded ENFSI Monopoly Projects 2012, 2016 and 2020: The way forward to the publication of Fingerprint Best Practice Manual

Since 2004 the Fingerprint Working Group of the European Network of Forensic Science Institutes (ENFSI) started the process of developing a Best Practice Manual. The completion of the document and its review from the EFPWG members was a cumbersome process, which was incredibly boosted by the Monopoly Program 2012 "Towards European Forensic Standardisation through Best Practice Manuals" (TEFSBPM), established within the 2012 Annual Work Programme (AWP) for the Prevention of and Fight against Crime as part of the General Programme "Security and Safeguarding Liberties" (ISEC Programme) of the European Commission (EC). Among others, the Project no. B6 consisted in the publication of the Best Practice Manual for Fingerprint Examination in 2015. An outline of the document published will be presented during this presentation.

Following this great achievement, within the Monopoly Program 2016 "Steps Towards a European Forensic Science Area (STEFSA)", aimed to promote the EU Vision for European Forensic Science 2020 with the creation of a European Forensic Science Area, the Project no. G10 consisted in the realization of the Best Practice Manual for Fingerprint Visualisation at the scene of crime. This document is aimed to cover the detection of fingermarks at the scene of crime, whilst the BPM for Fingerprint Examination covers the laboratory activities. A brief outline of this manual will be presented as well.

Finally, considering the huge standardisation effort made in the recent years in the fingerprint world, the outline of the the ongoing CERTAIN-FORS Monopoly Project 2020, Work Package 10, consisting in the publication of the 2nd edition of the Best Practice Manual for Fingerprint Examination will be presented, thus demonstrating how crucial is the EC support toward the harmonization of forensic processes and procedure in the fingerprint domain across Europe.



2 Jun

Abstract no: OP157



Francesco Zampa

RaCIS – Carabinieri Scientific Investigation Service (R.I.S.), Parma – Italy

| ORAL

The EU funded ENFSI Monopoly Projects 2013 and 2020 and the testing program within the EFP-WG: a story of fruitful support

As early as 2004 the Fingerprint Working Group of the European Network of Forensic Science Institutes (ENFSI) has organised proficiency tests (PTs) and collaborative exercises (CEs) as a way of raising standards within the fingerprint profession.

What emerged from the review of the PTs and CEs carried out within ENFSI between 2004 and 2012, was the extreme heterogeneity of the material provided for both visualisation and comparison tests. The exercises were often run by different Forensic Science Institutes, which may unconsciously transfer their own subjective thoughts into the testing material, without the necessary guidance defining and explaining the testing criteria.

Under these premises the Monopoly Program 2013 “TVEFS-2020” work package T3 (MP2013-T3) was created, as one of the six work packages funded by the European Union, as part of activities under the 2011 EU Council Decision – Council Conclusions on the vision for European Forensic Science 2020. There was the absolute need, within the fingerprint community, to set down the rules under which PTs and CEs need to be developed within the fingerprint domain.

This lecture will explain the boosting effect of the MP2013-T3 on the improvement of the procedures applied to design the annual testing program. The leading role of the EFP-WG will be outlined, as well as the functions of the Advisory Group appropriately created. Moreover, a brief outline of the ENFSI document “Guidance on the conduct of proficiency tests and collaborative exercises within the ENFSI Fingerprint Working Group” (2021) will be presented. This document, drafted during the MP 2013 T3 paved the way to an on-going activity, funded within the Monopoly Programme 2020 “CERTAIN-FORS” work package 10 (MP2020 WP10). This new challenge consists in the benchmarking of PTs produced by professional providers, with the aim to provide a practical guidance to European fingerprint laboratories on the selection of commercially available proficiency tests conforming the ISO 17043 norm, whilst ensuring adequate representation of real casework.



1 Jun

Abstract no: KN017



Geoffrey Stewart Morrison

Forensic Data Science Laboratory, Aston University

| KEYNOTE

Advancing a paradigm shift in evaluation of forensic evidence: The rise of forensic data science

Currently, across the majority of branches of forensic science, widespread practice is that analysis and interpretation are conducted using human perception and subjective judgement. Human-perception-based analysis and subjective-judgement-based interpretation methods are non-transparent and are susceptible to cognitive bias. Across the majority of branches of forensic science, the framework for interpretation of evidence is often logically flawed, and forensic-evaluation systems (the end-to-end combination of analysis and interpretation methods) are often not empirically validated or not adequately empirically validated.

A paradigm shift in evaluation of forensic evidence is ongoing in which methods based on human perception and human judgement are being replaced by methods based on relevant data, quantitative measurements, and statistical models; methods that:

1. are transparent and reproducible;
2. are intrinsically resistant to cognitive bias;
3. use the logically correct framework for interpretation of evidence (the likelihood-ratio framework); and
4. are empirically validated under casework conditions.

This presentation describes these elements of the new paradigm, impediments to the paradigm shift, and the presenter's strategy for facilitating and thus advancing the paradigm shift.

The presenter argues that this is true a Kuhnian paradigm shift in the sense that it requires rejection of existing methods and the ways of thinking that underpin them, and rejection of the idea that progress can be made by incremental improvements to existing methods. Instead, it requires the wholesale adoption of an entire constellation of new methods and new ways of thinking.



1 Jun

Abstract no: OP159



Imen Ben Amor

Laboratoire Informatique d'Avignon, EA 4128, Avignon Université, France

| ORAL

BA-LR: binary-attribute-based likelihood ratio estimation for forensic voice comparison

In Forensic Science, the Likelihood Ratio (LR) appears more and more as the best support of the expert's conclusion. However, the level of information it provided does not always fully facilitate decision-making in court. For instance, an LR equal to 50 indicates only that the evidence supports 50 times more the prosecution hypothesis than the defence hypothesis. Whereas if we know that this LR is obtained from two distinct and independent factors associated respectively with an LR of 2 and 25, it not only indicates the support "x 50" for the accusation but it also says that this support comes mainly from the second factor. Adding information to the identified factors may also grantly help the judge, jointly with the other case information, to take in hands the weight of evidence. For instance, the LR of 2 could come from highly discriminant factor but with a low estimation reliability, while the LR of 25 is potentially linked to a factor with a moderate discriminant power but with a very reliable estimation. To that end, we propose the Binary-Attribute-based LR estimation approach (BA-LR) for Forensic Voice Comparison (FVC) where the LR is obtained as the composition of partial LRs, each dedicated to an attribute. An attribute is expressed by the presence/absence of a speaker voice characteristic. A partial LR is directly computed following a formulation of prosecution and defence hypotheses using three probabilities which describe explicitly the behavior of the considered attribute. An implementation of our approach is evaluated on VoxCeleb1&2. The results show the effectiveness of our BA-LR approach and give hope on a better handling of LR-based FVC conclusions.

Speaker Recognition



1 Jun

Abstract no: OP160



David van der Vloed

Netherlands Forensic Institute

| ORAL

Scarcity of data when performing automatic forensic speaker comparison

When forensic speaker comparison (FSC) is applied for the evaluation of the evidence, an audio recording of the voice of an unknown speaker is compared with an audio recording of the voice of a known speaker. Any findings in the comparison are evaluated in light of two hypotheses: the same-speaker-hypothesis and the different-speaker-hypothesis. This process leads to an inference about the identity of the speaker in the unknown recording.

One of the methods employed in FSC is computer-assisted. The case audio recordings are compared by software and a score is obtained. This score is normalized using a data set that can be called a normalization cohort. Then, it is interpreted as evidential value (Likelihood Ratio) using yet another data set, the test set. Both sets need to be representative of the case conditions and need at least thirty speakers, without overlap. Due to these requirements the method is prone to be discarded due to data scarcity.

In this research mock cases (85 speakers) are assessed using each of three methods:

- (1) with different normalization and evaluative cohorts (30 speakers each),
- (2) without normalization, (3) using a leave-one/two-out procedure in which only one set is needed. To account for variation due to speaker selection, the mock case, normalization and evaluative data selection is repeated 1000 times randomly. Each of the methods will produce a set of LRs, which can be described by the C_{llr} . The C_{llr} values of the LRs from the mock cases of each of the three methods can then be compared. This will show whether the leave-one/two-out method is a viable strategy to combat data scarcity.

Speaker Recognition



1 Jun

Abstract no: OP161



Philip Weber

Forensic Data Science Laboratory, Aston University

| ORAL

The E³ Forensic Speech Science System (E³FS³): Design principles and validation of core software tools

The E³ Forensic Speech Science System (E³FS³) is being developed in collaboration with multiple research and operational forensic laboratories. It is designed for conducting forensic-voice-comparison research and casework. When complete, E³FS³ will include open-code software tools, data-collection protocols, databases, standards and guidelines, standard operating procedures, a library of validation reports, and training for practitioners. The core software tools are based on state-of-the-art automatic-speaker-recognition technology, and are accompanied by detailed documentation explaining which algorithms were implemented and why they were chosen. For maximum transparency, the software is written in Python (a popular free high-level programming language) and the code is extensively commented. As each component of E³FS³ reaches the stage at which it is suitable for general release, it will be made available via <http://E3FS3.forensic-voice-comparison.net/>

This presentation describes the design principles for E³FS³, and reports on validations of an alpha version of the core software tools. The validations include a benchmark validation using the `forensic_eval_01` data that has previously been used to assess the performance of multiple other forensic-voice-comparison systems. They also include validations conducted under the conditions of the first case for which E³FS³ was used. This includes multiple recordings conditions, including multiple different questioned-speaker recording durations. Validations were conducted and reported in accordance with the “Consensus on validation of forensic voice comparison”.





**SCENE
OF CRIME**



31 May

Abstract no: OP163



Alicja Menzyk

| ORAL

Forensic Chemistry Research Group, Institute of Chemistry, University of Silesia in Katowice, Poland; Institute of Forensic Research, Krakow, Poland

Breaking with trends in forensic dating: A likelihood ratio-based approach for bloodstains age determination

Contrary to widely held assumptions, the reason for delayed exploitation of temporal information written in blood evidence is not the lack of analytical methods for monitoring degradation processes but the variability of the environmental and circumstantial conditions. For the first time in bloodstains dating, the need to break with current approaches based on absolute age estimations to finally answer time-centered questions in real forensic scenarios is demonstrated.

The present study hypothesizes that aging kinetics' variability impediments should be addressed by substituting a case-suited comparison problem for the conventional dating approach. The critical aspect of this concept is the likelihood ratio-based (LR-based) estimation of the (dis)similarity between the evidence and reference bloodstains decomposition obtained through supervised aging, recreating the degradation of the evidence on site. Every dating procedure would be constructed on a case-by-case basis, each time tailored to the degradation of blood evidence. In such a way, the influence of external factors on the aging kinetics should be considerably reduced.

The best LR-based models established for Raman signatures, founded on the 1200–1410 cm^{-1} and 1200–1300 cm^{-1} combined with 950–1020 cm^{-1} ranges, delivered approximately 10% false negatives and 20% false positive answers. The empirical cross entropy plots evidenced ca. 50% reduction of information loss. Given the multidimensionality of the considered issue, the capability of developed models to discriminate between differently-aged samples was more than satisfying, providing preliminary evidence of the effectiveness of the proposed dating framework.



31 May

Abstract no: OP165



Justus Läsker

The National Forensic Centre, Swedish Police Authority, Linköping, Sweden

| ORAL

Expired blood –a study of expiration patterns

Bloodstain Pattern Analysis (BPA) can be a vital part of a forensic investigation. Expired blood (defined by the IABPA as blood that is blown out of the nose, mouth, or a wound) can give information about the position or movement of a victim or perpetrator on a crime scene. Distinguishing bloodstain patterns caused by gunshots or blunt force trauma from those produced by internal injuries is a challenging but important task. Additionally, the characteristics of expired blood are not well studied in the literature. In this study, expired bloodstain patterns were produced by a volunteer transferring 2 mL of blood into the oral cavity or nostrils and then expelling it onto cardboard by coughing or talking. The distance between the volunteer and the cardboard was 10, 30, 100 and 200 cm and the coughing/talking lasted for 30 seconds. When blood is mixed with saliva and expelled through the mouth, certain characteristics can be used to identify an expiration pattern. The formation of bubble rings, beaded stains as well as the formation of irregularly shaped stains was investigated. Beaded stains and irregularly shaped stains were observed at a distance of up to 30 cm from a coughing volunteer while bubble rings were present at a distance of 200 cm. None of the characteristics could be observed for a volunteer talking with blood in the oral cavity or nostrils, not even at close distances (10 cm).

Bloodstain Pattern Analysis



31 May

Abstract no: OP166



Minna Eriksson

| ORAL

National Bureau of Investigation, Forensic Laboratory, Finland

Lumiscene or Bluestar Forensic for visualizing latent/invisible bloodstains?

Luminol based reagents are used for detecting latent/invisible bloodstains at crime scenes and on items and clothing in the forensic laboratory. The sensitivity of the different reagents has been widely discussed and in this study, different Lumiscene reagents were compared to Bluestar Forensic. Bluestar Forensic is commonly used at the National Bureau of Investigation, Finland.

Different dilutions of blood were made on various surfaces (wood, glass, vinyl flooring and textile) and the dried bloodstains were treated with Lumiscene, Lumiscene Ultra, Lumiscene Field and Bluestar Forensic. In addition, Lumiscene, Lumiscene Ultra and Bluestar Forensic were tested on blood stained wet soaked and washed textiles.

Since DNA-analyses are a crucial part of crime scene investigation, DNA-analyses were performed to Lumiscene, Lumiscene Ultra, Lumiscene Field and Bluestar Forensic treated bloodstains.

The results show that Lumiscene and Lumiscene Ultra give similar reactions to Bluestar Forensic. The intensity of the reactions was dependent of the surface material. On soaked/washed textiles, all the reagents gave similar results and the intensity varied depending on the material. The most challenging textile was jeans.

Treatment with Lumiscene Field and Bluestar Forensic had no effects on DNA-results. Lumiscene and Lumiscene Ultra had some effects on the DNA-results, but comparable DNA-profiles were still obtained after the treatment.



31 May

Abstract no: OP167



Laura Hugh

| ORAL

Cranfield University, Bedford, UK; University of West London, London, UK

Use of micro-computed tomography imaging in the interpretation of bloodstain patterns within carpets

Within bloodstain pattern analysis, routine assessment and interpretation of bloodstains and bloodstain patterns detected on crime scene exhibits is undertaken by eye by trained individuals. These include exhibits with a wide range of surface topographies such as clothing, carpets, and weapons.

Carpets represent a 3D surface, which exists in many different fibre types and constructions, for which little is known about the interaction of blood within the structure. The purpose of this study is to evaluate the interaction of blood with common household carpet types, with particular focus on bloodstains resulting from individual blood droplets falling onto carpet through gravity. The resultant bloodstain pattern, known as 'passive bloodstaining', is derived from movement of an individual(s) with an injury, or through movement of an item(s) wet with blood, such as a weapon. Blood deposited onto the carpet surface wicks between yarns and fibres, to differing degrees, dependent on the impact velocity of the blood droplet and the carpet type surface, which results in differing bloodstain morphologies.

For the first time, Micro-Computed Tomography imaging has been used to analyse the interactions of blood within carpet pile. This non-destructive technology utilises x-ray beams to exploit density differences between blood and the air-filled carpet to create a high-resolution 3D image. This imaging technology enabled the analysis of the effects of varying blood droplet impact velocity and carpet type on the resultant bloodstain morphology within the pile.



2 Jun

Abstract no: OP162

**Katri Matveinen**

| ORAL

National Bureau of Investigation, Forensic Laboratory, Vantaa, Finland

AFORE WP2: Accreditation model for crime scene investigation

Crime scene investigation and evidence collection play an important role in the forensic process and have a crucial effect on any further forensic work carried out in the laboratories. A quality management system for crime scene investigation based on an international standard(s) is a powerful tool for ensuring the validity of evidence, which consequently has an impact on the credibility of the entire forensic process.

The status of accreditation of crime scene investigation has been recognised by the Council of the European Union in Conclusions on European Forensic Science Area 2020. By means of accreditation, forensic service providers can demonstrate the competence and reinforce the confidence for court proceedings.

The aim of the EU-funded AFORE Work Package 2 (WP2) is to develop a European Accreditation Model for crime scene investigation that meets the requirements of the ISO/IEC 17020 standard. Forensic service providers can use the model in developing a standardized quality management system for accreditation.

The survey was carried out to obtain a European overview to what extent Forensic Units and Crime Scene Units have a quality management system in place for crime scene activities. The results of the survey showed that the benefits of a quality management system were well recognised.

AFORE WP2 exploits the results of the survey in two training seminars and in the development of the Policy Document and the Best Practice Manual. These documents will support the process of development of a quality management system for crime scene activities for accreditation as well as provide proposals for the support to be requested from ENFSI and the European Union.



1 Jun

Abstract no: OP168

**Giuliano Iacobellis**

| ORAL

Raggruppamento Carabinieri Investigazioni Scientifiche, viale Tor di Quinto, Roma, ITALY

A novel rapid approach to crime scene investigations proposed in the framework of the H2020 RISEN project

Nowadays, the development and testing of novel technologies is becoming of primary importance for a rapid and accurate crime scene search and first assessment operated by forensic science specialists. EU is supporting this type of research within the H2020 funding program. The RISEN (Real-time on-site forenSic tracE qualificatioN, ID:883116) EU project is developing a set of rapid, contactless sensors and an augmented crime scene investigation on-field system for the optimization of trace detection, classification and interpretation, able to create an interactive 3D model of the crime scene with the position and labeling of traces and the relative results of the on-site analysis. The sensitive nature of data produced in the field of forensics dictates that RISEN's approach and developments are in compliance with the ethical and legal EU directives.

In the present communication, the main objectives of the RISEN project will be outlined together with some preliminary experimental activities performed during the first 2 years of the project. In particular, the Research and Development Department of the Raggruppamento Carabinieri Investigazioni Scientifiche studied the application of hyperspectral imaging photogrammetry in a simulated environment for the digitalization of forensic traces. This approach showed to be successful with selected traces and materials at the crime scene and it can be considered a proof of concept in extracting 3d object with specific optical properties opening to the possibility to use in reality capture application. The results obtained during our experimental work will also allow to discuss the possibility to use of the results obtained in court.



1 Jun

Abstract no: OP169

**Annemieke van Dam**

| ORAL

Amsterdam UMC, University of Amsterdam, Biomedical Engineering & Physics, The Netherlands

Towards the development of an on-site analysis tool to determine the time of deposition of human biological evidence

Estimating the time of deposition of human biological evidence can be of great value to prioritize and validate forensic evidence. Although extremely important, until date no methods are available that can predict the time of deposition of human biological evidence at the crime scene. Developing an age prediction method is difficult due to large inter- and intra-variation in the chemical composition of biological evidence, but also because of the different environmental aspects that might affect the ageing process. Recently, we introduced a method based on fluorescence spectroscopy that is able to predict the time of deposition of fingermarks and semen stains. This method uses the intrinsic fluorescence of biological evidence, whereby the degradation rate of proteins and the formation of fluorescent oxidation products (FOX) can be measured. By measuring at consecutive time points the fluorescent properties, and introduce the data in a stoichiometric ageing model, the time of deposition can be predicted. Although this method shows promising results, whereby the age of biological evidence can be predicted, it has one major drawback: a large benchtop fluorimeter is needed that cannot be applied at the crime scene. This highly limits the application of such a method. Therefore, the aim of this study was to develop a portable and non-invasive fluorescent analysis device to predict the time of deposition of human biological evidence, including fingermarks, saliva, semen, serum, and urine. In this presentation we will show that age estimation of biological stains is possible, and that this portable device has the potential to be implemented in forensic casework.



1 Jun

Abstract no: **KN018**



Eva Ljungkvist

| **KEYNOTE**

National Forensic Services (NKC), Special Crime Unit, Danish Police

Forensic science means science – how to thrive in the future by cutting the edge together

Forensic medicine and science has evolved over the centuries and with the uplifting book "Washing away of wrongs", our field of expertise went into the written word. This made it possible to transfer experience and knowledge to subsequent generations of forensic scientists more effectively. But the pendulum, as we know, swings in two directions, and so has the development of forensic science particularly over the last 100 years.

Silverbacks, myths, reduced training, fragmented research, and everyday operation, are some of the factors that limit our advancement as a scientific discipline. And in the worst case, it can impair the quality of our forensic results and impact on the delivery of justice.

The only thing we know about the future is that many of these factors will remain, and there is a risk that we will lose expertise as budgets reduce and priorities change.

With a humorous twinkle in our eye, we take a closer look at today's pioneers and the fantastic opportunities we have to break new ground, develop our technology, and keep true to the development and implementation of our scientific methodology.



1 Jun

Abstract no: **OP276**



Oleksandr Shmereho

| **ORAL**

Head of the Life Safety Research, Fire Engineering and Electrical Engineering Research Department Kyiv Scientific Research Institute of Forensic Expertise Ukraine

The art of manufacturing devices for ignition and evaluation of their use and the achieved effect of application

The art of building fire engines requires good knowledge of fire dynamics, materials and the context in which they are placed. To succeed as a fire station, you must also test and modify the design to achieve its purpose. To succeed as a fire investigator, you must master all this even better and also be skilled in finding the small traces that may be left at a fire site. Directly from the Kyiv Institute, Ukraine comes an experienced fire investigator with the latest on testing prototypes, developing designs and evaluating fire patterns, fire spread and the following effect, and the ability to find remnants of the fire engine at the fire site. There will be a presentation of an igniter based on a chemical exothermic reaction between potassium permanganate (KMnO_4) and glycerol $\text{C}_3\text{H}_8\text{O}_3$, with the spread of combustion to the available combustible material (fabric, cotton), with the participation of the combustion intensifier (gasoline). And also, a demonstration of the use of an electric igniter of combustible material by mechanically connecting the contacts from the power supply to the voltage on the electric igniter.



3 Jun

Abstract no: OP170



Jurrien Bijhold

| ORAL

Leiden University of Applied Sciences, Lectorate of Digital Evidence & E-discovery, Leiden, Netherlands

Mixed Reality for crime scene investigators

Mixed Reality (MR) is a mix of real-world reality, as experienced e.g. on a crime scene, and virtual reality (VR) as experienced e.g. in a game, with VR-glasses. MR-glasses, like the HoloLens can offer an experience in which a virtual world is superimposed on the real world. In a very simple form for CSI's, this world could exist of virtual trace markers placed in a real crime scene, or, some real traces on real-world surfaces in a mock-up crime scene for training CSI-skills.

At the Leiden University of Applied Sciences, research has been done on applications of mixed reality for CSI's. Since 2019, many different applications have been tested, demonstrated and discussed with CSI's and forensic investigators. A number of potentially useful applications have been found in three fields: (1) crime scene investigation and documentation, (2) scenario testing and (court) presentation, and (3) training and education.

In this presentation, a brief explanation of the technology is given, and a number of applications are demonstrated, using a direct video link with our HoloLens. Topics like data security, CSI workflow, interdisciplinary collaboration, classification of information and feedback from test users will be discussed.



3 Jun

Abstract no: OP171


Anna Jinghede Sundwall

| ORAL

Karolinska Institutet, Stockholm, Sweden; Polismyndigheten, Sverige

The forensic nature of child victimization – a population based study of child homicides in Sweden during 20 years

Child homicide investigations are challenging and surrounded by potential pitfalls. Crime scene processing is recognized as a crucial step in homicide investigations. However, neither crime scene management nor the profile and recovery rates of forensic evidence in child homicides have been explored previously. The aim of the study was to provide an evidence based body of knowledge about the forensic characteristics of child homicides.

Police reports, crime scene and autopsy protocols of cleared Swedish child homicides, 1992 to 2017, were retrospectively reviewed with focus on epidemiological and forensic variables.

All-in-all were 71 cases with 82 victims (41 girls, 41 boys) aged 0-14 included. The annual frequency was 3.6 cases (4.1 victims) where of 79% were intrafamilial. In 29 incidents (35%), the homicide was followed by offender suicide. Most children died from a concentrated killing act, most frequently blunt and sharp violence (n=19 and n=18 respectively). 17 victims (21%) did not display any apparent signs of violence.

Most crime scenes (54%) were found in the parental home. 50% of the scenes displayed signs of violence such as blood spatter, torned furniture and pulled hair. The body was commonly (43%) found in a lying position. The original posture of the body had frequently been altered, either by emergency rescue personnel (23%) or the offender (17%). Crime scene processing included both documentation and biological and physical evidence collection in 63 cases (77%). Active efforts to mislead the investigation followed 19 cases (27%). The study may contribute to investigational recommendations and a reduced risk of child homicide cases going undetected.



3 Jun

Abstract no: OP172

**Isabelle Radgen-Morvant***School of Criminal Justice, University of Lausanne, Switzerland*

| ORAL

The impact of decontaminants on fingermarks and digital evidence

Nowadays, a comprehensive approach and a specific forensic methodology for the investigation of fingermarks and digital evidence from incidents involving the use of chemical warfare agents and more broadly CBRN agents, is still lacking. Basically, there are two possible approaches in dealing with the traditional forensic analysis of contaminated exhibits. The first one is to analyse the contaminated items under safe conditions (i.e. in laboratories dedicated to the handling of such substances), while the second relies on item decontamination in a way that they can be processed in traditional forensic laboratories. One of the main limitations of the latter is that the decontamination process may affect or even destroy the traces. Hence, it is crucial to have as much information as possible on the impact of different decontamination agents and procedures on traces, and specifically to investigate the effects of decontaminants on forensic evidence.

This research presents experimental results on the recovery of fingermarks on glass and paper as well as digital content from USB memory sticks after the application of decontaminants used in case of chemical incidents. For fingermarks, we evaluated the impact of 12 decontaminants on traces (by visual examination) and on subsequent enhancement methods. Results obtained enable a better understanding of the impact of different decontamination pathways (physical or chemical) on fingermarks and their chemical enhancements. For digital evidence, the integrity of data stored on decontaminated USB memory sticks was assessed. Depending on the decontaminant used the most suitable forensic approach will be presented.



3 Jun

Abstract no: OP173

**Olivier Maresca**

| ORAL

Forensic science institute of the french Gendarmerie

Victim identification in a multi-hazard environment – Technical acts in the CBRNE exclusion zone – Two case studies

Since 2006, IRCGN has been developing a response team, composed of scientists from the laboratory, able to perform crime scene investigations and analyses in a CBRNe environment. Their mission also includes disaster victim identification involving body examinations and autopsies. Our model assumes that most of the action must be realised in the hot zone. The identification of victims is a delicate, multidisciplinary operation that must be carried out with care and method. The exercise becomes more complex when it has to be carried out by forensic experts in the exclusion zone.

In 2018, Our team was given the task of investigating the cause of death of a French citizen who died abroad. The victim's body having been treated with large quantities of formaldehyde, experts from CBRN forensic team were deployed, supported by the C2NRBC unit (in charge of detecting the chemical agent and providing the appropriate PPE). From the arrival of the coffin at Roissy airport to the delivery of the results, this feedback will highlight the steps taken to ensure the safety of the experts and guarantee the quality of the results.

In 2019 a Mirage 2000D having taken off from the air base 133 of Nancy for a "current operation", had disappeared from the radars, this Wednesday shortly before noon, while flying over the Jura. Fixation of the crash area by laser-scanner, geolocation and sampling of body fragments for identification, DNA analysis as close as possible to the crash site. The experts had to evolve in a degraded environment (snow, temperatures, kerosene, and dangerous materials embarked on a fighter plane of this type) while applying a precise methodology to identify the victims.



1 Jun

Abstract no: **OP174**



Stuart Ritchie

ANZFSS, AFI(NSW), NAFI

| ORAL

Co-Operation between Police and Private Experts in the investigation of a deliberate fire event

The investigation of fire scenes are initially undertaken by the Police and Fire Brigade. The success of such Police investigations can be dependent on the level of expertise in the first responders in correctly identifying and attributing indicators of physical evidence attributable to criminal activity.

Situations can occur when indicators are not identified leading to an incorrect initial determination, and an incomplete investigation.

The insurance industry source and utilize highly skilled and court accredited forensic experts in Fire origin and cause investigations.

An understanding and acceptance of such private forensic resources, by Police/Fire brigade authorities, can assist in maximizing the success of criminal investigations with regards fire events.

The process of public/private resources working together requires an understanding and acknowledgement by public authorities of private sector forensic expertise, with such resources often accompanied by assistance in complex scenes requiring engineering or demolition solutions.

The case study to be presented relates to an insurance claim that involved a forensic fire scene investigation by the author (and other subsequent forensic expert resources), of a fire scene not initially investigated by Police, that was subsequently identified via detailed scene examinations, as a deliberate fire event.

By working together, and utilizing available resources, a complex and successful Police investigation was undertaken, that resulted in a suspect being identified, charged, and convicted by court. This promoted a safer world, which, on a local scale, was facilitated by public and private industry co-operation.



1 Jun

Abstract no: **OP175**



Graham Strong

Forensic Services, Scottish Police Authority, Inverness, Scotland, UK

| ORAL

Fire and Explosion Investigation: Butane Honey Oil Case Study

This presentation examines a typical response to an explosion and fire within a house in Scotland, UK. A case study, given from the point of view of the author, is used to illustrate how the requirements of the Best Practice Manual published by the ENFSI Fire and Explosion Investigation Working Group were followed by first responders from Police Scotland and the Scottish Fire and Rescue Service to best preserve and examine the scene of an explosion which was related to the illegal production of Cannabis Oil where butane was used as a solvent.



1 Jun

Abstract no: OP177



Olivier Delémont

Ecole des sciences criminelles, University of Lausanne, Switzerland

| ORAL

Should forensic fire investigation undergo a digital transformation?

While in some places or times it has been practiced more as an art passed on by peers, fire investigation has gradually consolidated around a scientific approach. At least on the European continent, it is now commonly recognised as a type of crime scene, and as a fully fledged forensic science activity. This anchoring must lead us to question the place and role that the 'trace' plays in it, the latter constituting the elementary component of forensic science.

Traditionally, fire investigation focused on the observation, documentation and interpretation of traces caused by the direct effect of fire, such as fire patterns or electrical arcing. But times are changing, and the societal evolutions induced by digital transformation have an impact on the nature and the extent of the material traces that are caused by a fire. At the previous EAFS (2018), we've outlined the central role played by images in fire investigation. In this presentation, we highlight the importance of a scientific approach for the search and collection of these images, as well as the large variety of digital traces produced during a fire. By means of concrete examples, we wish to draw attention to the increasing significance of digital traces as artefacts in a fire event, and to the information potential of these traces.

The digital transformation is leading us to fundamentally revise our approaches to the fire scene, focusing on as yet unrecognised and under-exploited but highly informative forms of evidence. We believe that this change will challenge the practice of fire investigation, opening up new fields of investigation, and new scenes of examination beyond the traditional focus on the fire site.



30 May

Abstract no: KN027



Mike Groen

| **KEYNOTE**

Netherlands Forensic Institute, The Hague, The Netherlands / Leiden University, The Netherlands

Reconstructing Crime Scenes: An Archaeological Approach

Archaeologists reason backwards when reconstructing the past, from the observed finds and features to the human activities that caused this record of the past. However, the archaeological paradigm is hardly known within the forensic community. This is unfortunate as the understanding of the natural processes and human activities of the past has been a key issue in the archaeological discourse since the 19th century. An outcome of this discourse was that archaeological reconstructions differ from the reconstructions as derived from the classical experimental sciences. Archaeology, like crime scene investigation (CSI), can seldom offer certainty. The archaeological discourse furthermore focused on the status of archaeological reconstructions; are such reconstructions scientific and objective, or mainly the result of our own hermeneutic process? Thirdly, there was the awareness that archaeological reconstructions need to be grounded in field mapping and documentation, background knowledge, actualistic experimental studies and anthropocentric theoretical models. The focus of this presentation is on exploiting the applicability of archaeological reasoning on the CSI, as related to major crimes. An evidential reasoning framework for CSI will be offered that is based on physical evidence as recovered at a crime scene, forensic knowledge, criminalistic experimental studies, anthropocentric theories and mutually exclusive hypotheses. Introducing the archaeological paradigm into the CSI process will undoubtedly bring with it new challenges. However, it will also help to improve the CSI practice, by offering access to information needed for answering questions at the activity level.



30 May

Abstract no: OP190



Zoe Cadwell

School of Criminology and Criminal Justice, University of Portsmouth, Portsmouth, United Kingdom

| ORAL

The use of burial for temporary concealment of commodities by criminal entities

This paper addresses an under-explored issue that intersects forensic archaeology, the investigation of serious crime and forensic evidence recovery. Within forensic archaeology literature, the focus of both research and case studies is on the clandestine burial of human remains, there is limited discussion on commodity burial by criminal entities. Here, the term commodity is used to encompass items that form the currency of the serious and organised crime networks and are valued by them, namely drugs, cash and weapons. These commodities require concealment from authorities and other parties who might seek to seize and control these assets, whilst still being accessible for use in business transactions by these groups. As such, burial is utilised as a method of temporary concealment, and yet the extent of this has not yet been explored within the forensic and criminal justice literature.

This paper proposes the first contextual review of commodity burial, with a view to developing an awareness as to the extent of the practice, and how law enforcement and forensic practitioners might seek to maximise the forensic and intelligence potential of the buried items. Whilst the supporting data has been obtained through support from UK Police forces, the issue is a global concern and, across Europe, criminal networks seek to transport these commodities across boundaries. The research that underpins this presentation is envisaged to support further studies into informed approaches, including strategies, for law enforcement personnel searching for such caches, and for forensic practitioners seeking to maximise forensic recovery to identify offenders and disrupt these networks.



30 May

Abstract no: **OP267**



Oscar Ibáñez

| **ORAL**

Faculty of Computer Science, CITIC, University of A Coruna, Spain; Panacea Cooperative Research S. Coop., Ponferrada, Spain; Andalusian Research Institute in Data Science and Computational Intelligence, University of Granada, Granada, Spain

Towards a fully automatic approach to craniofacial superimposition

Craniofacial superimposition generates controversy in the scientific community. It is a challenging, time-consuming and subjective comparison method where two different objects are compared, a facial photograph and skull (2D or 3D) image. Although this technique has been in use for a century, its great potentiality (it only requires facial photographs as antemortem data) has not positioned it as a commonly employed identification methods due to the lack of objective, reproducible, accurate and automatic approaches. Additionally, it is currently not possible to make firm statements about its overall reliability because studies of its reliability have used small samples and have not been replicated. In this presentation we will briefly introduce and analyse the last achievements obtained by researchers from Panacea Cooperative Research and the University of Granada which position the technique as a fully automated process with the following stages: cephalometric landmark location in facial photographs, craniometric landmark location in 3D skull models, pose and subject to camera distance estimation in facial photographs, soft tissue depth estimation from craniometric landmarks, skull-face overlay over one or multiple-photos at the same time, ranking of candidates and decision making.



31 May

Abstract no: OP179



Lucia Elgerud

University of Tennessee Knoxville

| ORAL

Beyond the first body farm: research and development at the Forensic Anthropology Center, UT Knoxville, USA

Forensic anthropology incorporates analyses of osseous material, estimation of time for soft tissue decomposition, and the practice of archaeological methods. Knowledge regarding these processes has been propelled by forensic anthropology research facilities with human body donation programs. The Anthropology Research Facility (ARF), managed by the Forensic Anthropology Center (FAC) at the University of Tennessee Knoxville, has overseen the decomposition of nearly 2000 donors since its founding in 1981 and continues to engage in groundbreaking research. There are now several “body farms” around the world. Ethical and sound body donation programs are the core of such facilities. This presentation will outline key facets of the first facility, how it continues to enhance the field, and how it can serve as a model for Europe.

Body donations are intrinsic to ARF decomposition research studies and, once curated in the FAC skeletal collection, the donors facilitate the development of innovative forensic methods and knowledge. The donors are also fundamental to training courses in forensic anthropology methods. U.S. and international law enforcement officers and crime scene investigators have participated in these programs, observing decomposition and practicing methods for the discovery and recovery of human remains. While certain aspects of the FAC and ARF continue to benefit international work, studies in other contexts and climates are imperative to comprehensively understand human decomposition. This presentation will support European forensic anthropology facility programs by presenting ongoing research and development at the ARF and the first human body donation program.



31 May

Abstract no: OP180



Alisha Deo

| ORAL

Centre for Forensic Science, University of Technology Sydney, Ultimo, Australia

Comparison of desiccation of human and pig tissue via lipid analysis

Natural tissue desiccation is a phenomenon that may occur during the decomposition of organisms that have been exposed to dry, arid conditions such as those present in Australia. This process occurs when the body loses fluids to the environment via evaporation, causing the external tissue of an organism to desiccate and harden to form a preserving shell for internal tissues. This process makes it difficult to determine time since death using traditional means. This complicates forensic investigations as there is currently little research incorporating the effects of desiccation on human decomposition. This research explores this current issue through investigating lipids present within the skin and tissue of mummified human and pig remains. These aspects are investigated not only to identify the extent of lipid degradation within desiccated human skin and tissue, but also to compare humans and human analogues. Not only will this enhance our understanding of desiccation from a forensic perspective, but it will also enable pig versus human comparisons from an analytical context. This can assist in forensic science as a whole when looking at utilising pigs as human analogues. Gas chromatography – tandem mass spectrometry was used in multiple reaction monitoring mode during this project for lipid analysis with extraction methods optimised for both skin and tissue. Visual trends showed desiccation in both type of remains at different rates, with pigs mummifying faster than humans. In addition to contributing to the current research gap regarding mummification, the large-scale application of this research can include increased accuracy in postmortem-interval estimation.



31 May

Abstract no: OP181



Sharni Collins

| ORAL

Centre for Forensic Science, University of Technology Sydney, Australia

Determining the suitability of pigs as human analogues for post-mortem lipid analysis

The determination of time since death is a major challenge to law enforcement when faced with the discovery of human remains. This is due to the fact that decomposition is a complex, dynamic process influenced by several abiotic and biotic factors. For decades, post-mortem decomposition studies have used pigs as human analogues due to ethical and legal restrictions surrounding the use of human cadavers for such research. However, few comparative studies have been conducted to assess the suitability of these analogues. Recent forensic studies have successfully demonstrated the use of post-mortem lipids in textiles as a method to obtain vital information about decomposition process. The current investigation was conducted at the Australian Facility for Taphonomic Experimental Research (AFTER) and involved two studies: Trial 1 (summer) and Trial 2 (winter). Each trial with $n=1$ human cadaver and $n=2$ pigs. Samples were collected over a timeline of 105 days post-placement and analysed using attenuated total reflectance (ATR) Fourier-transform infrared (FTIR) spectroscopy. The data was then statistically assessed using functional principal component analysis, semi-parametric regression modelling and analysis of variance. The results demonstrated a clear statistically significant interspecies difference between pigs and humans in both trials. The implications of this study suggest that pigs are not suitable analogues for humans in decomposition research and have broader implications that caution the direct translation of decomposition data obtained from pigs to real human casework, particularly with respect to time since death estimations.



31 May

Abstract no: OP182

**Tristan Krap****| ORAL**

Maastricht University, Maastricht, The Netherlands; Ars Cogniscendi Foundation for Legal and Forensic Medicine, Wezep, The Netherlands; Amsterdam UMC, Location AMC, department of Medical Biology, section Clinical Anatomy and Embryology, Amsterdam, The Netherlands

Differentiating between mechanical or thermal fractures

When investigating burned human remains bone fractures can be encountered, the question then rises whether a bone fracture occurred before, during or after heat exposure. To investigate the differences between fractures that were already present before the fire versus those that occurred during and after the fire, 30 fresh human forearm bones were subjected to either blunt-force impact, burning, or both. Bones, covered in soft tissue and wrapped in clothing, were burned in a reconstructed house fire. The burning context and dynamics led to differential burning. A data collection sheet was developed based on the current literature on fracture features to analyze the damage to the bones. Observable and measurable changes on bone, and fracture surfaces, were macro- and microscopically analysed. Many features overlapped between the three groups, and thus are not usable for differentiation. Fractures caused by blunt force impact (post-mortem, before the fire) showed a different fracture surface with smoothness in curved/slanted regions near the margin after burning when compared to heat-induced bone fractures. The discolouration of the margins and surface of bone fractures that originated after the fire (indirect heat-induced), were different when compared to those of heat-induced bone fractures. These features are therefore usable for substantiating investigative hypotheses in forensic anthropological casework. However, knowledge on, and experience with, burned human remains and the context in which the remains were burned is of essential importance when investigating burned human remains and interpreting findings.



31 May

Abstract no: **OP183**



Petra Molnar

| ORAL

Forensic Section, Swedish Police Authority, Stockholm, Sweden

Forensic Anthropology in Sweden: An important tool in the aim to fully comply with the rule of law in murder cases

The aim of the presentation is to show the importance and potential of the use of Forensic Anthropology within the Swedish legal system, highlighted by recent cases and undertakings.

Internationally, Forensic Anthropology is a well-accepted and widely implemented field. There are documented advantages of close collaborations between Forensic Anthropologists, Police, CSI and Medical Examiners in examining skeletal elements with knife wounds, dismemberment marks, blunt force trauma and gunshot injuries. In these cases, the maceration of autopsy remains enables deepened skeletal injury analyses. The forensic anthropologist furthermore has the knowledge to differentiate injuries made in fresh bone from postmortem (or other) taphonomic damage. The examination of skeletal remains in Arson cases can reveal perimortem invasive injuries in burnt human remains, also useful in Disaster Victim Identification investigations.

In Sweden, there has been a steady increase of cases involving skeletal remains in the last few years. With the aim to function as a national resource, the Forensic Archaeology Working Group (including anthropology) at the Forensic Section in Stockholm can contribute on out-door crime scenes and with related undertakings. The group also deals with procedures for best practice and ethical handling of human remains found in various settings. On these occasions, the collaboration within various Police departments as well as with external authorities is essential, in order to determine the best cause of action in each unique case.

The aspiration is that Forensic Anthropology is more extensively recognised and implemented in Sweden in the future.



31 May

Abstract no: OP184

**Agathe Ribéreau-Gayon****| ORAL**

Université du Québec à Trois-Rivières (UQTR), Canada; Laboratoire de Recherche en Criminologie; International Centre for Comparative Criminology

Human decomposition trajectories in a cold, continental climate in Canada

There is a gap in the current knowledge base on the biological impact of cold, continental climates on decomposition trajectories of human remains, and its effect on postmortem interval (PMI) estimates.

To address this issue, six human corpses were studied at the facility for Research in Experimental and Social Thanatology (REST) in Quebec, the first human decomposition facility in Canada. The experiment took place over a two year period, from September to April each year. In the 2020 trial, one donor was deposited in September (female), one in October (female), and one in November (male). In the 2021 trial, two donors were deposited in October (both males) and one in November (female). Intrinsic and extrinsic data were collected from the donors and their depositional environment.

In both trials, there was a transition in decomposition as temperatures declined through fall and winter. The September 2020 donor showed signs of full bloat and active decay, while the October 2020 and 2021 donors only showed localized bloat and active decay. For both the November 2020 and 2021 donors, neither bloat nor active decay was observed prior to snowfall. Overall, the six donors followed decomposition trajectories that did not match those reported in the published literature. Hence, visual methods currently used to estimate the extent of decomposition are not suitable for Quebec's climate and are thus of limited support to local forensic investigations. These results are serving as a baseline to develop new standards for forensic taphonomy in Canada and to enable comparisons with other locations with humid continental climates, such as northern Europe.



31 May

Abstract no: OP185



Pier Matteo Barone

Nottingham Trent University; Forensic Geoscience Italy

| ORAL

Mapping decomposition: non-destructive detection of simulated body fluids in the shallow subsurface

The processes of decomposition that the body will have after the time of death are peculiar and complex. The body will swell, expel gases and fluids and the flesh will decay. It will also attract many insects and scavengers. We know that these fluids are nutrients for the vegetation and, if the body is inhumated in the subsurface, they allow a rapid crop growth markable by remote sensors. There are several studies that show how geophysical instruments such as ground penetrating radar (GPR), given its ability to detect dielectric constant changes in the investigated media, can be sensitive to the decomposition fluids of a buried body. Mapping the fluid migration in the subsurface can be helpful to estimate the Post-Mortem Interval (PMI) helping the forensic investigations.

In this work, an experiment will be presented simulating the dispersion of the body fluids in a shallow grave and detecting it through the GPR technique. Using a suitable solution that can simulate decomposition fluids with a dielectric constant very close to the real one, and adequately processing the GPR data, it will be possible to determine the relationship between GPR anomalies and fluid migration over a certain time in the subsurface.

Pringle, J.K., Stimpson, I.G., Wisniewski, K.D. et al. (2020). Geophysical monitoring of simulated homicide burials for forensic investigations. *Sci Rep* 10, 7544 (2020). <https://doi.org/10.1038/s41598-020-64262-3>

Wescott D. J. (2018). Recent advances in forensic anthropology: decomposition research. *Forensic sciences research*, 3(4), 327-342. <https://doi.org/10.1080/20961790.2018.1488571>



31 May

Abstract no: OP186

**Clara Alfsdotter**

| ORAL

Bohusläns museum, Uddevalla, Sweden; Linnaeus University, Kalmar, Sweden

Outdoor human decomposition in Sweden

Elucidating the circumstances of death is of paramount importance in medico-legal investigations, both from a humanitarian and a judicial point of view. In cases involving decomposed human remains this task becomes challenging and requires the use of methods that are not only scientifically accepted and validated, but also developed from regional data as decomposition is climate dependent. Decomposition knowledge can be used to facilitate the search for missing deceased people in specific areas, as well for time-since-death estimation and identification.

In Sweden, knowledge on the patterns and sequences of outdoor human decomposition is lacking. The aim of this paper is thus to start filling this gap and offer the first quantitative retrospective study on outdoor human decomposition in central and south-eastern Sweden. A total of 94 (43 terrestrial and 51 aquatic) cases with a postmortem interval (PMI) ranging from 6 days to 76 years have been analysed in terms of decomposition changes in relation to time and taphonomical variables. The results revealed differences in decomposition patterns and sequences between aquatic, surface, hanging, and buried remains, as well as differences in the applicability of universal PMI methods for estimation of time-since-death. Suggestions for the implementation of the results in practical caseworks and future perspectives, including research on saponification and its impact on PMI estimation, will be discussed.



31 May

Abstract no: OP187

**Tristan Krap****| ORAL**

Maastricht University, Maastricht, The Netherlands ; Amsterdam UMC, Location AMC, department of Medical Biology, section Clinical Anatomy and Embryology, Amsterdam, The Netherlands; Ars Cogniscendi Foundation for Legal and Forensic Medicine, Wezep, The Netherlands

Phosphorescence of burned human remains

Burned human skeletal remains luminesce visibly to the human eye when irradiated with alternate light sources. This characteristic can aid the recovery of human remains in difficult context and provide information on the exposure temperature. However, the observed colour of luminescence of samples collected from fire scenes is heterogeneous which makes the interpretation difficult. Little is known about the underlying processes that cause the luminescence and whether the luminescence is solely fluorescence or also phosphorescence. Therefore, a study was carried out to investigate whether thermally altered human bone phosphoresces.

Human cortical bone samples (304) were subjected to heat up to 1100°C for various durations and in different media. In addition, cremated remains of one donated cadaver were recollected after cremation at a modern crematory. Samples were irradiated with alternate light sources in the range from 350 to 470nm. The samples were investigated for phosphorescence. Data on phosphorescence intensity was collected by means of a scorings index, applied by two observers at two different moments without information on the heating conditions. The collected data was plotted and analysed with SPSS. A selection of phosphorescing samples was photographically documented with a DSLR.

Heated bone samples do phosphoresce, this became visible to the human eye at temperatures of 450°C and higher. However, the emission bandwidth profiles differ for luminescence and phosphorescence. This is a first step towards better understanding and interpreting the heterogeneous luminescent profile of burned human remains, which is useful for estimating the exposure temperature.



31 May

Abstract no: OP188

**Noemi Procopio****| ORAL**

Forensic Science Research Group, Faculty of Health and Life Sciences, Applied Sciences, Northumbria University, Newcastle Upon Tyne, UK; Forensic Anthropology Center, Texas State University, San Marcos, Texas, USA

Potential of simultaneous extraction of metabolites and lipids from bones for PMI estimation

One great challenge in forensic investigation of skeletal remains is postmortem interval (PMI) estimation. Currently applied methods suffer from poor accuracy and precision due to intrinsic and extrinsic factors affecting bone decay, and require relatively complete and/or intact remains. Molecular methods offer the necessary accuracy and reproducibility to meet court standards and can be applied where material availability is limited. This work tests the applicability of the biphasic Folch method for simultaneous extraction of metabolites and lipids on anterior midshaft tibia bone samples from four female donated humans. Samples were collected prior to burial at the Forensic Anthropology Research Facility (Texas), and after their retrieval at 219, 790, 834 and 872 days. Fresh and skeletonized bones were tested using Thermo Scientific Vanquish liquid chromatography connected to IDX high resolution Orbitrap mass spectrometer in hydrophilic liquid interaction chromatography (HILIC) for metabolites and in C18-RP chromatography for lipids. A total of 69 and 76 metabolites and 417 and 159 lipids in positive and negative ionization modes respectively, were profiled. Results revealed clear separation between different individuals when analysed by partial least square discriminant analysis suggesting different compound preservation with increasing PMI. Univariate analysis, in contrast, showed different patterns for different classes of compounds. Several compounds seemed to decay over time while others showed positive correlation with PMI. Our results suggest that bone metabolomics and lipidomics could represent promising avenue for the estimation of PMI from human bones.



31 May

Abstract no: OP189

**Bridget Thurn***Centre for Forensic Science, University of Technology Sydney, Australia*

| ORAL

Profiling the volatile organic compounds released from human remains covered with lime

Locating the remains of deceased individuals is a major challenge for law enforcement. To date, the best tools for this task are cadaver detection dogs, which rely on the volatile organic compounds (VOCs) produced during decomposition to find victims. Malefactors will attempt to conceal these putrefactive odours through chemical additions such as lime, which is also believed to expedite decomposition and prevent the identification of the deceased. This research aimed to determine whether such chemicals are successful in both concealing the scent of decay and in accelerating the taphonomic process. VOCs from the headspace of surface and buried human donors (with and without lime) were collected using sorbent tubes and analysed using thermal desorption with two-dimensional gas chromatography-time-of-flight mass spectrometry. The addition of lime decreased the rate of decomposition, reduced insect activity, and had a profound effect on VOC production. While the abundance of VOCs for the control donors peaked during active and advanced decay, the limed surface donor showed an initial increase in VOCs, followed by a plateau during the active and advanced stages. Despite this suppression of VOCs, the prevalence of sulfides, which are known biomarkers of human decomposition, were unaffected by the lime, which was also true of the limed burial. These results show that lime may hinder cadaver detection dogs during later decay but highlights that sulfides can still be used to locate limed remains. Gaining an understanding of how chemical additions affect decomposition can aid in locating missing individuals, and ultimately provide answers to families and assist in prosecutions.

Implementing New Technologies at Crime Scenes



1 Jun

Abstract no: KN019



Christianne de Poot

| KEYNOTE

Amsterdam University of Applied Sciences; VU University Amsterdam; Police Academy, the Netherlands

The reconstruction of crimes

Technological developments make it easier and easier to observe traces left by a crime, and to analyse them faster, more refined, and more accurately. Take for example the new methods available to type human cellular material. Not only can we extract DNA from this, we can now also determine what cell type it comes from and, increasingly, how long ago it was deposited. Important information when you want to determine the relationship between a trace and a crime. Such novel techniques enable us to produce better crime reconstructions, and to prove them more convincingly. However, effective use of these techniques and the information they provide requires more than just technical and legal knowledge. Vital too are an understanding of the social and psychological aspects of criminality and investigative work, and on human behaviour in general. Knowledge on how crimes are committed and where they are likely to leave traces, on the differences between traces that are linked to an offence and those unrelated to it, and on how professionals within the criminal justice chain observe, interpret, make decisions and communicate between themselves. In this presentation I will focus on the importance of this behavioural dimension for the recovery, analysis and interpretation of evidence. Based on the themes 'processing crime scenes', 'rapid identification technologies', and 'trace characteristics and activity level propositions' I will illustrate how the development of knowledge on human factors, properties of traces and the evidential value of traces can help to refine and improve the reconstruction of crimes.



1 Jun

Abstract no: OP191

**Andrew Hart***Forensic Services, Metropolitan Police Service, London, England*

| ORAL

Blood in the dark: The impact of resolution on the ability to locate bloodstains on dark fabrics using infrared

Infrared (IR) light has been used to locate bloodstains on dark fabric items in forensic casework for a number of years. An IR-converted standard DSLR (Digital Single Lens Reflex) is the most commonly used camera for this purpose. However, there has been a recent profusion of commercially available IR systems specifically designed for use in a forensic environment, all with different levels of resolution. In this study, the impact of contrasting resolutions on the performance of a number of IR systems was assessed by targeting a variety of bloodstain types and fabrics in comparison with white light. The systems ranged from low-budget, low resolution options, such as portable webcams, to vision-industry standard, high resolution, purpose-built cameras for more detailed blood searching of suitable items in the laboratory. A variety of frequently encountered stains on different dark fabric surfaces were examined under IR conditions, including blood spatter, transfer bloodstains, dilute bloodstains, blood mixed with other body fluids and environmental contaminants to determine the effect of the resolution differences. All IR systems were able to locate bloodstains to a greater or lesser degree, with significantly more bloodstains being found with IR compared to white light. Resolution was found to have a significant effect on the ability of the systems to locate bloodstains. These findings will be presented in more detail, and the balance between the ability to locate bloodstains based on system resolution and practicality, as well as possible efficiency gains, will be discussed.



1 Jun

Abstract no: **OP192**



Jan Peter Van Zandwijk

| **ORAL**

Netherlands Forensic Institute, Department of digital and biometric traces, The Hague, The Netherlands

Icarus: validation of a biomechanical model of the human body for forensic fall analysis

Forensic reconstruction and scenario testing are important means in criminal investigations into deaths under suspicious circumstances or violent incidents. These means can be used as to find out what may or may not have happened. For instance: has the victim fallen down the stairs or has he been pushed? In the Icarus research project, we use a biomechanical model of the human body to simulate forensically relevant drops from heights. The aim is to enable making probability statements about various drop scenarios in a case, such as falling, jumping or being pushed, in the form of a likelihood ratio in a Bayesian evaluative methodology.

As a first step in developing a validated model for such scenarios, we assessed the commercially available passive Madymo ellipsoid pedestrian model for forensically relevant. For this purpose, experimental data was collected from ten subjects performing various backwards and sideways drops from a 1.5 m height into a foam pit: forward jumping, backwards and sideways falling and being pushed backwards and sideways. Collected data include kinematics of the drop motion from initiation until landing and external forces exerted on the subject. Next, using measured initial positions and velocities from the experiment, the performance of the was assessed by comparing the modeled and measured body posture and orientation just before landing.



1 Jun

Abstract no: **OP194**



Steffen Franz

German Federal Criminal Police Office, Wiesbaden, Germany

| ORAL

Smartphone-based crime scene documentation with INSITU

A consistently documented crime scene is paramount for the ability of others to take the finished product to use in either reconstructing the scene or the chain of events in an incident as well as court room presentations. Modern technologies like digital photography, laser scanners and drones can play an important role in achieving that goal. But even though a variety of tools are used during documentation, that produce digital data, the German police authorities have not yet had a system available that supports the work process of crime scene documentation in a digitally holistic manner.

The project INSITU (lat. in situ: "on site") aims to close this gap by providing a documentation system that enables a smartphone-based, digital crime scene documentation that ensures data consistency right from the start. INSITU is a software system consisting of a smartphone app and a web application as well as a shared data model. With the help of the INSITU app, forensic personnel can document evidence and describe the crime scene topologically and geometrically. This gradually creates a digital, multimedia model of the crime scene that comprehensively captures the situation. With the INSITU web application, the recorded crime scene data can be visualized, searched and analyzed.

At the EAFS 2022 we will present the results of a 3-year research phase (2018-2021) during which a demonstrator system with all relevant core functions has been developed that offers great potential for accelerating work processes and the efficient exchange of information. Based on the promising results of the research phase, the German police authorities are now pursuing the roll-out into live operation.



2 Jun

Abstract no: KN026



Keith Inman

| KEYNOTE

Leverhulme Research Centre for Forensic Science

How we look determines what we see

It is common for crime scene investigations to consist primarily of the technical exercise of scene processing, recovering obvious traces. The danger in this approach is that it passively guides the SOCO to specific types of objects without consideration of what is important (relevant) to the specific event in front of them.

Instead, the primary purpose of a thorough investigation is not merely to find, document, collect and preserve traces, but from the outset to consider matters such as the location and distribution of relevant objects, their orientation, their production and mechanism for transfer and retention, and their significance and relation to the act itself in order best to inform the final inferences about the investigated event.

Therefore, how we “look” at the crime scene determines what we see, find, document, and collect. This phrase applies both to our conceptual “looking” as well as to our physical looking. The SOCO/CSI individual is required to think scientifically, not merely mechanistically.

One aspect of crime scene investigation that receives insufficient consideration is the existence of other physical items that are a part of the background material, and whose presence might unavoidably be collected with the relevant traces. As laboratory analyses become more sensitive and specific, so too the collection of traces will require expansion into the collection of relevant background samples in order better to inform the inferences drawn during the interpretation and reconstruction stages. If we don’t “look” in these areas during the investigation, we lose the potential to “see” material that should properly be considered during the reconstruction.



2 Jun

Abstract no: OP195

**Alexander Smyth***Smytec Ltd, Market Harborough, United Kingdom*

| ORAL

BlindSite: Non-Contact Confirmatory Method for Visualization and Identification of Biological & Chemical Trace Evidence

BlindSite is an innovative patent-pending, digital, non-contact & non-destructive technology for the location, visualization and confirmation of trace evidence. It is handheld, portable, and can be used for searching a crime scene, visualizing and providing a confirmation of trace evidence. No prior treatments are required nor any specialized scene setup, useable in bright daylight or dark conditions. BlindSite can visualize and confirm blood and semen biological trace evidence, as well as estimating age of blood, leaving the evidence in situ for additional analyses to be performed, such as DNA. For chemical trace evidence, BlindSite can identify drugs and explosives, improving first responder safety, with various drugs and explosives having similar visual appearance to the human eye, such as TATP and MDMA. This is not via IR or Raman, both of which can induce vibrational energy at molecular level and ignite volatile explosives like TATP. The confirmatory identification of trace evidence is via integrated proprietary algorithms and additional hosted analytical applications.

BlindSite possesses a secondary live video camera, which continuously records the scene while in use. This saved live video feed can be referenced when interpreting evidence. Metadata is continuously recorded, including GPS time, date and positioning, increasing the integrity and robustness of evidence captured. All evidence and data can easily and quickly be integrated into various digital case management systems.

We present the scientific advancements incorporated in BlindSite and the benefits this brings to forensic practitioners, evidential quality, and interpretation from scene to court.



2 Jun

Abstract no: OP196



Céline Burnier

| ORAL

Ecole des Sciences Criminelles, Université de Lausanne

Investigation of transfer and persistence of condom evidence

Condom evidence has become in the past years a very relevant item of evidence in sexual assault or rape cases, being an objective help in the reconstruction of the activity. Traces recovered from a vaginal swab might help to identify whether a condom or other lubricants were used, and thereby possibly confirming or infirming allegations of the parties. However, the interpretation of condom traces can be challenging and requires a detailed understanding of various factors like condom lubricant chemical composition and occurrence on the market, transfer and persistence parameters and background.

Transfer and persistence studies can help in the interpretation of the results. Significant variations could be highlighted, with silicone compound such as PDMS being detected between 12- and 48-hours post-coitus. The difference in reported maximal persistence of silicone compounds makes the interpretation of traces complex and highlights the need for more investigation in terms of transfer and persistence. This is underlined by the fact that the time between an assault and the time of the collection of the trace is generally less than 24 hours, so being in a time span where different studies report different times of persistence.

This presentation aims to present the preliminary results obtained studying transfer and persistence parameters of condom evidence in the vaginal matrix, by going through the five main impact factors which are known to affect both transfer and persistence, aka the donor, the receiver, the contact, the time elapsed and the activity of the victim.



2 Jun

Abstract no: OP197

**Céline Burnier***Ecole des Sciences Criminelles, Université de Lausanne*

| ORAL

On the use of textile underwear as a support for condom evidence in rape cases

Condom lubricants have been found to be a new type of evidence to investigate and analyze in sexual assaults and rape cases. Casework studies highlighted two main types of trace evidence supports collected from the victim and send to forensic laboratories: cotton swabs and victims' underwear. If cotton swabs have been used in most of the recent published research papers, the underwear and the textile effects on the recovery of condom lubricants are under investigated although such studies are very important for the interpretation of the evidence, as highlighted in the Regina v. Andrew Nicholas Malkinson case.

Diffuse Reflection Infrared Fourier Transform Spectroscopy (DRIFTS-FTIR) and Attenuated Total Reflectance (ATR-FTIR) were used to investigate the content of various feminine underwear and the effect of a laundry procedure on the recovery of any type of evidence. The spectra obtained were qualitatively analysed based on visual observation before being subjected to chemometrics.

In a second step, silicone oil was deposited on the underwear and the latest were washed. Analyses were run prior and post laundry to evaluate the losses generated. With regard to laundry detergents, analyses were led to ensure they were not containing any silicones that could interact with the target compounds.



2 Jun

Abstract no: OP198

**Anouk de Ronde****| ORAL**

Amsterdam University of Applied Sciences, Amsterdam, The Netherlands; VU University Amsterdam, Amsterdam, The Netherlands

The evaluation of fingermarks on knives given activity level propositions

Nowadays, fingermarks are mainly used to determine the donor of a fingermark. While it is generally not disputed that a fingermark is indicative for direct contact between friction ridge skin and a surface, the activity that led to the deposition of the fingermark may be contested. This presentation demonstrates how Bayesian networks could help with the evaluation of fingermarks given activity level propositions.

A study was conducted in which a Bayesian network was constructed for a case in which the activity that was carried out with a knife was disputed. Case-specific experiments were conducted in which participants carried out two separate scenarios using a knife: stabbing and cutting food. The fingermarks were visualized and video footage of the scenarios together with the fingermarks on the knives were used to inform probabilities of the transfer, persistence and recovery of marks from particular areas of friction ridge skin to particular locations on the knife. The resulting Bayesian network can be used for the evaluation of fingermarks on knives given activity level propositions disputing the activity of stabbing or cutting food. However, in casework, comparison of the fingermarks with reference fingerprints of the suspect is usually required to determine the area of friction ridge skin that left the marks and video footage is generally not available. In a follow-up study, the experiment is replicated taking the quality of the fingermarks into account to study probabilities of transfer, persistence and recovery. We will discuss the differences between the two methods of evaluation and show the potential of evaluating fingermarks given activity level propositions.



2 Jun

Abstract no: OP199

**Geneviève Massonnet***Ecole des Sciences Criminelles, ESC, Batochime, UNIL-Sorge, Switzerland*

| ORAL

The use of Design of Experiments (DOE) for transfer and persistence studies: the example of soil transfer on shoes

Transfer parameters are very important in a forensic context to assess the evidential value of microtraces at the activity level.

Designs of experiments (DOE) allow studying the simultaneous variation of several parameters over an experimental range. The advantage of DOE, compared to a univariate approach, is the possibility to collect data and analyze them with proper statistics to obtain maximal information, such as important factors affecting the targeted response. DOE also allows to consider interactions between the different factors and to examine their effects, in order understand transfer or persistence data. The use of DOE, its advantages and limitations will be illustrated by the study of soil transfer on shoes.

In criminal activities, soil can be transferred from a crime scene to items linked with a perpetrator. Several parameters will influence the quantity of soil transferred. The knowledge of the most influencing factors can help the expert to assess the evidence at the activity level or to predict the amount of soil that can be expected.

In this study, the use of DOE enabled to determine which factors affect the most the transfer of soil on shoes and to obtain a more comprehensive overview of the transfer process. Five factors were selected: shoe profile, shoe size, weight of the person, type of soil and humidity.

The findings demonstrated that soil type and humidity are the determining factors in the soil transfer quantities. Moreover, it is the interaction between these two factors that is the most important. Our results highlighted that the higher the clay content and/or the humidity, the more influence on the quantity of the soil transferred to shoes.



30 May

Abstract no: OP200



Birgitta Rådström

National Forensic Laboratory (NFC), Sweden

| ORAL

Examination of Evidence Evaluation and Reporting in the Basic Training of Swedish Crime Scene Investigators

The educational programme for Swedish crime scene investigators (CSI) comprises four modules with specific scopes and increased complexity: i) volume crime ii) violent sexual offences iii) other violent crimes and iv) suspected arson.

Each module includes theory, practical exercises, a theoretical exam and investigation of a mock crime scene, evidence evaluation (“investigative crime scene analysis”) and reporting (written and oral). The participants work in pairs on the scenes, and oral feedback on their reports is given both by two other participants and by senior instructors.

Module iii) contains a formalized exam. Investigation and documentation of the scenes is done in pairs, as above, but the final evidence evaluation and the writing of the report is done individually. Each report is scrutinized by two senior instructors (a CSI + a forensic expert), and the participant gets both oral feedback (as above) and a detailed written feedback, stating what must be corrected for the participant to pass. In addition, the report is presented at a mock court trial.

The overall goal of this training, continued feedback and examination is to ensure that all participants leaves the programme with sufficient knowledge and skills not only in crime scene work but also in evidence evaluation and reporting.

In future, a separate examination module employing 3D mock crime scenes may be added to the programme. Such digital scenes are currently used in various exercises with positive results. 3D mock crime scenes can be customized to fit a certain theme while the details are “randomized” so that each participant investigates and reports on a unique crime scene.



30 May

Abstract no: OP202



Vincent Mousseau

| ORAL

School of Criminology, Université de Montréal; International Comparative Center for Criminology (ICCC); Laboratoire de Recherche en Criminalistique (LRC)

Learning on the field: A study of Quebec crime scene examiners' knowledge regarding the search for clues

Despite a sustained preoccupation with prioritization in the deployment of forensic resources within law enforcement agencies, courts, forensic laboratories and the academic community, decisions made during crime scene investigations have rarely been the subject of empirical study. In fact, even if some authors have proposed some theoretical models on how investigation should be conducted, only a few have taken interest in the actual practices of crime scene examiners (CSEs) on the field: how do CSEs actually search for clues? How do they choose which investigative strategies to be deployed? Despite little attention from researchers, this first stage of the investigation is nevertheless decisive for the rest of the judicial process. This presentation thus intends to contribute to a better understanding of how CSEs learn to decide and prioritize their research efforts in the context of crime scene inspection. To do so, 17 semi-structured interviews and around 100 hours of ethnographic fieldwork have been completed with and along crime scene examiners in Quebec (Canada). Our preliminary results shed light on the leading role of professional socialization for CSEs in the development and consolidation of tacit knowledge on which their decision-making is based. It also highlights that experience, rather than training, seems to provide rules-of-thumb, or heuristics, on which crime scene examiners really rely to make decisions when looking for clues on crime scenes. These results thus invite to reflect on the content, and form of trainings dedicated to future crime scene examiners.



30 May

Abstract no: OP203



Amy van Bilzen

| ORAL

Operational Science and Technology, Australian Federal Police

Police Recruit Gradual Exposure to Deceased Persons: task oriented & compassionate approach to death & traumatic scenes

Crime Scene Investigators (CSI) process death scenes & work on disturbing scenes as a way of emotional desensitisation. Traditional training satisfied management demands of reaching operational capability at the expense of welfare. Training involved coaching from senior colleagues, inconsistent if that member did not have good coping strategies. Grief response develops when traumatic memory is not processed due to avoidance. Unsupported exposure contributes to absenteeism, reduced mental health & in extreme circumstances, self-harm. External consultation identified a lack of training programs that gradually exposed the CSI to trauma. In 2018, a 5 phase program was developed: minimise psychological harm, exposure to various death stages (morgue/field) & psychologist support with coping strategies & phase progression, emphasis on tasks & develop a culture of understanding. Some members were found unsuitable, self-identifying due to life experiences or psychological triggers. An early intervention & harm minimisation program had been initiated: where to now? Police often investigate death & engage with those who experience trauma. Little death awareness training existed, the focus predominantly administrative, rather than psychological. In 2020, a recruit trial commenced: task-oriented approach for police & to normalise not being ok. 3 phases: loss, mental health, identifying their role at the scene, understand post mortem change & develop realistic expectations. The recruit program provides recognition tools for vulnerability and being comfortable in that space to conduct duties. The ability to cope and respond effectively reduces stress on the member, friends & colleagues.



30 May

Abstract no: OP204



Sami Huhtala

National Bureau of Investigation, Forensic Laboratory

| ORAL

Untapped ground – assessing best practices for soil sampling in Finland from forensic perspective

The number of environmental offences has increased globally during last decade. These offences are typically financially motivated crimes. National legislation, police investigation and forensic processes vary within the EU. Documentation and verifying the effects of environmental offences may require environmental sampling. Most guidelines and standard methods in environmental sampling have been developed for environmental monitoring. In general, collecting representative environmental samples can be challenging because matrix is usually heterogenous and sampling requires expertise on natural sciences, e.g. environmental chemistry.

We discovered that the essential elements of environmental offences are described complicatedly in the in the national legislation in Finland. Thus, determining the effects of illegal activities of environmental offences is difficult.

We recognized a knowledge gap between law enforcement and environmental protection officials when assessing soil sampling procedures in an environmental crime investigation context. This might be due to the differing interests and viewpoints of different actors and institutions. Forensic perspective has been largely neglected in sampling related to environmental offences. There is a need for development of sampling methods that incorporate forensic approach. Multidisciplinary approach and more active communication within and between different authorities are essential and should be developed in cooperation. A list of best practices for soil sampling was created. Emphasis was on formulating clear objectives and research questions that fit the needs of investigation



1 Jun

Abstract no: **OP201**



Benny Thomsen

| **ORAL**

Danish National Police, National Forensic Services, Crime Scene Section, Fire investigation Unit

Is it possible to do a good Fire investigation in Virtual Reality? Investigation In Real Life vs Virtual Reality

It was a unique opportunity with the creation of three crime scenes that were set on fire. The objective was to train forensic science investigators. The scenes included homicide and arson and was digitally documented in order to give us a virtual village with different types of scenes.

This presentation will show the result of a comparison of investigation on three different fire scenes investigated by trained fire investigators. The comparison will show pros and cons for using virtual reality as an investigation and training tool.

Three teams of fire investigators (both experienced and new) conducted the investigations in real life and the other three teams investigated the same scenes but only in virtual reality. The presentation will show the results of these investigations, evaluation from the fire investigators experiences and evaluation of the quality of the investigations done.

Included in the presentation is the result of different ways to use both IRL and VR in maintaining the qualifications of trained fire investigators as well as give unexperienced investigators methods of conducting investigations of fire scenes.

The image features a dark blue background with the European Union flag's twelve yellow stars arranged in a circle. A central black hexagonal box with a red border contains the text "EUROPEAN PERSPECTIVE". White, wavy, multi-line decorative elements flow across the scene, starting from the top right and bottom left corners and curving around the central text box.

**EUROPEAN
PERSPECTIVE**



2 Jun

Abstract no: KN020

**Erkki Sippola***NBI Forensic Laboratory, Vantaa, Finland*

| KEYNOTE

ENFSI collaboration and communication in the international playground

Networking is typically sharing of information, but it is also a form of collaboration. ENFSI has the purpose of improving the exchange of information in the field of forensic science.

Forensic science is a multidisciplinary collection of scientific principles and techniques that are applied to matters of criminal justice. The number of expert areas still grows constantly.

ENFSI alone has 73 member organisations coming from 39 countries and employing thousands of experts. ENFSI is a member of the International Forensic Strategic Alliance and ENFSI has agreements with international organisations such as Europol, CEPOL, Eurojust, EA and ILAC. To achieve the goals of ENFSI, huge number of organisations and persons needs to be reached.

The world is currently full of communication tools and platforms. Still the email system is typically the most frequently used tool – also for ENFSI activities – as it is easy to use and available to everyone. However, email system alone is not enough.

Permanent information cannot be published by email only. Organisations typically use web sites for this purpose. Most information is public, but sometimes it is confidential. Additionally, communication automatically creates the need to store information and documents – i.e. to archive data. The applied tools should also support these needs.

ENFSI has acquired various tools to exploit all these features. For example, Europol being one of the main partners of ENFSI, has made their communication platform EPE available to the ENFSI community.

This presentation discusses about the recent development in ENFSI collaboration and communication, including challenges and achievements.



2 Jun

Abstract no: KN021

**Nada Milisavljevic****| KEYNOTE***European Commission – DG Migration and Home Affairs (HOME)*

Forensics – EU Security Research and Innovation Perspective

New and emerging technologies provide opportunities to various aspects of forensics and that is one of the angles where the EU security research programme has been providing support for years, with the aim of improving European investigation capabilities to fight crime and terrorism. Needless to say, challenges are numerous. For instance, in conventional investigations, rapid and near real-time forensics often plays a crucial role in preventing subsequent crimes. On the other hand, with the ever increasing digitalisation of society, virtually any type of crime can have its digital component, which creates a challenge as well. Within the EU security research efforts, various cross-cutting aspects have also been analysed, such as the issue of a lawful court-proof collection of crime evidence, curricula for the training of forensic investigators to use these new tools, or methodologies to compare results produced by forensic organizations across Europe to contribute to the EU-wide consistency of forensic work. Furthermore, research can help understanding how human interaction, in the European context, impacts on decisions at all levels of an investigative process as well as develop methods to avoid biases and improve European common forensic investigation capabilities and cross-border exchanges.

This talk will give an overview of the work covered by the EU security research and innovation regarding forensics, opportunities that this programme offers in this sense, and provide some ideas as well as open questions regarding its perspective from various angles, such as the active involvement of forensic institutes and police authorities in the process, the role of policy, etc.



2 Jun

Abstract no: KN031



The Quality and Competence Committee (QCC). QCC

| **KEYNOTE**

QCC, Wiesbaden, Germany

The effectiveness of the deliverables of Monopoly Projects

The presentation will exemplarily show some of the impact and effectiveness of the deliverables of Monopoly Projects particularly around

- Best Practice Manuals and Guidelines,
- Proficiency and Collaborative Tests,
- Databases,
- Quality Assurance procedures and
- Training and Education.

The impact of the products of the Monopoly Projects has shown to last well beyond the projects. There is evidence to show that new activities are undertaken by ENFSI and laboratories within Europe still rely on some of the deliverables from Monopoly projects showing their long-lasting effects.



2 Jun

Abstract no: OP205

**Kornelia Nehse**

| ORAL

State Criminal Police Office, Forensic Science Institute – LKA KTI, Berlin, Germany; European Network of Forensic Science Institutes – ENFSI, Wiesbaden, Germany

A European approach to share forensic data to assist forensic examination and criminal investigation where to from now?

Forensic science relies on collections of information and databases. Many such databases have been developed in individual European forensic laboratories or by the working groups of the European Network of Forensic Science Institutes – ENFSI. The exchange of such information has been actively supported by ENFSI for many years to ensure data availability for all member institutes.

Finally, ENFSI was supported by the European Union Internal Security Fund to develop a set of selected examples of next-generation databases in different forensic areas.

In addition to the newly developed or improved databases in specific forensic areas to be shared at European level, an overarching concept has been developed to show that different European forensic databases can be integrated.

Sharing forensic databases across Europe is highly desirable in order to avoid duplication of work and to provide the basis for a better understanding of laboratory results and their relevance. This is intended to strengthen the evidentiary value of findings.

The linking of data and databases provides the opportunity to implement information from the crime scene, as well as new analysis tools and advanced methods of data analysis and statistical interpretation to advance the forensic process from crime scene to court and to support the analysis and interpretation work of forensic scientists and law enforcement authorities in solving crimes.

Courts can benefit from digital documentation and strengthened forensic results in their administration of justice.

How to use and share information across forensic examination and investigation originating from these databases is a challenge for the future.



2 Jun

Abstract no: OP206

**Peter van de Crommert***DITSS, Netherlands*

| ORAL

CYCLOPES: building an innovation-driven network of European LEAs combating cybercrime

The CYCLOPES H2020-project aims to build and maintain an innovation-driven network of LEAs combating cybercrime – accelerating the EU’s ability to counteract growing pressures of cyber threats. Dedicated teams will scour markets, identifying solutions and research activities to highlight actions and innovative products to assist LEAs tackle the complexity of cybercrime. All CYCLOPES outcomes will be suitably considered for exploitation – helping to propel the EU in the fight against cybercrime. Practitioners’ workshops, annual conference and joint live exercises are a driving forces behind the project and cover three 3 domains:

- Cybercrimes that directly affect systems
- Cybercrimes that directly affect people
- Digital forensics

The Digital Forensics impact area will be achieved through several actions. One of them is related to the practitioners’ workshops, where the specialist team distinguishes the current capabilities, but also the gaps and requirements of practitioners working in the Digital forensics areas of cyber-related crime. Moreover, the expected impact will be achieved through the annual Joint Live Exercises. The events will be organised in facilities prepared for testing and training (including areas used for digital forensics, which mostly require sophisticated tools, computers and software to conduct training and testing). It is planned to use the premises of consortium partners (i.e. TNO, SPA), but also external institutions that have expressed their willingness to support the CYCLOPES project. A policy paper on digital forensics foresight will be delivered by ZITIS partner around the EAFS conference and will be part of this presentation.



2 Jun

Abstract no: OP207

**André Saraiva***Forensic Science Laboratory, Lisbon, Portugal*

| ORAL

Development of a Forensic Multilingual Voices Database

The variety of the languages spoken in Europe has proven to be a difficulty for forensic automatic and semi-automatic speaker recognition, given the absence of adequate reference populations of voices in languages other than native languages, or native languages spoken by foreigners. These reference populations play a key role in generating statistical models for this type of forensic examinations.

In addition, the COVID-19 pandemic represents a new challenge for forensic speaker recognition given the mandatory use of protection masks in almost every daily situation, as these act as voice barriers or filters.

Started in January of 2022, a work package, part of the EU-funded CERTAIN-FORS project, aims to tackle both issues by developing a voice samples database to be shared with ENFSI FSAAWG members. It will be built with samples obtained from individuals speaking native and non-native languages, both with and without protection masks.

All FSAAWG members will be invited to contribute to the collection process using a pre-defined protocol. Samples should be collected from volunteers, avoiding data protection and biometric regulations. The project team will carry out data compilation, characterisation, database testing and dissemination of results.

The execution of this project will allow the improvement of the forensic expert's daily work and resources optimization, increasing the exchange of data, information, and experience between ENSFI members, enabling a better characterization of the speakers in each country and facilitating the elaboration and performance of PT and CE.

The development state of the project and preliminary results will be presented and discussed.



2 Jun

Abstract no: OP208

**Friedrich Grone**

| ORAL

DBI- The Danish Institute of Fire and Security Technology

EU FireStat – possibilities and Impact of fire investigation results on fire statistics and prevention measurements

An ongoing EU pilot-project called EU Fire Stat – Closing data gaps and paving the way for pan-european fire safety efforts is carried out by a consortium composed of nine international fire safety institutions based in Denmark, France, Germany, Netherlands, Russia, Spain, Sweden, Turkey, UK and USA. The main aims were to map the existing fire data already collected across the EU members states and propose meaningful data sets to allow knowledge based decisions regarding fire safety and prevention in the member states but also on EU-level.

The presentation will try to give a studybased overview of the present situation of fire-statistics in various countries, specifically with regard to different data collection methodologies and dataset variables and values. Particularly the challenges of obtaining valid investigation data and transferring it into the national and international statistics, status quo and desired methodology, will be discussed. In addition some examples will be given, how different terminology and/or collected variables and values can lead to wrong and incomprehensive statistics. Part of the project was therefore also to propose a common terminology to get comparable and reasonable statistics fire prevention and security measurements could be based on.

Some proposals for reaching the aim to be able to incorporate the best possible and most valid fire investigation results into fire statistics and thus also to increase fire safety will be given and can be seen as the challenge for a future methodology ranging from the collection of evidence to technical expertise, comparable terminology and data collection.



2 Jun

Abstract no: OP209

**Simon Baechler****| ORAL**

Ecole des Sciences Criminelles, University of Lausanne, Switzerland; Head of forensic science and crime intelligence, Police neuchâteloise, Switzerland; Forensic Research Group (LRC), Université du Québec à Trois-Rivières, Canada; Centre International de Criminologie Comparée, Montréal, Canada

Forensic profiling of fraudulent identity and travel documents to fight organised crime: the European ProFID ISF project

An innovative forensic profiling system, called ProFID, was developed in Switzerland and is now expanding in Europe thanks to an Internal Security Fund – Police granted by the European Commission over 2021-2023 (ISFP-2020-AG-POLCOP). The ProFID system is intended to produce forensic intelligence and aims to detect and investigate criminal networks or terrorist groups that produce, distribute and/or use fraudulent identity and travel documents.

The method and tools to enable the systematic comparison of fraudulent documents as well as the detection and management of series within the ProFID system will be presented, showing how humans (forensic document examiners) and machines (computer imaging and data processing techniques) may pool their respective strengths to highlight and trace back the activity of criminal networks.

Results gained since 2017 through the use of ProFID in Switzerland show that half of the 2'600 fraudulent documents profiled in the system are forensically linked, leading to the detection of more than 200 series. Several of these series led to initiate joint investigation teams in order to prevent further use of such fraudulent documents and to trace back their source. Similar compelling results were obtained in the framework of a cross-border pilot project involving France and Switzerland, with about 20% of fraudulent documents making transnational links.

Building on these convincing results, the presentation describes the ProFID ISF project, its objectives, roadmap, stakeholders and challenges. It underlines the key contributions of forensic document examination in an intelligence-led policing perspective.



2 Jun

Abstract no: OP210

**Francesco Zampa**

| ORAL

RaCIS - Carabinieri Scientific Investigation Service (R.I.S.), Parma - Italy

Multidisciplinary collaborative exercises: lessons learnt and perspectives within the EU funded ENFSI Monopoly Projects

Historically collaborative exercises (CEs) have been solely single forensic discipline specific. An EU funded project (STEFA Monopoly Project 2016, Work Package G3), carried on by DNA, Fingerprint, QD and Handwriting ENFSI WGs run a CE that addressed multiple forensic disciplines involving interaction between laboratory-based practices. The design, the developing and the validation of this collaborative exercise will be described, mentioning some of the significant issues that impacted on its development progress. The collected results of the participating laboratories will be presented, as well as suggested working practices to maximize forensic evidence.

This lecture will also explain how the lessons learnt from STEFA experience will guide the ongoing CERTAIN-FORS Monopoly Project 2020, Work Package 9. Two new multidisciplinary collaborative exercises will be prepared and offered to the forensic community in 2022/23. For the participating laboratories these CEs will constitute useful instruments to demonstrate the reliability and the accuracy of their processes and services provided.



2 Jun

Abstract no: OP211

**Tomasz Dzedzic***Institute of Forensic Research, Krakow*

| ORAL

STEFA G03 – Joint Collaborative Exercise for Document Examination, DNA, Fingerprints and Handwriting

As part of the 2016 ENFSI Monopoly Grant from the European Union, a series of ten projects were selected to form the overarching project “Steps Towards a European Forensic Science Area (STEFA)”. This project formed a strategic element of the ENFSI Horizon 2020 project.

STEFA G03 related to the development of a “Collaborative exercise covering the forensic disciplines of DNA, document examination, fingerprint examination and handwriting examination”. This presentation will describe the processes involved in developing the first pan-European Collaborative Exercise, focusing on the concepts, planning, design, preparation, implementation, co-ordination and evaluation of the CE.

The results of this project demonstrate that it is feasible to develop and run a multidiscipline forensic Collaborative Exercise with results that can help to develop best practice and procedures for examining threatening letters in the future.



2 Jun

Abstract no: OP212

**Bart Nys****| ORAL***Nationaal Instituut voor Criminalistiek en Criminologie – NICC/INCC*

The ENFSI Research and Development Standing Committee : Past, Present and Future

The European Network of Forensic Science Institutes is perhaps best known for its seventeen Technical Working Groups, uniting over a thousand forensic scientists in their respective communities based on their forensic disciplines. The ENFSI community, however, also comprises of two supporting permanent committees which have a specific task and report directly to the Board of ENFSI. There is the Quality and Competence Committee (QCC), best known for its work in the support of forensic scientists in reaching and maintaining the required quality and supporting competence testing of labs. And there is the Research and Development Standing Committee (RDSC), which supports the forensic community in a number of ways to ensure that their knowledge and skills are at the forefront of technology and that the Board is assisted in making scientifically sound strategic decisions. Last but not least, the RDSC assists in the organisation of the tri-annual European Academy of Forensic Science Conference (EAFS).

In the presentation, an account will be given of some of the past activities of the RDSC, together with an overview of its current missions – as defined by the Board in its Strategic Plan 2020–2023. Finally, as ENFSI is working towards becoming a recognised, globally present, professional organisation, our collaboration with forensic scientists, the scientific community, established global networks and our partnership with sponsoring organisations will become increasingly important in the near future. This aspect of the ways RDSC will help to attain these strategic goals will be the subject of the final part of the presentation : discussing the future of the RDSC.



2 Jun

Abstract no: OP213

**Charles Berger**

| ORAL

Leiden University, Leiden, Netherlands; Netherlands Forensic Institute, The Hague, Netherlands

The New ISO 21043-4 Standard for Interpretation in Forensic Science

The worldwide ISO-21043 Forensic Sciences standard has been in the making for several years.

The author was lead editor for Part 4: Interpretation.

In this talk the audience will be introduced to this new standard, which for the first time addresses forensic interpretation specifically.

The interpretation standard is structured around types of questions and types of answers, the use of multiple propositions to make questions explicit, and the assignment of probabilities to express opinions.

The ideas behind the structure and content of this standard, common misconceptions, challenges in drafting a worldwide standard for forensic interpretation, and the consequences for forensic science in the coming years will be discussed.



2 Jun

Abstract no: OP214

**Andra Sirgmetš**

| ORAL

Estonian Forensic Science Institute, Tallinn, Estonia

Use of Facial Recognition in the Investigation of Crime across EU Member States

The increasing number of surveillance cameras installed in public places and the wide use of image capturing devices means that criminal activities are ever more likely to be recorded. Thus, the broad availability of facial images, creates a huge potential for facial recognition (FR) to contribute towards the fight against crime and terrorism on both national and international levels.

While the technology has much potential for combating crime, the use of FR in the investigation of crime varies a lot across the EU Member States. Some Member States have not yet started to consider the technology, others are beginning to set up FR infrastructures ready for implementation, whilst yet others have been using the technology for several years or even for well over a decade.

An extensive study on the current use of FR in relation to criminal investigations in the EU Member States was conducted between 2019–2020 by a group of six European forensic and police authorities in the context of a project “Towards the European Level Exchange of Facial Images” (TELEFI project) funded by the European Union’s Internal Security Fund – Police. In addition, the TELEFI project considered the potential for facial image exchange within the Prüm framework. The key findings and recommendations of the TELEFI project will be summarised in this presentation.



2 Jun

Abstract no: OP268

**Valentina Zuri***Europol*

| ORAL

Supporting law enforcement innovation in Europe: the experience of the European Clearing Board

The European Clearing Board (EuCB) was launched by the Europol Heads of National Units in 2020. It is composed of Single Points of Contact from the Europol Innovation Lab, all EU Member States and the four Schengen-associated countries.

Its mission is to provide a forum for subject matter experts and investigators to:

- Convey requirements to the technical and strategic level
- Translate research results into practice
- Raise awareness of ongoing initiatives and projects
- Exchange experiences and lessons learned
- Prevent duplication of overlapping initiatives in Europe

Within the EuCB, members can share and co-create innovative and pragmatic case-specific tools and solutions that address their operational needs.

To achieve this, EuCB members (i) share Requests for Information (RFIs) to learn more about how other members deal with a specific problem, whether they have developed or are using an existing solution; (ii) gather in Groups with nominated experts to work on a single topic. Each Core Group focuses on a specific technology: based on a work plan, technical experts co-develop innovative tools. Strategic Groups focus on academic, policy and legislative debates around topics of interest to law enforcement, and where possible develop a common law enforcement position.

In less than two years, the EuCB launched 10 RFIs and 10 Groups on a variety of topics, including entity extraction from ID images, facial recognition, artificial intelligence, speech/text analysis.

This presentation aims at illustrating the EuCB as a success story of collaboration within the European law enforcement community and at explaining how EAFS delegates can benefit from it.



2 Jun

Abstract no: OP269

**Anneli Ehlerding**

FOI, Swedish Defence Research Agency

| ORAL

EXERTER, Security of Explosives pan-European Specialists Network

EXERTER, Security of Explosives pan-European Specialists Network, is a H2020 network project for explosives specialists. It connects 20 practitioners from 13 EU member states, and in addition includes a wide community of practitioners, researchers, industry and government across the world.

The project aims at increasing the exchange of information and be a link between practitioners, academia, industry, research organisation and other stakeholders in the field of explosives. In discussions within EXERTER, areas in need of development, or recommendations and ideas for improvements, are highlighted and put forward. EXERTER focus on the explosives threats in various situations, but are also extending the discussions to a wider view on countering current and emerging terrorist threats.

Each year, EXERTER defines a theme, or a set of scenarios, and use it as a basis for discussions around needs, requirements, gaps and ideas with practitioners and other stakeholders. Based on these discussions, research findings and issues related to certification and standardisation connected are identified and brought up for discussion and presentation to the community. The discussions are ongoing through multiple EXERTER webinars, workshops, annual conferences and other meetings within the community.



2 Jun

Abstract no: OP270

**Costas Kalogiros**

AEGIS IT Research

| ORAL

Automating Crime Investigation with Autocrime platform

Law enforcement practitioners need to be able to efficiently and successfully investigate a large number of criminal cases at the same time, while following relevant ethical guidelines. This calls for an efficient way to analyse potentially relevant information and automate the most time-consuming tasks. The ROXANNE autocrime platform will enhance criminal network analysis capabilities by providing a) a suite of multi-modal technologies for extracting evidence and actionable intelligence and b) an effective and intuitive forensics visualisation scheme that streamlines the discovery, presentation and evaluation of these insights.

Key backend technologies of autocrime include Speaker Identification, Automatic Speech Recognition and Natural Language Processing, as well as criminal Network Analysis for identifying communities, etc. Furthermore, autocrime offers an intuitive user interface supporting (criminal) network analysis for understanding how entities interact and uncovering patterns of interactions on the temporal dimension, equipped with advanced filtering for narrowing down the results according to users' criteria. Taking for granted that human expertise and judgement is key, autocrime allows practitioners to judge and update the outputs (e.g., by suggesting changes to the speaker identification/ clustering) so that the AI-based technologies are improved in the long run.

The added value of autocrime platform has been evaluated using a synthetic dataset for a fictional drug-dealing case that includes more than 100 target phone calls and related metadata (i.e., CDR info) and is currently being extended to process additional document types such as images or videos.



2 Jun

Abstract no: OP271

**Eva Škruba***EACTDA, San Sebastian, Spain*

| ORAL

EACTDA and Tools4LEAs project

EACTDA is a European non-profit association that includes ministries of interior, law enforcement agencies and other public entities fighting cybercrime, as well as universities, research and technology organisations and private companies.

EACTDA is responsible for the successful implementation of the Tools4LEAs project, an EC co-funded project. EACTDA and the Tools4LEAs project aim to establish a long-term and sustainable structure to deliver on a regular basis fully tested and operational-ready tools (mainly software) to EU public security entities, with no license cost and access to the source code.

EACTDA focuses on further development of pre-existing prototypes and tools in what we call “last-mile development projects” and on the uptake of those technological solutions by the EU public security entities. The typical maturity level of the pre-existing prototypes would be around TRL 6-7 and within the Tools4LEAs project it would be enhanced to a TRL 8. Therefore, it is very important for EACTDA to reach an agreement with technology providers on the exploitation and licensing terms and conditions.

EACTDA is an end-user driven organisation by-design. During the EAFS conference, we will present the role of the end-users in the process of identification and prioritisation of end-user needs, as well as the evaluation and adoption of the results. We will also introduce the details of the collaboration with technology providers.



2 Jun

Abstract no: OP272



Coert Klaver

Netherlands Forensic Institute

| ORAL

FORMOBILE project results

The Formobile project just ended after three years of hard work. The overarching objective of FORMOBILE was to establish a complete end to end forensic investigation chain, specifically for mobile devices. We have looked at mobile device acquisition, - decoding, - analysis, legal and ethical issues, training and standardisation. In this talk we will very shortly highlight the key results of the project and dive deeper in some research tools that have been developed; tools and methods for RAM acquisition in live phones, RAM decoding tools and an eMMC emulator.



2 Jun

Abstract no: OP273

**Katrijn Vandersteen****| ORAL**

Belgian Nuclear research Centre SCK CEN, Crisis Management & Decision Support Unit, Mol, Belgium

How the EU strengthens crime scene forensics capabilities in investigating CBRN incidents: an example from the Western Balkans and the Black Sea Region

The European Union Chemical Biological Radiological and Nuclear Risk Mitigation Centres of Excellence Initiative (or EU CBRN CoE) was launched in response to the need to strengthen the institutional capacity of countries outside the European Union to mitigate CBRN risks. These risks may have an intentional, accidental or natural origin. The countries that join the initiative, work together in eight regions, headed up by a secretariat at regional level. The project that is presented here, called Project 57, has been implemented in 9 countries in South East and Eastern Europe.

Project 57, which ran from 2017 until 2020, was created with the intention to strengthen the forensics capabilities of the crime scene investigators and forensics institutions in the environment of a CBRN incident. The project was implemented by a consortium consisting of the Belgian Nuclear Research Centre (SCK CEN), the Netherlands Forensic Institute (NFI), the National Institute for Public Health and the Environment of the Netherlands (RIVM), the International Security and Emergency Management Institute of Slovakia (ISEMI), the National Institute of Criminalistics and Criminology of Belgium (NICC) and the Forensic Science Centre Ivan Vucetic of Croatia (FSI IV).

The aim of the project was threefold: (1) to strengthen the existing traditional forensic capabilities in investigating CBRN incidents among police experts; (2) to develop a training system on forensic investigations in CBRN-related cases, and (3) to foster the establishment of networks of CBRN and forensics-related institutions and networks of forensics experts dealing with CBRN-related investigations at the sub-regional level.





2 Jun

Abstract no: OP277



Patrick De Smet
NICC, Belgium

| ORAL

The ValiD project: IT forensic tools test and validation database

There is an over-arching requirement for forensic service providers to validate complex digital forensic processes (known as Method Validation), for example, to achieve accreditation to ISO/IEC 17020, 17025 or generally to achieve best evidence. The validation of a provider's methods in digital forensics is a huge undertaking. Whilst the precise validation process created by each provider will be unique to that individual provider there will be commonality in the forensic tools that they use. It is the purpose of this project to bring together the common elements of digital forensic tool testing and validation into one validation database to minimise the repetition of the same tests, share the burden of testing, benefit from the scrutiny of many reviewers and enable the sharing of the data and experience across the ENFSI and other European digital forensic service providers. This will increase the robustness of digital forensic evidence in the criminal justice systems across Europe. The work will devise methodologies (i.e. protocols and procedures), for: (i) the creation of ground-truth atomised data sets, (ii) tool testing, and (iii) the estimation of errors (limitations and uncertainty) in tool output. These methodologies will, in themselves, be a legacy of the project, as will also be the production of real results for each of the point mentioned above and the construction and population of the ValiD database containing all the available and produced data sets, testing results and information, etc.

This project was funded by the European Union's Internal Security Fund — Police (ISFP-2016-AG-IBA-ENFSI: STEFA-G6/ValiD).



2 Jun

Abstract no: **OP278**



Constantinos Patsakis

| ORAL

The LOCARD project

Digital evidence has become an integral part of most criminal investigations. Nevertheless, in most cases of digital crimes the first responders are not LEAs. This creates a very heterogeneous set of interactions among different stakeholders from the private and the public sector. Even more, digital evidence is most likely not hosted in the same jurisdiction where the crime was committed or from which it originates mandating the exchange of digital evidence across jurisdictions. LOCARD aims to facilitate the management of digital evidence and their exchange keeping track of the chain of custody in blockchain so that it is transparent and immutable and all actions are recorded, authorised, and can be traced back. This talk will present the main concepts behind the LOCARD, how it homogenises the procedures and demonstrate the platform.

EURS OPEL



FORENSIC MANAGEMENT

person

person

suitcase

handbag



“Doing the Right Thing”



1 Jun

Abstract no: KN030



Annemieke De Vries

Netherlands Forensic Institute

| KEYNOTE

Innovation for the forensic questions of tomorrow

The Netherlands Forensic Institute is the leading forensic research and knowledge institute in the Netherlands. We independently answer complex, criminalistic questions. The institute has three core tasks: case research, innovation and knowledge exchange that are inextricably linked. The NFI consists of approximately 650 employees in more than 35 areas of expertise that are linked by the joint mission: Focused on truth. Guided by science. For a safe society.

Technological, scientific and social developments are moving fast; it is therefore important for a forensic institute to anticipate timely and to continuously improve the forensic investigations. At NFI this is done by – in addition to our major focus on case research – substantially investing in knowledge and innovation. Science and innovation are therefore strongly driven by experiences from forensic practice. In addition to the technological and process-based improvements of forensic case research, we have developed a thematic knowledge and research agenda to guide our research initiatives aimed at broader scientific and social developments relevant for the tasks of our institute. For this, we closely collaborate with various scientific research institutes in the Netherlands as well as Internationally with ENFSI partners.

In this way, the NFI can not only answer the forensic questions in an adequate manner today, but is also ready for the forensic questions of tomorrow.



30 May

Abstract no: OP217



Martina Nilsson

Swedish Police Authority, Stockholm Region, Forensic Section Stockholm, Sweden

| ORAL

Increased potential of forensics in sexual assault crime investigations

The handling of investigations involving sexual assault crimes in the Stockholm Police Region, Sweden has been evaluated. Despite the fact that the estimated number of unknown cases not reported are high (80-90%), approximately 1500 rape and rape attempts are reported in Stockholm each year, of which around 10% leads to prosecution.

The rape and rape attempt cases have been evaluated regarding parameters including the frequency of contact with forensic specialist, requests of crime scene examination, the handling of sexual assault kits (SAKs) and the number of performed forensic analyses of secured evidence. With these data at hand, great potential of improvement was demonstrated to ensure more robust investigations of sexual assault crimes.

The project Sexual crime investigation 2.0 was initiated with the ambition to increase the awareness and actions taken within this crime category, with focus on an increased forensic ambition. The goals of the project were to accomplish more robust investigations where all relevant actions are performed, support the legal system for an increased confidence and to achieve higher rates of prosecution. Education regarding forensic possibilities, the legal requisites, norms and attitudes have been performed to increase competence and awareness among wide targeted audience within the Stockholm Police Region. Moreover, efforts have been made to formalize more adequate evaluations for the future handling of sexual crimes. As a consequence of the project, several improvements and positive effects have been observed, that will be presented further at the conference.



30 May

Abstract no: OP218



Eva Wettborg

| ORAL

Swedish Police Authority, Stockholm Region, Forensic Section Stockholm, Sweden

Sexual assault kit backlog in Stockholm Police Region, Sweden – Project Victoria

In order to ensure a legally secure handling of traces from plaintiffs and suspects in rapes, national guidelines for sexual assault kits (SAKs) used in sexual crime investigations were introduced in Sweden in April 2018. The national guidelines were further implemented in the Stockholm Police Region on January 1st 2019, where the Forensic Section collects and administers the SAKs from the medical examinations of the plaintiffs and the suspects. An evaluation of the handling of sexual offenses demonstrated that the new guidelines were necessary, since it was only in approximately 50% of the cases possible to track if SAKs existed and where they were stored.

During introduction of the new guidelines, it was decided to initiate project Victoria, where more than 560 SAKs in 450 cases were further administered (the oldest crime was reported in 2005 and the youngest in 2018). During the project, the SAKs were collected, inventoried and legally assessed regarding the possibility of investigating the case further, to see if traces could be sent to the National Forensic Center for new or additional DNA analyses or to National Forensic Medicine for toxicology analyses. In addition, the decisions to archive or destroy the samples in the SAKs could also be made.

The results of the project with information of some of the investigations and the additional DNA analyses performed will be further presented at the EAFS conference together with representatives from the National Forensic Centre (NFC).



30 May

Abstract no: OP225



Sheila Willis

Leverhulme research Centre for Forensic Science, University of Dundee, Dundee, Scotland, UK

| ORAL

WHAT are the BARRIERS to FORENSIC SCIENCE PROFESSIONALISING?

At EAFS 2015 in Prague I explored whether or not forensic science had the characteristics of a profession from a sociological viewpoint. Many of the characteristics were present and in this presentation some seven years on, I discuss whether the discipline has moved closer or further away from being a profession. I will include the role and inference for professional bodies.

Initiatives exist that affect forensic science in a general way. Accreditation which has the approval of a wide part of the sector is an extremely useful management tool but it does not define the discipline. Evaluative reporting could help in this direction but a sufficiently large number of people seek data which may never be enough and discard the framework preventing it's universal adaption.

All the while criticisms continue and solutions are suggested. This is a little like Mintzberg's adhocracy model where problems and solutions exist and we hope a suitable solution will meet the appropriate problem. Meanwhile the sector grows in complexity and sub disciplines multiply.

This is very evident in the field of professional bodies where there is a tacit acceptance that there is a need for a professional body for forensic science but the allegiance of many of its members is to some other discipline such as Chemistry or Medicine. Forensic Science is discussed but other than a trivial definition of use of science in court, we struggle to define it in a way that assists professionalisation.

This gap has been addressed by the definition and principles set out in the Sydney Declaration. Adaption of these principles would help the discipline to professionalise and for professional bodies to add value.



31 May

Abstract no: OP215



Lena Widin Klasén

| ORAL

Department of Electrical Engineering, Linköping University, Sweden; Office of the Police Commissioner, Swedish National Police Authority, Sweden

Digital Forensics Sweden – a network that brings together Swedish expertise in digital forensics

Digital Forensics Sweden is since 2018 a network that brings together expertise to exploit and evolve digital forensics for the future. The goal is to form a national research center that provides excellence and acts in a rapidly changing global context to meet the strain on our society brought by crimes evolved in the digital era. A survey was conducted in 2021 to understand the partners need and to prioritize actions. 26 partners were interviewed, all being highly engaged and open minded. The questionnaire focused on 5 questions; daily operations, research and business needs; what is needed from the center; what can be provided to the center; observed trends in digital forensics, and not the least; what's needed to communicate to the political arena. This work presents the outcome of the survey. The result shows, for example, a rapid increase in digital forensics employed at companies. Highlighted is the strain on management brought by a rapidly increasing cyber-attacks and thus more digital investigations. Moreover, lack of higher education such as master programs is reported. Partners also report willingness to eg harmonize methods and are interested in cooperation in the network. This is to ensure uniformity in investigations among actors in law enforcement, but also increased quality at companies and efforts to strengthen the integrity of employees in eg internal investigations. The strongest result is an urgent need to bring up the situation on the political arena, as we're falling behind on digital forensics. This can be one of the biggest threats to organizations, companies and society and there are currently too low investments in the field of digital forensics.

“Doing the Right Thing”



31 May

Abstract no: OP216



Eva Wettborg

Swedish Police Authority, Stockholm Region, Forensic Section Stockholm, Sweden

| ORAL

Forensic casework using intelligence- challenges and possibilities

Analysis of forensic evidence is often a valuable tool with the possibility to solve crime. However, for optimal results we should use forensic intelligence to a greater extent and analyze more traces to be able to link investigations in the hunt for the perpetrator. Unfortunately, we continue to downgrade traces and do not see the possibilities of investigating and analyzing minor crimes, such as burglaries, theft or even sexual crimes (rape for example). An increased focus and prioritization of analyzing forensic traces in minor crimes will help detect perpetrators in other crimes and also in major crimes. In addition to more traditional forensic analyses, it is valuable to allow and perform additional forensic analyses in order to get investigative leads and improve the odds to get a robust investigation. What happens when we, based on the forensic intelligence analysis, ask clarifying questions to the forensics and tries to see the opportunities that may still be in negative conclusions?

The development of more advanced and sensitive technologies within the forensic field during the last decades are giving us more possibilities. Technologies available today make it possible to give indications and do predictions that are valuable to the investigation, by using approaches different from the more conventional, most commonly used today. But are we doing that?

Case examples using improved technologies, proven to detect low amounts of DNA, will be presented and described in more detail, to demonstrate the possibilities and effects of using forensics to a greater extent for more robust investigations.



31 May

Abstract no: OP219



Céline Weyermann

Ecole des Sciences Criminelles, Université de Lausanne, Switzerland

| ORAL

Shifting forensic science development from the organisation to the discipline

The usefulness of (forensic) science in criminal justice systems is widely recognised. However, several reports indicate that forensic science efficiency in court remains very limited and is occasionally highly controversial. Until now, attempts to solve the issues do not seem to have durably solved the forensic science “crisis”.

An alternative path forward is suggested in this contribution by contrasting the forensic science means and purposes under the prism of the discipline (i.e., forensic science) rather than the organisation (i.e., practice). Indeed, nowadays, forensic science is mainly viewed as applying science(s) to legal matters and is rarely considered as an academic discipline. Thus, the forensic science development has essentially been driven by organisations through the improvement and standardisation of means and processes. However, organisations and processes are highly dependent on the political, economic and legal structures in which they operate. This may explain why proposed solutions could hardly be efficiently applied transversally to all forensic science models.

This contribution will show how shifting the forensic science focus from means to a purpose provides a basis on which organization (s) and current practice(s) can more adequately evolve, eventually leading to a more impactful and long-lasting improvement of forensic science basic knowledge and subsequently application.



31 May

Abstract no: OP220



Sheila Willis

Leverhulme Research Centre of Forensic Science, University of Dundee, Dundee, Scotland, UK

| ORAL

Survey on the fitness for purpose of the standard ISO17025

From the mid-1980s, there was an increased focus on a systematic approach to quality management in forensic facilities / laboratories. Despite this a specific forensic science standard was not in place and the implementation of an existing, internationally accepted standard was sought. The outcome was the adoption of standard ISO17025 as it was deemed the most appropriate for this purpose, although it had not been specifically developed for the forensic domain. While ISO17025 had the presumptive advantage of being focused on laboratories, many aspects of the work undertaken by forensic laboratories and the competences of forensic scientists may challenge its fitness for purpose. Nevertheless, ISO17025 became the most-frequently used standard in forensic laboratories world-wide, most commonly as a step to achieving a formal accreditation.

The forensic community has now worked to the standard ISO17025 and later also to the standard ISO17020, for some decades so it is time to reevaluate the appropriateness of the various elements of the standard. As a first step, a structured survey was developed and disseminated to directors of forensic laboratories and quality managers under the auspices of Monash University in collaboration with the University of Technology Sydney and cooperation of the International Forensic Strategic Alliance and its regional forensic networks: ASCLD, ENFSI, ANZFEC (formerly SMANZFL), AICEF, AFSN and SARFS. The key elements for exploration in the survey comprise:

- Fitness for purpose
- Competences
- Education and training

The preliminary results of the survey will be presented and the implications for quality management in forensic science discussed.



31 May

Abstract no: OP223



Céline Weyermann

Ecole des Sciences Criminelles, University of Lausanne, Switzerland

| ORAL

Towards more relevance in forensic science research and education

Forensic science is often considered as a specialisation acquired in a second degree or through practice. Thus, its development has largely been led by scientists and managers from other main disciplines, such as medicine, chemistry, biology, computer science, cognitive science or even quality management. Such a tendency can also be observed in research and education. This may explain why, despite a continuous increase in the number of forensic science-based journals, research papers and education programs, forensic science basic knowledge is insufficiently addressed by the community (at least proportionally compared to the total number of contributions).

Starting from an overview of current education models and research published in forensic science, this presentation will suggest that a shift from quantity to relevance is needed to increase the usefulness and impact of forensic science education and research in practical settings. The first step towards such a change is to recognise forensic science as a discipline in its own right.

Such recognition will allow the development of forensic science basic knowledge and principles rather than furthering the fundamentals or application of a multitude of other disciplines. Developing the discipline (rather than sub-specialities) may be the first step towards a more impactful development of forensic science.

“Doing the Right Thing”



31 May

Abstract no: OP224



Hans Henseler

Netherlands Forensic Institute; University of Applied Sciences Leiden, the Netherlands

| ORAL

Transformation of the Digital Forensic and Investigation Process

Digital evidence is involved in most cases challenging forensic labs and police forces worldwide. They are not able to deal with the amount of digital evidence being gathered, e.g. in cases such as harassment, sexting and serious domestic abuse. Every officer needs to understand evidence from phones and CCTV as the nature of crime changed.

Policing needs to be transformed rather than improved by incremental change¹. Investigation of digital evidence should be in the hands of the investigators, case backlogs in the digital forensics lab should be reduced through digital forensics as a service² supporting collaboration between investigators, digital forensics experts and case managers³.

Police forces and digital forensics labs need a solution which will enable them to “industrialize” the processes around the examination of digital devices. The representation of digital evidence should be standardized⁴ and processes should extend across organizations from crime scene to court.

The objective is to speed up the examination process, deliver proportionate examinations and direct the output to the point of need (i.e. investigator, analyst, prosecutor) whilst operating within the required quality and legal standards.

The real challenge of digital evidence is not the lack of experts, tools or money but is the transformation of the processes and the implementation of an ICT solution across the organization to face the challenging requirements of the future.

Refs.

1 www.npcc.police.uk/Digital%20Forensic%20Science%20Strategy%202020.pdf

2 doi.org/10.1016/j.fsidi.2020.301021

3 dfrws.org/presentation/the-digital-evidence-dashboard-project

4 doi.org/10.1016/j.diin.2017.08.002



1 Jun

Abstract no: OP221



Dyon Deckers

Netherlands Register of Court Experts

| ORAL

The 10 year Odyssey of the Netherlands Register of Court Experts

In the past, anyone could declare themselves an expert before the court and it was up to the judges to determine fidelity. This manner has led to a number of miscarriages of justice, including several cases in the Netherlands. The Netherlands Register of Court Experts (NRGD) was established to endeavour eliminating these miscarriages of justice. To do so, we created a system where court experts are extensively assessed by their peers on their ability to give reliable and accurate statements concerning evidence before the court of law.

The NRGD is the first register for court experts with a legal basis, an independent position and structural funding. Our task is to guarantee and improve a consistent, high quality of individual court experts working within criminal law. The NRGD develops objective, substantive and specific quality standards in conjunction with experts and is open for applications from domestic as well as foreign candidates. Currently, the register has developed standards for 11 different fields of forensic expertise, such as DNA-analysis, Toxicology and Digital Forensics. Currently, the register has assessed over 1500 applications for registration. Consequently, NRGD registered experts are accepted by the court and can be trusted to give reliable and accurate statements concerning evidence.

This presentation will cover the experiences and challenges of the register's ten years of existence, the position of the NRGD within the forensic network and the cooperation with its stakeholders. Accordingly, we hope that other organisations and countries can learn from the NRGD odyssey.



1 Jun

Abstract no: OP222



Sofia Rodriguez Lopez

Universidad Complutense de Madrid, Madrid, Spain

| ORAL

The challenges of working in forensic archaeology and anthropology field in Spain

Forensic archaeology and anthropology are two disciplines which can be challenging in every country for different reasons, making important to present the current situation in Spain. In this case, every aspect of the issue seems to be related to the other producing a huge chain of disagreements, which without knowing could end in a roller coaster full of errors.

To begin with, education is one of the aspects which seems to be problematic regarding this field. Many universities as, Universidad Complutense de Madrid or Universidad Autonoma de Barcelona, Universidad de Granada have a few courses related to physical anthropology or forensic anthropology, giving the students an approach experience to the field. In some cases, students work with real bones from historical or contemporaneous bone collections, for basic theoretical formation towards the future. Unfortunately, none of these courses offer the opportunity to work in real cases, where the students are involved in real situations showing true skills after learning field basics. Following this, many professionals decide to study abroad searching for more experiences or job opportunities but also to increase their professional performance. As consequence, forensic teams are constantly changing because not regular personnel are hired leading forensic anthropologists' or archaeologists' teams to lose continuity as well, valuable knowledge and experience which supports the teams.

To conclude, this work pretends to present the Spanish context to work in forensic field, to look forward to improving the quality of work in this field as well, understanding the importance of doing the right thing.



31 May

Abstract no: KN028



Simon Walsh

Australian Federal Police, Canberra, Australia

| KEYNOTE

Essential strategic, operational and enabling reforms to implement a forensic operating model for the contemporary criminal and security environment

In keeping with the rest of society, crime is more digitised, globalised and connected, manifesting as a hybrid of the physical and digital worlds. Whilst the harm is real and lasting, methods and enablers of crime are increasingly dependent on technology. Our connected world offers criminals and terrorists unfettered access to potential victims and funds. Operationally there is increased emphasis on prevention and disruption, which is redefining offence categories, powers provided to police, prevalence of multi-agency partnerships, and the expectations of Governments and the public.

Against this backdrop, traditional forensic science operating models, are outdated, ill-suited and constrained to the extent that they risk irrelevancy. Defining our role and contribution as “from crime-scene to courtroom” diminishes our value proposition and excludes us from contributing to prevention and disruption outcomes. Our practice should no longer be portrayed or executed as linear, segregated, discipline-specific domains. Apart from imposing inefficiency and duplication, it reduces the problem-solving potential of our specialisations.

The AFP Forensics command has transformed its operating model to meet the challenges of our dynamic and complex crime environment. Consequentially, our role and impact has increased, our capabilities have expanded, our impact on new threats and new offences has been demonstrated, and our value in organisational and operational strategy has been entrenched. This presentation outlines essential strategic, operational and enabling reforms to implement a contemporary forensic operating model, with evidence-based and operationally focused examples.



30 May

Abstract no: OP230



Sheila Willis

Leverhulme Research Centre for Forensic Science, University of Dundee

| ORAL

Expertise and Professional Development for Forensic Scientists

Continuing professional development is the means by which forensic scientists maintain and improve their knowledge, skills and competence, and develop the professional qualities required throughout their professional life.

Funding for forensic science provision is not unlimited and forensic scientists are in demand for delivery of casework. Given these constraints, there is a potential risk to the continuing professional development and hence the expertise of forensic scientists. The authors consider that CPD must be seen as a fundamental part of functioning as a forensic scientist and undertook this research to sample the existing situation and highlight the need.

This study assessed views from forensic scientists on the range of professional development opportunities available to them including internal and external training, access to the scientific literature, seminars, conferences, mentoring and opportunities to engage in research and development. Views from investigators and legal professionals on their perception of the level of expertise of forensic scientists were also gathered.

Anonymised surveys were used to gather data in the United Kingdom and Ireland; results will be presented, together with a consideration of gaps identified and ways in which these may be filled.

“Doing Things the Right Way”



30 May

Abstract no: OP231



Karien Van Den Doel

Netherlands Register of Court Experts

| ORAL

Five tools to improve the quality of Ad Hoc experts

In criminal procedures, experts of all kinds of disciplines give their testimonies. Most of these experts are trained in some kind of forensic science or have extensive experience in reporting for the court. However, sometimes there will be experts that have neither, the so-called ‘Ad Hoc’ expert, e.g. the sea current expert, the diamond expert, the gynaecologist. They may be within the top of their field but are they able to write a reliable unbiased report for a criminal law procedure? In the Netherlands, the testimonies of these kinds of experts have led to miscarriages of justice.

To overcome these challenges the Netherlands Register of Court Experts (NRGD) has started the Ad Hoc Expert Project. In this collaborative project between the NRGD, the public prosecutor, the police, and multiple judges, we have developed five distinct tools to help both the court and the experts to write reliable reports and give reliable testimonies; Overview of Organisations of Experts, Appointment Questionnaire, Criminal Law E-learning Module, Forensic Report Guideline, Report feedback. These tools help the judge or prosecutor to find the correct expert for the job and they give the expert information concerning the criminal procedure and prepare them for what is to come. Furthermore, the expert can use these tools to write a reliable report within a forensic context.

In 2020 the tools were distributed throughout all the courts in the Netherlands and have already been widely used in many criminal cases. Feedback from these Ad Hoc experts themselves and from judges alike have emphasized the usefulness of the tools and consequently the importance of these tools in criminal cases.



30 May

Abstract no: OP235



Marce Lee-Gorman

Forensic Science Ireland, Dublin, Ireland

| ORAL

The impact of a merger and Covid 19 on exhibit/ evidence submission to Forensic Science Ireland

Forensic Science Ireland (FSI) is the only forensic laboratory in the Republic of Ireland that receives exhibits/cases from all regions of An Garda Síochána (AGS – The Irish Police). Up until 2019, FSI received on average 16,000 cases annually for DNA, Drugs and Chemistry analysis. Each Garda district had its own dedicated day (not time) to submit exhibits to the Case Intake Section (CIS) at FSI, mostly by a dedicated AGS Exhibit Liaison Officers (ELO). Using the Laboratory Information Management System (LIMS), CIS staff received exhibits from the ELO on a first come first serve basis and from time to time expedited urgent work when requested by AGS. Over the years for the most part, this model worked. During the summer of 2019, exhibit submissions began to rise, triggering delays and long queues. ELO's disliked the apparently arbitrary manner in which high priority cases were prioritised for receipt, which sometimes resulted in routine cases not being logged in on that day. In December 2019, the Fingerprints and Documents & Handwriting of the Garda Technical Bureau transferred to FSI, causing exhibit submission to increase by almost 40%. In March 2020, due to the COVID 19 pandemic, the 2m social distancing rule became mandatory in the workplace. Due to limited working space at FSI, this permitted only 50% of staff from CIS to work on any given day. This paper will discuss innovative approaches adopted to manage case submissions without reducing the level of service provided. The lessons learnt may be seen as a model for best practice for Forensic Science providers for the future.



31 May

Abstract no: OP226



Giulia Cinaglia

| ORAL

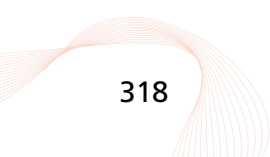
University of Lausanne, School of Criminal Justice, Switzerland

Cold cases: where do we stand? A comparative study of practices in cold case investigations

Besides the obvious structural difficulties resulting from the effects of time, cold cases raise several issues, especially when it comes to their management. For instance, it seems that there is still a lack of consensus concerning the definition of what is a “cold case” itself (what kind of crimes can be considered “cold cases”? How long before such crimes become “cold”?). Answering these questions can directly influence the selection process, the use of forensic evidence and ultimately the investigation of cold cases, e.g. how do police forces decide which cases should be reopened? How do they prioritize those cases? What’s the perceived role of forensic evidence in this regard?.

Based on 16 interviews conducted in Canada, France and Switzerland, our study addresses these questions through the experiences and the narratives of various stakeholders (i.e. detectives, crime scene investigators, forensic scientists and crime analysts). The data collected provide an in-depth look of the strategies adopted in cold case investigations, as well as a comprehensive appraisal of the role of forensic science in cold cases, namely the usefulness, the resources allocated, and the challenges encountered when dealing with old evidence. In particular, the potential of new forensic techniques is identified as a key aspect, even though the risks associated with the (mis)use of forensic evidence are sometimes underestimated.

Our findings confirm the complexity of defining, investigating and managing cold cases. While highlighting the importance of forensic science, the results suggest the need to raise awareness amongst police forces concerning the effects of time on forensic evidence.





31 May

Abstract no: OP228



Juha Lampinen

National Bureau of Investigation / Forensic laboratory, Vantaa, Finland

| ORAL

Designing forensic laboratory services

NBI Forensic laboratory maintains a product catalog. Each examination is described, and their scopes, possible constraints and maximum delivery times are given. The customers, i.e., law enforcement units, can then request these examinations. In general, the reports are then produced using first-in first-out principle. The laboratory functions as a factory producing forensic reports. The dilemma is that forensic reports have no value on their own. The value of a report is created by combining information on it with circumstances and other information of the criminal case. Also, the value of an individual report might change during the criminal investigation.

The value of forensic services is therefore co-created with the customer. And to maximize that value, the delivery of services should be adjusted to meet the specific needs of each customer, instead of customers adjusting to meet laboratory specifications. It's a non-trivial task because flexibility costs resources.

Service design is about using design thinking to create services. Design thinking is an iterative process to understand users, redefine their problems and create new innovative solutions. Service design approach might be a way to add more value to our work in forensic laboratories.

In this presentation we present methods and results from our pilot project where we developed a new service prototype using service design methodologies. The new service is tailored for cases which have suspects imprisoned during the criminal investigation. The imprisonment triggers specific deadlines for the police to present evidence. The service was co-created with police investigators and laboratory personnel.



31 May

Abstract no: OP229



Alison Sears

| ORAL

Science & Technology Unit, Forensic Evidence and Technical Services, New South Wales Police Force, Australia

Development of an FGG operational capability: an Australian perspective

Forensic Genetic Genealogy (FGG), also referred to Investigate Genetic Genealogy (IGG), is rapidly gaining the interest of law enforcement agencies. The infamous Golden State Killer (GSK) case has highlighted the benefits of such a capability, whilst also highlighting an urgent need to manage expectations through an improved forensic quality framework. The required framework is varied, dependant on local jurisdiction policy and legislation, including ethics and privacy laws. Whilst there are nuances between using this capability for deceased person identification versus application of FGG to criminal investigations, the work undertaken by this group has highlighted there are also some similarities that demand equal attention. Scientific techniques for generating DNA information is one such example, with privacy and ethical considerations of the use of genealogy another prominent aspect of this capability. Interestingly, a common misconception is that FGG is by nature deeply embedded in the DNA analysis capability. This groups work estimates DNA analysis, whilst important, in fact accounts for approximately 20% of the overall FGG capability. The Australian experience will be presented supporting the necessity to merge several areas of expertise to form a more holistic and effective operational framework to integrate this as a robust capability for law enforcement use.



31 May

Abstract no: OP232



Sonja Bitzer

Université catholique de Louvain, Louvain-la-neuve, Belgium; National Institute for Criminalistics and Criminology, Brussels, Belgium

| ORAL

Forensic advisor: a place for the generalist in forensic science

The multiplication of the parties and the specialization of their roles in the criminal justice process have increased the need for a generalist forensic scientist to act as a forensic advisor, someone who can advise on matters related to trace processing in order to advance justice and aid in crime prevention efforts.

This generalist should have not only a broad scientific knowledge, but also in-depth knowledge of forensic science, criminalistics, crime scene and criminal investigation. Forensic advisors can help bridge gaps and break down silos between different actors in the criminal justice system by facilitating communication between the various parties involved in the investigation: magistrate, police and crime scene investigators, and forensic experts. By occupying a centralizing role in regards to information related to traces, from processing to their interpretation, these generalist forensic scientists assess and monitor the potential contribution of clues to investigative and evaluative efforts.

We conclude that, despite certain organizational challenges, experience has shown that the implementation of the forensic advisor role, occupied by generalist forensic scientists, can help diversify and increase the contribution of forensic science to the criminal justice process.



31 May

Abstract no: OP233



Mikaela Cruz Delgado

| ORAL

Forensic station Solna, Forensic Section, Investigations Division, Stockholm, Swedish Police Authority

Forensic guidance to investigators at Forensic stations, Police Region Stockholm, Sweden

How the evidence initial is collected and secured is crucial for which value the forensic examination will have on the investigation. Special emphasis must be placed on avoiding incorrect handling of the evidence, which in the worst case can lead to convict an innocent or acquit a guilty person. There are good reasons to collect and secure many traces/goods, yet also important to further select those traces/goods proper to move the investigation forward.

While the National Forensic Center, NFC, completes more cases yearly the demand for their services rises constantly as the incoming cases at the Swedish Police Authority increases. Due to high processing time for each case, affecting the period in detention, prolonging the investigation time, Forensic stations were opened as a nationwide regulated decision. Since 2021, the national guideline for requesting forensic examination came into force stating that the preliminary investigation leader decides whether a forensic examination should be requested. All forensic evidence, before it reaches NFC, must pass Forensic Section either through a crime scene investigator or forensic evidence specialist. Prior to 2021 the investigators often requested forensic examination themselves, without guidance from forensic expertise.

The new professional role, forensic evidence specialist within the Swedish Police Authority, is highly appreciated. The guidance to investigators has been shown to be an important competence support in the preliminary investigation. The forensic evidence specialists have diverse educational backgrounds. After employment, the forensic evidence specialists are further educated by the Forensic Section and NFC.



31 May

Abstract no: OP234



François Heulard

Institut de recherche criminelle de la gendarmerie nationale

| ORAL

The Forensic Science Laboratory of the French Gendarmerie (IRCGN) : An original and singular management

IRCGN is, in France, much more than a forensic laboratory using a list of sciences and techniques for the criminal trial. It is also an institute where Research plays a central role, fully integrated into forensic science. Multidisciplinarity is at the heart of its organisation, with more than fifty fields of activity in which PhD's, engineers and specialists work together. The uniqueness of the IRCGN is built around a management made up of gendarmerie officers. While this model may seem surprising at first sight, we will show the virtues of this organisation, but also its limits, in the french system. Recruited both on scientific skills and on their aptitude to be a manager of the french gendarmerie, how do they manage to go from learning and practicing "forensic science" to managing the laboratory? Their rich career path, alternating between positions as public security officers with positions as department heads or laboratory managers, gives them a broad view of their environment. The challenges of forensic science are not only in the laboratory, with its well-established training, qualification and quality assurance process. They are also upstream and downstream, with the investigative services and the magistrates, but also with the administrative authorities concerning public order. This global vision, which still needs to be enriched by cross-exchanges with the network of directors and managers sharing the same issues, enables the mission to be fulfilled in the best possible way, by managing day-to-day demands and facing up to transitions in order to prepare for the future.



31 May

Abstract no: OP236



Karen McGregor Richmond

iCourts, Copenhagen University, Copenhagen, Denmark

| ORAL

The Influence of Marketisation on Forensic Science Provision in England and Wales: An empirical case study

Expert scientific evidence is generated from a convergence of investigatory, analytical, and interpretative processes, involving a diverse array of agencies. Therefore, the durability of the relationships between these institutional agents is of central importance to ensuring the accurate, efficient, and consistent, production of expert scientific reports. Thus, it is unusual to encounter a jurisdiction in which forensic science – generally perceived as a matter for public sector provision – is reconfigured around a fully marketised system of delivery: England and Wales are unique in this respect. Given that the scientist’s ability to harness the objective scientific precepts on which the forensic sciences found may be influenced by interposing political, economic, and organisational factors, this policy-driven transition from public to private forensic provision raises significant concerns regarding the potential for commercial markets not only to reliably support the criminal justice system, but to influence – and even distort – the very process of forensic analysis and interpretation. Employing a critical realist, comparative case-study approach, and utilising a palette of qualitative methods, the instant study sought to limn the contours of this unexplored domain of marketised scientific practice, rendering visible the links between changing governance structures and the performance of forensic expertise.



1 Jun

Abstract no: OP227



Andre Hendrix

Chief Superintendent, National Police, National Forensics Portfolio, Tilburg, The Netherlands

| ORAL

Crime Scene to Court Collaboration in the Dutch Criminal Justice System; Faster Results and Greater Public Satisfaction

It is widely accepted that providing more and faster forensic results can catch more criminals more quickly, ultimately reducing crime. However, the number of published studies supporting this general claim are limited.

In the Netherlands, the Ministry of Justice & Security has initiated a number of projects and pilot studies under the overarching program ‘Intensification & Repositioning Forensics’. One such project, in the Limburg region, involved increasing the intervention of DNA in acquisitive crimes and greatly improving the speed of the supply chain. This ‘Snelle DNA-Straat’ (Fast Track DNA) project is a three-year program.

Snelle DNA-Straat has involved the co-ordination of every stage of the process from crime scene to court. Working together, the Police, Prosecutors, the Netherlands Forensic Institute and Eurofins TMFI have ensured that no time is lost at each stage of the evidence handling process and that any resulting DNA intelligence is actioned quickly. A Public Private Partnership has been established with Eurofins TMFI in the local area to carry out rapid DNA profiling, and the Police have co-located their Biology Examination Laboratories with the DNA lab. for maximum effect.

Results are presented that show that the DNA supply chain can be greatly enhanced without compromising quality or scientific standards. Furthermore, initial independent evaluation demonstrates that there was a demonstrable increase in crime detection rates in the Limburg area, a marked increase in morale of the Police staff involved in forensics and investigations in particular, and an increase in overall public confidence in the police’s response to acquisitive crime.



30 May

Abstract no: KN029



Melissa Taylor

| KEYNOTE

National Institute of Standards and Technology

The Dirty Dozen – understanding the 12 most common preconditions for human error

Human error is inevitable. It happens in crime laboratory systems just as it happens in all other complex industries such as aviation, health care, and nuclear power. Human factors research focuses on advancing our understanding of the nature of errors, with a particular focus on those factors that influence human error. Lessons learned have led to significant reductions in errors and accidents. The dirty dozen was originally developed as a tool to classify the most common root causes of air maintenance-related accidents. The list refers to 12 of the most common human error preconditions, or conditions that can act as precursors, to adverse events and has proven to be transferable to other complex industries -- stress, fatigue, complacency, distractions, lack of awareness, lack of communication, lack of assertiveness, lack of knowledge, norms, pressure, lack of teamwork, and lack of resources. When the dirty dozen are present, they can impact performance and create the perfect environment for mistakes, errors and violations to occur.

It is important to know the dirty dozen, know how to recognize their symptoms, and most importantly know how to avoid or learn from the errors caused by them. Using examples from forensic science settings and everyday life, this presentation will provide a brief human factors overview, describe the dirty dozen, and offer strategies for individuals and crime laboratories to address these common human factor issues and reduce the likelihood of errors.



1 Jun

Abstract no: OP237



Philippe Davadie

Gendarmerie Nationale / PJGN, Pontoise, France

| ORAL

Research and education: french cooking in PJGN

French PJGN is a unique forensic unit. It consists in a forensic laboratory and an intelligence unit. The question is how can it always do not only things right, but also the right things? A solution is conceiving and performing a genuine research and educational politics. I think it is mandatory.

The first step is considering this politics as a long term one. Hence, projects' term range may be short (some months) or long (many years).

Then, to conduct all these projects, different steps are required. First, a human resources policy relying on high standard recruitment (engineers and PHD are welcome). Second, a strong internal educational program to become expert. Third, a commitment to promote PHD among our employees.

Third, we participate or even conduct complex research projects funded either by the european union or the french national research agency (ANR). Leading or taking part in these projects, our aim is to get a result with the higher TRL possible (not under 7). These results must also be realistic and easy to use. To perform these requirements, the operational experience of our people is very helpful.

Results of such a politics are remarkable. 5 patents have been delivered to PJGN.

In order to achieve these ambitious goals, we have organized a virtuous way. It consists in specific financial means, various partnerships and dedicated educational program.

This last item, cornerstone of our successes, is a mix of inner and academic programs.



1 Jun

Abstract no: OP238



Anders Nilsson

National forensic centre (NFC), Sweden

| ORAL

A National Swedish Program gives Selected Crime Scene Investigators an Enhanced Competence in Blood Pattern Analysis

Examination of blood patterns on a crime scene often provides important information in investigations of serious crime. It's important that BPA is done using state-of-the-art methods and by CSI:s with the right competence. Basic level BPA is included in the training of all Swedish CSI:s while advanced blood pattern analysis (BPA) is performed by crime scene investigators (CSI) with an enhanced BPA ability. Advanced BPA casework is coordinated on a national level by a specially appointed coordinator. The national coordination also includes mandatory peer reviewing and monitoring of each individual to ensure that he/she performs advanced BPA to an extent that ensures competence maintenance.

The national Swedish competence requirements for CSI:s define the knowledge and skills of a CSI with an enhanced BPA ability. A new educational program has been set up to continuously provide the Swedish police authority with such CSI:s. The program emphasises the need to closely combine education and supervised BPA casework. The program takes a minimum of two years to complete and is comprised of three parts. The first part includes basic methodology i.e. stain characterisation, classification, evidence evaluation and photography. Then follows a progression into more advanced methodology and discussion of cases. The program uses a mixture of e-learning, digital exercises, and in-place education and training. The e-learning includes digital presentations, movies and digitally corrected exercises and tests. Supervised BPA casework, coordinated and monitored on a national level, is also included. The program ends with an examination.



1 Jun

Abstract no: OP239



Sani Marttila

National Bureau of Investigation, Forensic Laboratory (NBIFL), Vantaa, Finland

| ORAL

Competence assurance in forensic laboratory

The new version of standard ISO/IEC 17025 represented the words “monitoring of competence”. What does it actually mean in practice?

The forensic laboratory of NBI in Finland (NBIFL) gained its first accreditation year 1996. Ever since the scope of accreditation has expanded and new areas have fulfilled the accreditation requirements. We can show a long list of quality assurance including proficiency tests and collaborative exercises, but were questioned by FINAS how do we actually show the assessment of competence.

A project for the development of competence and know-how was carried out during years 2018-2019. It was observed that pt-tests and number of cases worked through don't necessarily give the right impression of the competence of personnel. In conclusion the assessment of competence was added to the yearly performance appraisal for aims and improvements.

In the first round, year 2020, the experts were asked to assess themselves reflecting the competence criteria in scale 1-5, from “basic training needed to no particular development needed”. The same assessment was done by their superiors and conversation between the person and the superior carried out for possible differences and future needs. After the assessments the feedback was collected from the whole personnel.

On the strength of the results the criteria of competence was opened using Bloom's taxonomy which helped to show the depth of the knowledge needed in different roles. The scale was also cut to three levels: gold, silver and bronze.

In this study the development of the competence assessment methods and encouragement of the experts to find the right balance for monitoring will be discussed.



1 Jun

Abstract no: OP240



Oceane Laisney

| ORAL

Leverhulme Research Centre for Forensic Science, University of Dundee, Dundee, Scotland

Impact of Science Capital and communication within the criminal justice system: a non-scientist professionals' approach

How scene examiners, police officers and lawyers engage with scientific evidence is critical since it has the potential to impact the investigation and ultimately criminal trials and sentencing. It is therefore crucial to consider the human factors associated with evidence-based decisions that are founded on that scientific evidence, to improve the value of forensic science in the criminal justice system.

For this study, the concept of Science Capital was adapted to examine the influences that might impact the way that professionals within the criminal justice system interact with scientific evidence. A survey was administered to gain an understanding of the ways in which the Science Capital of each profession effects their decision-making, from the investigative crime scene to the court process. This holistic approach suggested variations in the extent to which Science Capital impacted the professionals' decision-making.

These findings lead to focus further research on one of the underpinning concepts of Science capital, that of "who you know", to understand how non-scientists communicate and network with scientists. This presentation will explore the results of the interviews conducted with scene examiners, police officers and lawyers. Findings unveiled significant insights into how they interact with science and scientists allowing the identification of communication channels, enablers and barriers to communication, the nature of their interactions and the networking opportunities presented to non-scientists. The implications include the need for explicit recognition of the value of communication and networking as efficient components of the forensic process.



1 Jun

Abstract no: OP241



Céline Weyermann

Ecole des Sciences Criminelles, Université de Lausanne, Switzerland

| ORAL

The potential of digital technologies to teach forensic practice

Simulating and supervising realistic practical teaching activities is a complex task that tends to become more challenging in the actual sanitary situation and with an increasing number of students. Thus, an educational innovation project aimed at implementing digital tools in a “forensic practice” course to support the learning experience of students with two main complementary components:

a computer-based crime scene simulation tool allowing students to visualise 360° crime scenes and relevant items,

a messaging tool to simplify and centralise the communication between the students and the teaching staff.

Prior to 2020, the practical course was carried entirely on-site without specific technologies. Due to the COVID-19 pandemic, it was entirely on-line in 2020. Finally, in 2021, on-line and on-site activities were implemented with success, combining the best of both approaches in a hybrid teaching mode.

An overall satisfaction of students and teaching staff was observed toward the implemented tools. Limiting presence on-site allowed students to take a step back from the activities and collected items. This promoted critical thinking, and together with an increase in structured (on-line and on-site) interactions allowed for a positive, continuous learning experience. However, some drawbacks were also observed. For example, 360° visualisation of crime scenes to simulate CSI does not allow physical manipulations, which are crucial for the acquisition of practical skills. This contribution will describe the implementation, added value and limitations of the digital tools in such problem-based learning activities.



1 Jun

Abstract no: OP242



Frank Crispino

UQTR, Chemistry, biochemistry and physics Dpt

| ORAL

The Trace Transfer Analysis Database (TTADB): Whom for? What for?

In charge of gathering and analyzing forensic evidence, the forensic scientist must reconstruct from traces the causes of a complex past event not reproducible. Beyond the identity of source, he/she can also infer the activity generating the trace, much more relevant for the case to be solved, calling on notions of transfer, persistence, retention between the trace and its support, or even to the background noise in the environment investigated and to the degradation of the trace over time. In short, the more relevant expertise is the one not only identifying the source of the trace, but also assessing its consistency in relation to the criminal or innocent activities that may have generated it.

Five years of research funded by SSHRC (Canada) aimed to synthesize the state of knowledge regarding the activity of transfer traces in the form of a structured knowledge base available to researchers and scientific practitioners or jurists, TTADB, the subject of several international presentations and three publications in the Canadian Journal of Forensic Sciences. It is proposed to present to the European community the background and the functioning of this database to which they also have a free access to. Within a paradigm of transparency of the expert opinion, this work addresses the educational and data-driven dimension of doing the right thing right.

**FORENSIC
STATISTICS**

The background image shows a person's hand holding a document in front of a computer monitor. The monitor displays a spreadsheet with various data points, including columns for 'Account', 'Description', 'Date', and 'Amount'. The text 'FORENSIC STATISTICS' is prominently displayed in a black hexagonal box with a red border in the center of the image. The overall scene is a desk with a computer, a keyboard, and several papers, suggesting a forensic or data analysis environment.



3 Jun

Abstract no: KN022



Silvia Bozza

| KEYNOTE

Ca' Foscari University of Venice - Department of Economics; University of Lausanne - School of Criminal Justice

Statistical modeling of complex forensic data

Statistical methods are largely used in forensic science for assessing the probative value of scientific evidence. The evaluation of the value of scientific findings can be performed by means of a Bayes factor, a rigorous metric nowadays largely supported by operational standards in different forensic disciplines. The assessment of a Bayes factor may represent a challenging task involving forensic, statistical and computational aspects that can represent a substantial obstacle in practical applications. Forensic laboratories have frequently access to equipment which can readily provide scientific data characterized by a complex dependence structure, with several levels of variation, a large number of variables and where standard parametric families do not apply. A practitioner may therefore face several sources of difficulty and uncertainty mainly due to the complexity of the case and of the available background data, to sensitivity issues related to prior assessments and model choice, and to computational impasses. This may also give rise to different views about what should be the most appropriate way to report such uncertainties at trial.



1 Jun

Abstract no: OP243

**Tereza Neocleous***University of Glasgow, Glasgow, UK*

| ORAL

A logistic regression approach for the classification of forensic evidence

There are many methods that can be used for classification of multivariable data into known categories, although not all of them allow for the calculation of a likelihood ratio which is often desirable as a measure of the strength of evidence in a forensic context. We explore the use of regularised logistic regression as a classifier which allows for the calculation of likelihood ratios even in the presence of separation/perfect prediction. We demonstrate this method via the use of an open-source online tool on a case study of indirect biomarker data for classifying chronic alcohol drinkers. The approach is well suited to analytical chemistry datasets and more general datasets with a large number of variables, and it has the further advantage of allowing for flexibility in model assumptions such as multivariate normality.



1 Jun

Abstract no: OP255

**Charles Berger****| ORAL**

Leiden University, Leiden, Netherlands; Netherlands Forensic Institute, The Hague, Netherlands

Use of Bayesian Inference in Interpretation in Forensic Anthropology

Providing an opinion on (elements of) the identity of skeletonized remains is an important part of forensic anthropologists' daily work. Forensic anthropologists often accompany such opinions with measures of uncertainty that give posterior probabilities without taking into account all the other (non-anthropological) evidence and information in the case. The application of logic, through the use of Bayes' theorem can provide a solution for this issue. We explore how a simple Bayesian approach can be applied to interpret features observed during the examination of skeletal identifiers. We specifically focus on two basic elements of the forensic anthropological biological profile; one with a binary outcome (sex estimation) and one with a categorical or continuous outcome (age estimation). Besides others, the formulation of propositions, the calculation of likelihood ratios, the choice of reference data, and the combination of evidence are discussed.

We found that a simple Bayesian approach performed as well as, or better than, much more complex published approaches. This makes it possible for forensic anthropologists that are not proficient in complex statistical methods to assess the evidential strength of their observations themselves.



1 Jun

Abstract no: OP274

**Ruoyun Hui***Alan Turing Institute*

| ORAL

Evaluating the weight of fingerprint evidence at activity level

Fingerprint examiners are sometimes asked to address propositions relating to the activities that may have led to a particular fingermark, or set of fingermarks, being deposited at a crime scene. This is indeed an area where they have a lot to contribute from their expertise, and practitioners routinely go through such reasoning when prioritising casework too. Our project aims to develop a logical and probabilistic approach to assist practitioners in evaluating the weight of evidence at activity level, following the case assessment and interpretation framework.

Case circumstances become more relevant at the activity level, adding new uncertainties. An uncertainty at source level may propagate to activity level. When multiple fingermarks are present, the evidential value added by each additional fingermark depends on whether it comes from the same digit, the same hand, and the same contact event as any previously considered fingermarks, as well as the nature of the activity under dispute.

Using a case study, we illustrate how we gradually build up a Bayesian network to address increasingly complicated scenarios. The model succinctly expresses conditional dependencies among the variables, at the same time allowing practitioners the flexibility in selecting relevant features, deciding discrete states of the features, and assigning subjective probabilities. Automated tools are available to calculate the likelihood ratio from observations once the model has been fully specified. This work is part of a broader project on developing graphical models to assist the evaluation and communication of the weight of scientific evidence at activity level.



2 Jun

Abstract no: OP244

**Peter Vergeer**

| ORAL

Netherlands Forensic Institute, The Hague, The Netherlands

A more accurate metric to measure calibration of likelihood ratios?

In forensic science, it is common to evaluate evidential strength in terms of a likelihood ratio (LR).

The fundamental property that makes a likelihood ratio indeed a likelihood ratio is that 'the LR of the LR is the LR', or in other words that LRs are well calibrated. In line with this, forensic scientists advocate to measure the calibration error for LR-data generated by LR-systems [1].

Metrics [1–5] have been introduced that can be used to measure the calibration error for LR-data. The most popular metric is known as Cllr-cal [4,5]. Unfortunately it has drawbacks [6].

We compared performance of Cllr-cal to a newly introduced metric, devPAV [6]. We compared the ability of the metrics to distinguish well-calibrated from ill-calibrated LR-data in several scenarios. Also variance over perfectly calibrated LR-systems with different discrimination and over LR-datasets with different sizes is studied. We show that for many of the simulated scenarios, devPAV performs equally good or better than Cllr-cal. Moreover, devPAV is more stable for the range of simulated conditions, being less confounded with discrimination and test dataset size.

We also encourage forensic scientists to try out the metrics themselves, by reference to open source software [7].

References

- [1] Ramos et al. *FSI* 230 (2013) 156–169
- [2] Good. *Bayes Stat* 2(1985) 249–270
- [3] Royall. *Statistical Evidence: A Likelihood Paradigm*, CRC Press, 1997
- [4] Brümmer et al. *CSL* 20 (2006) 230–275
- [5] Ramos et al. *Entropy* 20 (2018) 208
- [6] Vergeer et al. *FSI* 321 (2021) 110722
- [7] LIR Python Likelihood Ratio Library on Github





2 Jun

Abstract no: OP247

**Pablo Ramírez-Hereza**

| ORAL

AUDIAS Lab, Unviersidad Autonoma de Madrid, Spain

Gaussianization of LA-ICP-MS Features to Improve Calibration in Forensic Glass Comparison

The forensic comparison of glass aims to compare a glass sample of unknown source with a control glass sample of known source. In this work, we use multielemental features from laser ablation inductively coupled plasma (LA-ICP-MS) to compute a likelihood ratio. This calculation is a complex procedure that generally requires a probabilistic model of the within-source and between-source variability of the features. The assumption that the distribution within each measurement group (and even within source) is normally distributed is a safe one with the available data. However, the variability between sources from different glasses cannot be assumed to be normally distributed. That is why we have used a kernel density distribution to describe the between-source variation. In this work, instead of modelling distributions with complex densities (such as kernels), we propose to Gaussianize the data and to use a model with Gaussian assumptions. We believe that this simplification will help to have a model less sensitive to the data dimensionality, and more prone to be extended with Bayesian techniques. However, this assumption of normality represents a strong limitation on the performance of the likelihood ratio. Thus, in this context, in order to obtain a better fit of the features with the Gaussian model assumptions, we propose the use of different normalization techniques of the LA-ICP-MS glass features, namely marginal Gaussianization based on histogram matching, and a more complex joint Gaussianization using normalization flows. We report an increase in the performance of the likelihood ratios computed by the model and, consequently, a more reliable forensic comparison model.



2 Jun

Abstract no: OP249

**Eleni Sergidou****| ORAL***Netherlands Forensic Institute, The Netherlands; University of Amsterdam, The Netherlands*

Likelihood ratios for speaker verification using fused linguistic and acoustic information

Is the suspect speaking in a disputed speech fragment? Such a question can be addressed with speaker verification, usually performed with an acoustic analysis and sometimes supported by an automated speaker verification system (ASVS). Additional information may be obtained from linguistic analysis, which constitutes an authorship analysis on spoken text. This has particular value when the poor audio quality limits the applicability of acoustic analysis, such as when analyzing telephone conversations. The authorship analysis should be sensitive to speaker style, not to the topic of conversation. Automated methods for authorship analysis exist, e.g., focusing on usage of very common words. The focus of this work is on the fusion of an automated authorship verification system (AAVS) and an ASVS within the likelihood ratio (LR) framework. We consider three different methods to derive a combined LR (multiplication, logistic regression, and passing the score of the acoustic ASVS as additional input to the AAVS). We apply our method to the forensically relevant dataset FRIDA, and we evaluate our results in terms of log likelihood ratio cost (Cllr) and equal error rate (EER). We show that fusion can be beneficial, especially in the case of intercepted phone calls. We achieve 30% relative reduction in Cllr and 34% in EER over the acoustic only ASVS. This shows that adding linguistic information aids in building empirically-based LR systems.



2 Jun

Abstract no: OP250

**Martin Lory***Zurich Forensic Institute, Switzerland*

| ORAL

Machine Learning tools in two settings: gasoline detection in fire debris / author determination of text messages

The application of classical machine learning tools (Random Forest, Gradient Boosting, Support Vector Machine and Naïve Bayes) with a training set made up of data originating from known sources can be very successful, reliable, and fast. The conditions are, that the variables (chemical compounds or vocabulary) are comparable, and that the training data is similar to that found in actual case scenarios, yet the correct classification of this data must be unmistakably clear and must include enough data entries of all possible categories. The data points must be preprocessed: For the gasoline detection, the GC-MS spectra should be time-locked, and the peaks of all measurements need to be clustered to be comparable. For the authorship determination, the text must be tokenized and resampled to accumulate and variate enough for successful training. Finally, different methods should be used, and the most important variables (for the machine learning model) should be listed to get an interpretable result. In order to obtain optimal results, the „leave one out cross validation“ should be applied to detect and delete ambiguous training data and potential wrong interpretations in past cases. Additionally, a deep learning algorithm with a pre-trained net was applied on pictures that have been created artificially from the GC-MS data with different methods. To increase the confidence in the machine learning methods to the customer (prosecutor, court, defense, and public), the concept of validation by test sets, randomly selected and taken out before any data was treated, has to be explained.



2 Jun

Abstract no: OP251

**Tuomas Korpinsalo**

| ORAL

National Bureau of Investigation Forensic Laboratory, Vantaa, Finland

Measuring the understandability of forensic reports: a questionnaire based test

It could be argued that a main purpose of a forensic report is to relay the evidential meaning of scientific findings to a recipient, be it a police investigator or a court of justice. Thus, a report given by a forensic laboratory should be readily understood. While several studies have investigated how well modern evaluative reports based on a likelihood ratio (LR) are understood by different demographics, little attention has been given to the ability of the forensic reports to actually convey their intended messages to the end users. Furthermore, previous research has not been concerned with providing practical methods for measuring whether adopting a new method of reporting provides any tangible benefits.

This background motivated the National Bureau of Investigation Forensic Laboratory in Finland to launch the “LYSTI” -project in 2020 with the aim to develop a questionnaire-based test for measuring the ability of forensic reports to communicate their intent and the strength of their conclusions. A pilot study targeted at technical, tactical and lead investigators as well prosecutors was conducted by providing recipients with example reports in both traditional and LR-based forms and then testing their understandability using the developed questionnaire. Based on the responses to the questionnaire, an “understandability index” was calculated to represent the reports’ ability to communicate evidential value.

In this presentation, the structure of the test and its basic concepts are described and the results of the pilot study are compared between the LR-based and traditional forms of reporting. Additionally, future work and applications are explored.



2 Jun

Abstract no: OP254

**Claude Roux***University of Technology Sydney, Sydney, Australia*

| ORAL

Understanding the factors affecting transfer and persistence of glass from different recipients and varying propositions

The evaluation of the results obtained at the end of the examination of microtraces (e.g. glass) requires forensic scientists to understand the transfer, persistence and recovery of the traces from the recipients. Although a number of studies exist that discuss properties of glass and breaking events, few studies exist that focus on recipients. In this study, we discuss different recipients, namely garment and footwear, as well as garment's dampness and footwear's contact surfaces, that may impact the transfer and persistence of glass after the breakage events.

Garment's construction, footwear's tread pattern and outsole types seem to influence transfer and persistence of glass. Overall, the characteristics of the transferred fragments and differential shedding behaviour followed similar trends to previous studies in dry or controlled conditions. The number of fragments transferred to loose-knit garments decreased with the degree of wetness but damp conditions aided transfer and persistence on tightly knitted cotton t-shirt. In case of footwear, all outsole types showed a reasonably sharp drop in fragment counts after a few minutes. Soft or uneven surfaces (e.g. grass) resulted in lower transfer than hard or smooth surface.

A forensic scientist may have a general idea about what to expect when a certain type of garment or footwear is obtained from a person of interest, however, this study provides an in-depth discussion on transfer, persistence and recovery of glass fragments from these recipients based on dampness levels or contact surfaces and get an idea about the time elapsed between the time of the crime and the recovery of the relevant garment or footwear.



2 Jun

Abstract no: OP275

**Maria Jofre**

| ORAL

Crime&tech – Università Cattolica del Sacro Cuore, Italy

Identification of terrorist financing threats and schemes for the development of prevention and monitoring technologies

Terrorist Financing is undergoing a technology-aided transformation. The monitoring and analysis of financial (e.g., cryptocurrency transactions, traditional financial transactions) and communication information (e.g., social media, darknet forums) play a critical role in the prevention of terrorism. Cut The Cord (CTC) provides technical solutions based on AI tools to improve law enforcement detection capabilities and further enhance Terrorist Financing counteracting strategies. In doing so, we first identify relevant threats and trends on the modus operandi of terrorist networks financing by reviewing several sources (i.e., literature, judicial/official reports, private insights, media articles). Furthermore, we collect 340 real-life cases and translate previous findings into a set of recurrent patterns and anomalous schemes. In order to successfully implement CTC technologies, we operationalize the identified schemes into use-cases and further use them to extract end-user requirements. The requirements analysis involves several elements, including functional and non-functional needs as well as expected outputs of the proposed technologies. Terrorist Financing threats and trends, and end-user requirements are ultimately validated in focus groups involving relevant stakeholders, such as law enforcement agencies and other competent authorities (CTC Project – ISFP GA 101036276).



3 Jun

Abstract no: OP245

**Jorge Sanchez***University of Glasgow, Glasgow, United Kingdom*

| ORAL

Contaminated mixture normal distribution models for spectroscopic data

Many classification problems like, for example, food authenticity studies, come with additional issues in the manner of outliers within classes and high-dimensionality that can have an impact on performance. We look to address these issues in the context of simulated and real spectroscopic multi-class data. The contaminated normal finite mixture classification model of Punzo and McNicholas (2018) is extended by wrapping a variable selection search around it. Variable selection is posed in a stepwise fashion, with 2 models compared at each stage, 1 with a particular variable included and the other excluding it. Model fit criteria can be used to decide on the variable's inclusion or exclusion. Combined with a search algorithm to explore the model space, gives a model which can handle class outlier points while selecting discriminatory variables to give improved classification performance.



3 Jun

Abstract no: OP246

**Miguel de Figueiredo****| ORAL**

School of Pharmaceutical Sciences, University of Geneva, Geneva, Switzerland; Institute of Pharmaceutical Sciences of Western Switzerland, University of Geneva, Geneva, Switzerland

Development and implementation of a multivariate blood steroid passport for the detection of doping

The athlete biological passport (ABP) is today a major approach in the fight against doping to monitor selected biomarkers that may reveal the effect of fraudulent practices. Although its objective is not to detect specific prohibited substances or methods, it constitutes a paramount forensic intelligence strategy to efficiently guide investigations and further testing of athletes. It has greatly improved the ability to indirectly detect doping through the longitudinal monitoring of biomarkers. The ABP makes use of Bayesian statistics to seize the dynamic nature of the data in order to define reference concentration ranges within which a new measure is expected to fall assuming a normal physiological condition. The ABP defines adaptive reference ranges initially based on population values, but the latter are adapted whenever a new sample is analyzed for a given individual, leading to individualized thresholds. An atypical passport finding can thus be generated if a value of a given biomarker falls outside the expected intra-individual range. However, the ABP is univariate in nature since reference ranges have to be defined for each individual biomarker before collating all the information. The main disadvantages of this approach are that an interpretation has to be made for each biomarker individually and, most of all, the ABP does not take into consideration the relationship between the biomarkers. To tackle these limitations, we propose a novel method to generate adaptive reference ranges for the multivariate longitudinal monitoring of multiple biomarkers within the blood steroid passport.



**LEGAL &
ETHICAL
ASPECTS**



2 Jun

Abstract no: KN032



Donatella Casaburo

KU Leuven Centre for IT & IP Law (CiTiP)

| KEYNOTE

AI evidence and data protection safeguards: The European legal perspective

The field of digital forensics is evolving, as new investigative instruments and data sources become available. Artificial Intelligence (AI) is now driving this transformation process. In the EU, AI-enabled emerging technologies are deployed by Law Enforcement Agencies (LEAs) to gather and process data about individuals, with the aim of obtaining evidence suitable to be used in trials. As AI techniques involve large-scale processing of personal data, the risk of breaching the right to privacy and data protection of a large number of natural persons is particularly high. To properly address this risk, LEAs are obliged to implement adequate mitigating measures.

Scholars have already examined the legal challenges related to AI evidence, especially their compatibility with the due process guarantees, including privacy and data protection principles. However, little has been said about the organizational measures mandated by the EU data protection framework that LEAs shall implement while collecting data for digital forensics purposes. The presentation aims to tackle this issue by analyzing the legal provisions contained in the Law Enforcement Directive (LED, Dir. 2016/680, along with their further implications, which are capable of preemptively mitigating the risks associated to the collection of evidence through the means of AI. Particular attention is paid to the requirements to (1) carry out a data protection impact assessment; and (2) cooperate with supervisory authorities. In this regard, the Belgian Supervisory Body for Police Information, the first EU supervisory authority exclusively responsible for monitoring the application of the LED, is brought as case study.



1 Jun

Abstract no: OP263



Dorijan Keržan

National Forensic Laboratory, Ljubljana, Slovenia

| ORAL

Issues in forensic science and ethics

Scientific ethics is often limited to cases of misuse of science by morally corrupt scientists. But unethical behaviour of individuals, while undoubtedly inappropriate, can conceal the real ethical dilemmas. While codes of ethics or (better) codes of conduct can solve certain aspect, it is important to understand, that position of forensic science within the realm of ethics is rather special and in certain way similar to the position of medicine within (medical) ethical thinking.

Forensics sits in the middle of the peculiar triangle consisting of science, legislation and society, which is often not really understood by the overworked forensic scientist painstakingly working with invisible or almost invisible traces, samples and data.

It is important, as the Code of conduct of ENFSI implicitly states, that ethical issues are strictly separated from the principles of science. But it is arguably not always the case that forensic science, with its entanglement with legislation and social consequences is ethically unquestionable. Bias in forensic science, as so many papers showed, is a case in point here as it is (almost) always undetected by the biased individual.

With this paper I wish to bring into the forensic field a dimension of the philosophy of ethics that should ensure additional element for even higher ethical standards of forensic scientist, particularly when one is confronted with the case that contradicts his personal ethical principles.



2 Jun

Abstract no: OP257



Rolf Ypma

Netherlands Forensic Institute

| ORAL

AI-based forensic evidence evaluation in court: the desirability of explanation and the necessity of validation

Explainability of (AI) algorithms receives a lot of attention in ethical and legal debates, and is often seen as highly desirable or a necessity. This raises the question of whether explainability is necessary for a forensic evidence evaluation algorithm. We argue it is not; although some level of understanding of the algorithm's working is needed, the answer on whether it is fit for courtroom use can only be provided by empirical validation. The question of the relative merits of explanation and validation are particularly pertinent for AI-based systems, as these are well-suited to validation but their decisions are often very difficult to explain.

We humans tend to trust conclusions more when they are explained. However, even when supported by explanations, conclusions may be over- or underconfident, or wholly misleading. For this reason, the preferred way to test validity is to empirically assess the quality of conclusions. Given the potentially high impact of any decision in forensic evidence evaluation, such a validation can and should be performed for any algorithm, during the method development and on a case-by-case basis.

We provide arguments for our opinion that empirical validation is necessary for any forensic evidence evaluation algorithm, whereas explainability is merely desirable. We discuss advantages and disadvantages of both explanations and empirical testing in fostering trust in systems. Finally, we touch on if and when these arguments apply to other applications of AI algorithms.



2 Jun

Abstract no: OP258



Ernestina Sacchetto

University of Turin, Italy

| ORAL

Automated Human Recognition Technologies and Criminal Justice in the light of the last EU legal framework

Over the years, law enforcement authorities and intelligence communities have used automated biometric technologies not only for preventive purposes, with the aim to avoid the perpetration of crimes, but also to figure out who someone is, during the initial stages of criminal proceedings. More in detail, the constant use of automated faced-based human recognition has triggered a lively multi-disciplinary discussion with regard to the different profiles of interaction between the investigative use of such software and several fundamental procedural guarantees. Rather than focusing on policing or prevention of crime, largely discussed by recent literature, the presentation will be focus on the ways in which such tools can affect the investigation and adjudication of crime. After a theoretical reconstruction of the EU legal framework and the possible applications, the analysis will focus on the relationship between the facial recognition tools in compliance with some typical procedural guarantees (right of defence, fair trial and presumption of innocence). Drawing on the comprehensive case law of the ECHR and of the CJEU, the presentation will give also some perspective reflections on the reliability and, ultimately, the admissibility of such evidence. Touching on the foundations of the civil law traditions, the presentation will offer insights into the usefulness of automated recognition systems in criminal proceedings.



2 Jun

Abstract no: OP259



Amade M'charek

University of Amsterdam, Amsterdam, the Netherlands

| ORAL

Governing the Future: Social and ethical questions in the advent of digital(ised) forensics

The evidential power of forensic traces is in flux due to novel possibilities in the fields of digitalisation and digital technology. These are believed to hold great promise for increasing the evidential power of forensic technologies across the board, speeding up forensic processes and engendering interdisciplinarity (combining different forensic disciplines). Furthermore, digitalisation and digital technologies produce new sites (online) for forensic policing, such as various digital social media platforms. Lastly, the application of AI creates novel possibilities for digital policing and forensics, such as the use of machine learning algorithms for the identification of objects in pictures (e.g. weapons).

While this all has potentials and promises for the field of forensics, it also raises substantial social and ethical questions, both within and outside the forensic community. One of the problems that has been identified with the use of algorithms is the problem of discriminatory, ethnic, and racial bias. Another is the repurposing of data collected from social media or public databases, which were never officially intended as 'forensic data.' Such examples raise various questions about current forensic infrastructures, including the different roles and responsibilities therein, and whether they are still capable of warranting the rights of citizens. In our paper, we draw on our research commissioned by Ministry of Justice and Security of the Netherlands about trends in crime, forensics, and policing. We will elaborate on some cases of digitalisation and tease out issues we encountered in the field, to better frame the societal and ethical challenges at stake.



2 Jun

Abstract no: OP260



Mónika Nogel

Széchenyi István University

| ORAL

Guiding Principles for Regulation of Forensic DNA Phenotyping in Hungary

The application of newly developing state-of-the-art forensic DNA technologies, such as massively parallel sequencing continuously poses new legal challenges for regulators. For example, the legal landscape for the usage of DNA phenotyping in criminal cases remains remarkably indifferent to the new challenges. A considerable amount of literature has been published on DNA phenotyping in the past few years, including a review of its benefits and risks, and regulatory issues. However, this problematic topic has received far too little attention in Hungarian literature, and no specific regulation exists. The goal of the presentation is to reflect on the cornerstones of the new regulation that is necessary to implement. The essential findings are:

- Forensic DNA phenotyping is an investigation tool, not evidence.
- Forensic DNA phenotyping is not a tool for individualization, but group narrowing.
- Experts providing DNA phenotyping reports should not be involved in evaluating DNA evidence.
- Forensic DNA phenotyping should remain an exceptional tool in a criminal investigation.
- Personal data concerning health should be excluded from forensic DNA phenotyping.



2 Jun

Abstract no: OP264



Martyna Kusak

Adam Mickiewicz University, Poznan ; Ghent University

| ORAL

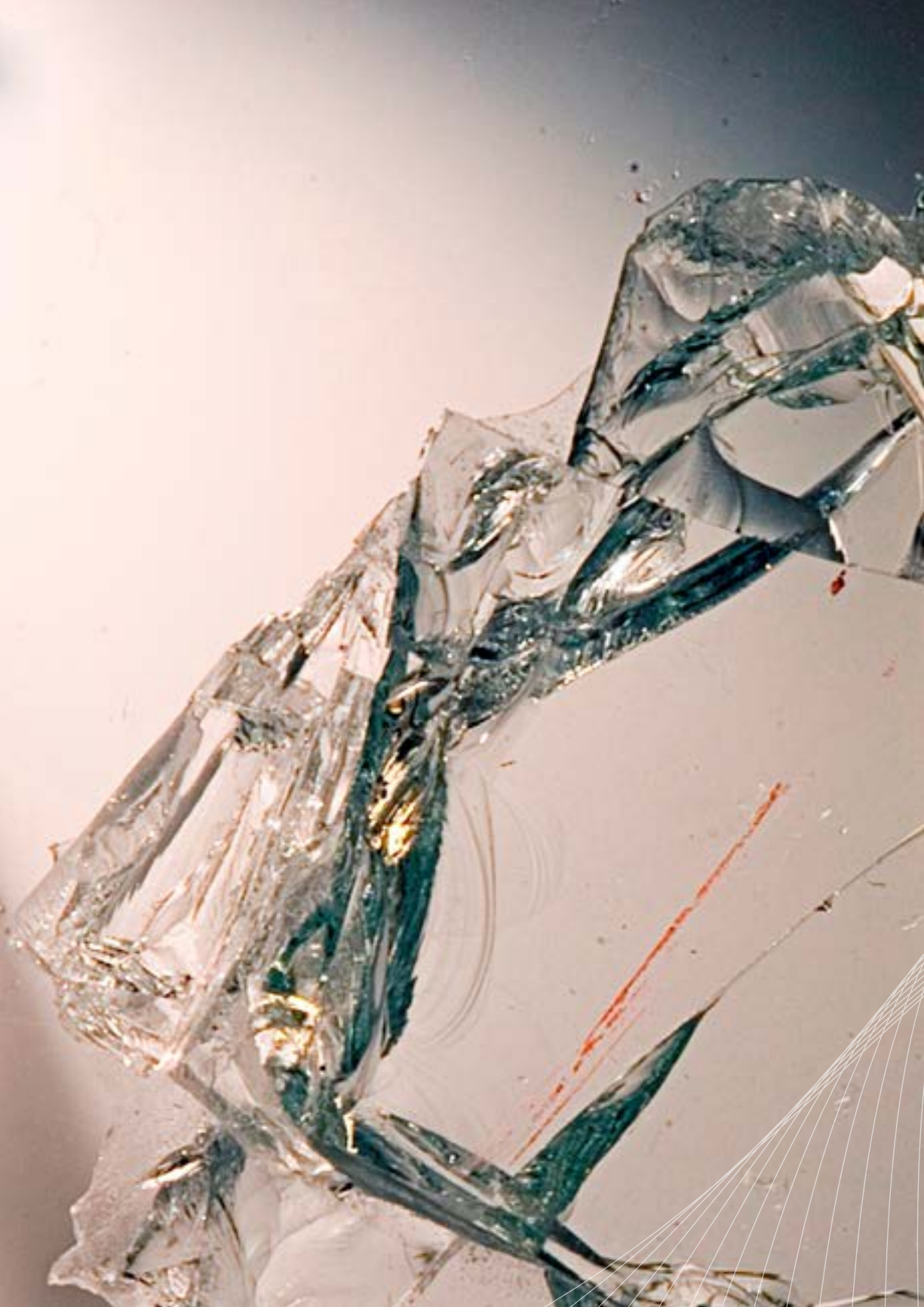
Legal mechanisms enhancing quality of police datasets that feed AI

This abstract builds upon a research on quality of datasets that feeds AI tools in criminal matters. Like in other sectors, so in law enforcement the key element of ensuring quality and reliability of AI tools is the quality of raw material. However, the negative effects of flawed data quality in this context extend far beyond the typical customer-company relationship, since it may lead to wrong and biased decisions, producing adverse legal or factual effects for individuals, such as detention or being a target of infiltration. This, in turn, may cause negative consequences not only for citizens (such as violation of privacy), but also for LEAs themselves, since relying on low quality AI tools may be misleading and deceptive, and result in wrong decisions made by LEAs. This, consequently, leads to a counterproductive fight against crime and undermines the legitimacy of LEAs and erodes public trust and LEAs confidence in this technology.

Therefore, the presentation will focus on police datasets as raw material that feeds AI tools, and present how the EU legal framework could be used to enhance quality of such datasets which, consequently, would positively impact on the lawfulness and ethical soundness of data-driven tools used by LEAs. Special attention will be given to the potential stemming from the right to privacy and data protection rules. The conclusions will be relevant not only for lawyers and police data protection officers, but also for data scientists and AI developers dealing with large datasets in police sector. The presentation will also cover the concept of police datasets quality index, that could be a useful tool enhancing privacy of data subjects.



POSTERS



A photograph of a satellite in space, showing various components like solar panels and antennas. A central black hexagonal graphic with a red border contains the word 'CHEMISTRY' in white, bold, uppercase letters. White wavy lines are overlaid on the image, flowing around the central graphic.

CHEMISTRY



31 May

Abstract no: PP002

**Sarah Hanniffy***Forensic Science Ireland*

| POSTER

A quantitative study (2016-2020) on the most common illicit drugs in Ireland

As an island nation, illicit substances are typically imported into the Republic of Ireland. In the Republic of Ireland, Forensic Science Ireland (FSI) receives all samples seized by Irish law enforcement agencies for examination under the Irish Misuse of Drugs legislation. Certificates of Analysis are issued by reporting scientists for court purposes,

Quantification of illicit substances is completed in FSI for intelligence purposes. A survey was undertaken over a five year period for cocaine, diamorphine and amphetamine at street and importation level seizures to estimate the cocaine/diamorphine/amphetamine content of the seizures. Common adulterants were recorded throughout the period of the survey (benzocaine, caffeine, paracetamol, levamisole) and comparisons were drawn between the presence and levels of adulterants found at importation and street level. Other areas of comparison include seizure location.

FSI aim to add to the quantification project's analyses in 2022, looking to extend our scope to both MDMA and methamphetamine seizures.



31 May

Abstract no: PP003



Rowan Blake

University of Strathclyde

| POSTER

Blazing Through the Detection of Synthetic Cannabinoids: Electrochemiluminescence as a Screening Methodology for BB-22

A continuously challenging area in the field of forensic science is the development of effective and accurate screening methodologies for the detection of illicit drugs. This is particularly true for new psychoactive substances (NPS), a group of compounds which mimic the effects of traditional drugs of abuse but with increased potency. Synthetic cannabinoids (SCs) are among the most widely abused type of NPS, such cannabinoid receptor ligands are infamous for their associated adverse physiological consequences, the most extreme of which resulting in fatalities or overdose. Within the past few decades there has been a rapid increase in the consumption and diversity of SCs yet few researchers have addressed the need to screen for these compounds. Electrochemical analytical methods are attracting considerable interest for the detection of illicit drugs due to their high degree of sensitivity, ease of use, low cost, portability, and rapid results. However, there has been little discussion on these methods for the detection of SCs and none thus far employing electrochemiluminescence (ECL). In this contribution we present, for the first time, the use of an $[\text{Ru}(\text{bpy})_3^{32+}]$ /chitosan screen-printed electrode sensor for the fast and cost-effective detection of indole-based SC BB-22 via ECL. The sensor displayed an appreciable ECL response with BB-22 as the co-reactant, ~15 times greater than that of the electrolytic medium blank. Though yet to be scrutinised further, this methodology shows promise for future use in the forensic field as a highly sensitive and selective screening method for SCs both in street and biological samples.



31 May

Abstract no: PP004



Karin M. Johannesson

| POSTER

Drug Analysis Section, National Forensic Centre, Swedish Police Authority, Linköping, Sweden

Corona Cannabis – How the closed national borders prompted the illegal drug market into utilizing hemp in new ways

During the beginning of 2020 the Drug Analysis Section at the Swedish National Forensic Centre noticed an extreme increase in low-THC cannabis, i.e. hemp products, in drug seizures. The number of analyzed hemp materials per month increased more than one hundredfold during 2020-2021. The products included for instance hemp buds, cannabis resin produced from hemp and capsules containing crushed hemp.

A new phenomenon that started to occur in 2020 was that cannabis of the drug type was 'diluted' with hemp, i.e. one bag could contain a mixture of cannabis and hemp. Another new product that occurred during this period was hemp or hemp resin mixed with synthetic cannabinoids, which had not been seen before. Cannabis resin with Δ^9 -THC as the dominant cannabinoid also started to appear during the summer of 2020. During the same period, the Drug Analysis Section also saw an increase in 'fake hashish', i.e. products that were packaged and made to look like cannabis resin.

One of the reasons behind the increase in the products and phenomena described above is probably the closed national borders during the Covid-19 pandemic. According to the National Operations Department of the Swedish Police Authority, the closed borders decreased the influx of illegal drugs to Sweden. In order to continue the supply of cannabis and cannabis resin to Swedish drug users, the drug market had to adapt and deliver new products. In this presentation the most commonly encountered synthetic cannabinoids in hemp and hemp resin will be presented as well as different types of fake hashish that were analyzed at the Swedish National Forensic Centre.



31 May

Abstract no: PP005

**Björn Ahrens***Forensic Science Institute, Wiesbaden, Germany***| POSTER**

ENFSI Drugs Working Group

The Drugs Working Group (DWG) was established in 1997 in Wiesbaden, as a part of ENFSI, to support scientists working in the field of forensic drugs analysis.

In line with the objectives of ENFSI itself, the DWG Steering Committee has defined several strategic goals, including:

- Enhancing the competencies of DWG members by defining and documenting best practice for Drugs practitioners
- Establishing quality assurance requirements and organising annual proficiency trials
- Encouraging information sharing between member laboratories and providing drug identification libraries and databases
- The Steering Committee commissions work on these goals through a number of area-specific subcommittees, and reviews and adapts the subcommittee structure to meet changing needs within the Drugs expert community.
- The DWG has published a number of guidelines and a best practice manual to support the work undertaken by Drugs practitioners and has developed software tools to assist with implementation. All of these resources are available on the EPE so they can be accessed by both the European Drugs forensic community and other interested experts around the world.
- The DWG holds annual meetings to enable practitioners to gather and share experiences and to encourage and strengthen collaborations with other organisations working in the Drugs field, such as EMCDDA, JRC, UNODC and SWGDRUG. These collaborations enable the DWG to influence the global response to the threat from drugs.
- The future work of the DWG will be aimed at providing resources to support Drugs practitioners in responding to the challenges of a constantly changing global drugs marketplace.



31 May

Abstract no: PP006



Louise Elmlund

| POSTER

Drug Analysis Section, National Forensic Centre, Swedish Police Authority, Linköping, Sweden

Evaluation of Illicit Drug Seizure's Homogeneity Using Near Infrared Spectroscopy and Hyperspectral Imaging

Selection of representative analysis samples from large drug seizures is a delicate problem for the forensic expert. Large seizures containing thousands of units are challenging in that both the analysis quantity and the case-handling time must be kept within the limits set by laboratory resources and investigating officer's timeframe. Moreover, due to the fact that doping and medical preparations from clandestine laboratories often display diverse content, sampling strategies based on the analysis of only a small fraction of the total seizure can lead to non-representative conclusions.

At the Swedish National Forensic Centre we have utilized the strength of near-infrared (NIR) hyperspectral imaging and segmentation tools along with principal component analysis (PCA) to develop a method capable of analyzing hundreds of drug items simultaneously. The method is non-destructive and shows great promise for the evaluation of homogeneity in seizures of tablets and capsules within minutes. If the analysis indicates diverse chemical content within the sample population the different groups can be separated directly on the analysis tray. In addition, the method requires minimal physical contact with the seized materials and no organic solvents, thereby ensuring a good and safe working environment.



31 May

Abstract no: PP007



Livia Andrani

| POSTER

School of Criminal Justice, University of Lausanne, Lausanne, Switzerland

Four-year long wastewater-based monitoring of illicit drug consumption pilot project in Switzerland

The potential of wastewater analysis to complement existing epidemiological tools and help assess illicit drug consumption trends in a defined population has already been established. Consequently, Switzerland has initiated a 4-year long wastewater-based illicit drug consumption monitoring program. The Dromedario project explores in depth the spatial and temporal dimensions through a high-frequency stratified sampling strategy with 24h composite samples collected every 13 days, for a total of 28 samples per year with each day of the week equally represented. 10 wastewater treatment plants (WWTPs) collecting wastewater from small to large cities as well as urbanized and more rural areas are included in the project, covering approximately 2 million people (23% of Swiss population). Samples undergo solid-phase extraction and ultra-high performance liquid chromatography coupled to tandem mass spectrometry (UHPLC-MS/MS) analysis to qualify and quantify 6 common illicit drugs and 6 urinary metabolites, following a validated analytical method. Obtained substance loads, together with metabolism excretion data and WWTPs contributing population, are used to back-calculate population consumption estimates. These results should offer extremely valuable knowledge on trends and variations in licit and illicit drug use as well as crucial information about market dynamics. This can in turn help relevant stakeholders, whether it be at law enforcement or public health level, to prioritise their activities and take better-informed decisions about illicit drug policies.



31 May

Abstract no: PP008



Scott Chadwick

| POSTER

University of Technology Sydney, Centre for Forensic Science, Australia

Has COVID-19 Influenced Injecting Drug Consumption in Sydney?

The COVID-19 crisis has and is still taking its toll on the global economy, public health, travel and people's way of life. Social distancing restrictions implemented by governments have impacted the illegal trade of drugs, which in Australia relies on air and sea cargos that have been significantly affected during the pandemic. Drug trend information on people who inject drugs (PWID) is primarily obtained from self-report data, which relies on the person's perception of the drug consumed and does not provide any information on cutting agents. These information gaps can be overcome by the chemical analysis of used injecting paraphernalia. This study will objectively assess whether the COVID-19 pandemic has an influence on the drugs consumed by PWID in Sydney and whether a switch of the preferred substance used has occurred.

Used syringes were collected from Sydney's Medically Supervised Injecting Centre (MSIC) in the second half of 2020. The residual content was extracted with methanol before detection by gas chromatography-mass spectrometry (GC-MS). This chemical analysis was then compared to self-report data obtained from MSIC and chemical analysis data obtained in 2019 and early 2020.

Preliminary results suggest heroin was still the primary substance injected (in decreasing purity), followed by methamphetamine and clonazepam. The cutting agents detected aligned with literature reporting. Additionally, there was an observed coherence between the chemical analysis of used syringes and PWID self-report data. Routine analysis by the approach discussed herein provides an alternative method to minimize harm to PWID by promoting awareness of current drug trends.



31 May

Abstract no: PP009

**Robert Waldebring**

| POSTER

The National Forensic Centre, Swedish Police Authority, Linköping, Sweden

Identification of plant toxins using liquid chromatography – high resolution mass spectrometry in cases of poisoning

When the Swedish Police seize materials in suspected drugging and poisoning cases the materials are sent to the National Forensic Centre for analysis. Around 80-100 different cases concerning poisoning, drugging, poisoned baits and similar matters are investigated annually. Since different poisons and matrices have extremely diverse physicochemical properties several analytical techniques and workup procedures are utilized in these analyses in order to maximize extraction efficacy and substance detection. The main instrumental techniques used within the National Forensic Centre in these cases are gas chromatography – mass spectrometry (GC-MS) and liquid chromatography – high resolution tandem mass spectrometry (LC HR-MS/MS). Traditional wet chemistry tests, such as the identification of cyanide, are also employed.

Typical substances found in these drugging and poisoning cases include pharmaceuticals, narcotic substances, rodenticides and plant toxins. This poster presents and discusses the identification of a number of plant toxins using high resolution LC-MS/MS. It focuses on plants easily accessible to prospective poisoners since they are present in the Swedish flora. Typical toxins found in different types of plants as well as results from actual cases are presented. Different degrees of identification, such as tentative identification based on the presence of a known exact mass and full identification based on the comparison of retention time and MS/MS-spectra with results from the analysis of reference materials, are discussed.



31 May

Abstract no: PP011

**Maximilian Greif****| POSTER**

Hochschule Fresenius gGmbH, University of Applied Sciences, Idstein, Germany; Federal Criminal Police Office, Forensic Science Institute, Wiesbaden, Germany

Non-target screening of production waste samples from Leuckart amphetamine for synthesis marker identification

Clandestine amphetamine production via Leuckart route and pre-precursor APAAN generates distinctive route-specific markers which are typically identified in synthesis wastes and in the consumable product via GC-MS-impurity profiling concepts. In this work approaches of suspect and non-target screening using LC-HRMS were applied to aqueous synthesis waste samples from controlled Leuckart amphetamine syntheses starting from APAAN for tentative identification of route-specific organic substances with an emphasis on compounds that are not accessible via GC-MS.

17 features were tentatively identified as suspects of which the characteristic synthesis by-products 4M5PP, DPIA and the intermediate N-FA could be confirmed with reference substances. All suspects were previously identified in GC-MS studies for synthesis marker assessment. Furthermore, it was possible to tentatively identify seven new potential synthesis markers, which were not yet reported and which were partly also detected in real case samples afterwards.

The added value of a non-targeted LC-HRMS approach for impurity profiling of route-specific markers related to clandestine amphetamine synthesis was successfully demonstrated.

Acknowledgement

This research work was done as a part of the European Union's Horizon 2020 research and innovation program under grant agreement No 787128 (Project SYSTEM).



31 May

Abstract no: PP012

**Anna Berthelot****| POSTER**

Forensic Toxicology Unit, Forensic Science Laboratory of the French Gendarmerie, Pontoise, France

Statistical interpretation of seized banknotes contamination: Importance of population studies and drug positivity

Drug trafficking does not only involve narcotics but also significant amounts of money. By seizing and searching for narcotics traces on banknotes, forensics laboratories can provide useful informations regarding their origin, whether they come from general circulation or from drug trafficking. However, banknotes contamination with one or more drugs alone is not sufficient to declare them to be the result of trafficking. Banknotes from general circulation can actually also be contaminated, mainly by cocaine. An adapted positivity threshold is then associated with the analysis methods in order to objectively conclude on the origin of the seized money.

Analyzed by LC-MS/MS, banknotes with a detection intensity above the defined positivity threshold are considered positive. The value of a banknote positivity threshold to one or more substances is therefore essential in order to be able to distinguish between the two populations.

Trafficked banknotes always show high contamination rates. However, the latest population studies show an increase in the contamination of bills from general circulation. This leads to a distributions reconciliation for the two populations, with a decrease in the strength of the hypothesis supported.

In order for the statistical tests to demonstrate that there is always a strong association between the frequencies of contamination and the origin of the banknotes, it therefore appears necessary to regularly reassess the decision threshold for each substance of interest, and in particular that of cocaine. A "ROC curve" will allow us to estimate the optimal threshold value to declare a positive bill or a bill contaminated by the said substance.



31 May

Abstract no: PP013

**Ana Flavia Belchior de Andrade***University of Derby, Derbyshire, England*

| POSTER

The development of microcrystalline drug analysis on phenethylamines 2C-C and 2C-B using various chemical reagents

The investigation studied the microcrystalline testing of two analogs of 2C-phenethylamine (2C-C, 2C-B) which structurally differ by one halogen atom, and observed their crystalline structure and how much they differentiated when using multiple reagents, in an attempt to form unique drug profiles from the forensic data science collected from the specific drug-reagent chemical complexing.

Both compounds were exposed to the following reagents. Gold chloride, gold bromide, and platinum chloride due to all been recognised to be highly successful at microcrystalline growth with designer drugs. The microcrystalline structures formed by each drug were recorded as photographs with 100x magnification. Repeats took place to ensure crystalline structures were consistently the same. One of which was done where the samples are unknown to ensure the application of the drug crystalline profiles can be used to identify each drug.

Both 2C-C and 2C-B produced unique crystalline formations with each of the reagents which were repeatedly observed enabling a drug profile to be formed for each reagent. Both drug and reagent concentrations were altered to enable the rate of crystal growth to be measured across a timeframe of 30 minutes allowing for unique crystal development trends to be recorded.

The forensic data science behind microcrystalline analysis is limited to a few reagents. Observing the whole crystalline growth process is unique within this study in comparison with others adding extra detail in how drug-reagent complexing occurs. The development of microtubules for crystalline drug analysis is a future field of exploration due to enabling substance identification at the scene.



31 May

Abstract no: PP014

**Jakob Wallgren**

| POSTER

Drug Analysis Section, National Forensic Centre, Swedish Police Authority, Linköping, Sweden

Trick or treat? Are there narcotics in your sweets?

In recent times the view towards the abuse of cannabis within certain societies has grown more lenient. This has resulted in decriminalization or legalization of the drug in several countries and American states. These legislative changes have paved the way for a plethora of new products containing cannabinoids, commonly referred to as “edibles”. Many of these edibles have been made to mimic the appearance of various well-known sweets, such as gummy bears and peach rings. Consequently, the risk of unwitting consumption of cannabinoid-infused sweets is palpable and the problem is perhaps best showcased by North American reports of small children being hospitalized after consuming cannabinoid-infused sweets mistaking them for conventional sweets.

From the perspective of forensic chemists the various matrices of edibles, ranging from candy based on flour/gelatin to pastries, stand in stark contrast to the more commonly encountered matrices such as plant material, powders and tablets. The high sugar, gelatin and/or fat content of edibles provide new challenges for the extraction process, so that damage to analytical instrumentation does not result through the injection of inappropriate materials. With the substantial variety in both matrix and active compound (e.g. Δ^9 -THC, 5F-EDMB-PICA and LSD), it is difficult to develop a single all-encompassing method. Therefore the Swedish NFC has instead developed a general strategy in order to tackle these ever-changing analytical problems. This strategy involves both methodological (e.g. maceration and extraction) and instrumental (high-resolution LC-MS/MS and GC-MS) alternatives, depending upon the material under investigation.



31 May

Abstract no: PP016

**Jenny P. Rosengren Holmberg****| POSTER***Drug Analysis Section, National Forensic Centre, Swedish Police Authority, Linköping, Sweden*

What lies beneath: drugs hiding in the Swedish postal flow

The internet sale of narcotics in Sweden has been well established over the last decennium and is a growing market, not at least through the use of the Darknet. The possibility of ordering narcotics, doping agents and other illicit substances discretely via different webpages and have them delivered by mail makes it a less risky and therefore attractive way of obtaining these types of substances.

The Swedish Police Authority registers and handles notifications regarding items in the domestic postal flow (letters, parcels etc) that for different reasons cannot be delivered to the intended recipients and are suspected of containing drugs. All such articles are then sent for chemical analysis to the Swedish National Forensic Centre.

Thanks to an intensive collaboration between the Intelligence Section and the National Forensic Centre, it has for several years been possible to carefully monitor the number and sorts of drugs found in the Swedish postal flow. Postal deliveries containing narcotics or other drugs have dramatically increased over the last years and in this presentation the occurrence, amounts and composition of drugs in the postal flow during 2016-2020 will be presented. A number of substances encountered in these postal deliveries have been completely new on the Swedish drug market and were therefore subjected to structural elucidation at the National Forensic Centre. These new substances and the structural elucidation procedure involving the use of GC-MS, high resolution LC-MS/MS and NMR will also be presented.



31 May

Abstract no: PP017



Irene Van Damme

| POSTER

University of Amsterdam, Amsterdam, the Netherlands

Obstructing terrorist use of homemade explosives through chemical precursor profiling and transfer/persistence studies

Attacks with homemade explosives (HMEs) remain an increasing threat to society, partly because the preparation of many HMEs is relatively simple and precursors are readily available.¹ Since deterrence by retaliation is generally considered a rather ineffective measure against terrorism, prevention strategies should be particularly focused on identifying suspects during the pre-blast stages of the terrorism timeline.² The forensic work package in the H2020 Secure Societies INHERIT (INHibitors, Explosives and pRecursor InvesTigation) project focuses on two objectives. The first is the development of novel methods to chemically profile precursors through elemental and isotopic analysis. Chemical profiles provide an indication of how and where material is acquired and can aid linking different attacks, crime scenes and suspects. The second goal is to gain more insight into the transfer and persistence of explosive materials through model studies. Improved scientific understanding of these processes allows for more strategic sampling and analysis of suspect-related items and can assist evidence interpretation at activity level. This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 101021330.

References

Shreve B.P. (2020). The Modern Explosive Threat: Improvised Explosive Devices. In: D. Callaway & J. Burstein (eds), *Operational and Medical Management of Explosive and Blast Incidents*, pp. 99-107. Springer, Cham. https://doi.org/10.1007/978-3-030-40655-4_7

Kroenig, M., & Pavel, B. (2012). How to deter terrorism. *Washington Quarterly*, 35(2), pp. 21-36. <https://doi.org/10.1080/0163660X.2012.665339>



31 May

Abstract no: PP018



Pietro Maida

| POSTER

Raggruppamento Carabinieri Investigazioni Scientifiche-Messina, Italy

Smartphone sensing and discrimination of TNT and amatol by optical array

Terrorist attacks using explosives have increased, in the recent years, and is widespread the construction of improvised explosive device (I.E.D.) using explosive removed from the blasting charge of ammunitions. For this reason, much efforts have been devoted to the detection and identification of explosive compounds by numerous analytical techniques, such as gas chromatography, ion mobility spectrometry, fluorimetry, surface-enhanced Raman spectroscopy and electrochemical detection. These methods usually need complicated protocols and measurements, suitable for laboratory tests. Optical sensors overcome these limits giving a rapid answer on the crime scene investigation, with cheap and simply to use, devices. In fact, they are able to exploit simultaneous interactions with the target analyte, leading to a characteristic fingerprint, improving selectivity respect and avoiding false-positive responses.

We report on the first sensoristic device based on optical array sensor, able to detect and discriminate TNT, one of the most common explosives used in blasting charges assembly of many different weapons, and Amatol, one of the other explosives, constituted by TNT and ammonium nitrate in a wide range of ratios.

This sensor can be used with a common smartphone as detector, leading to the possibility to use this prototype also in real field, to detect explosive amounts in the 125 mg ~ 125 ng range. Selectivity tests performed with other analytes demonstrate the high reliability of this sensor.



31 May

Abstract no: PP019



Laura Nsuamani

| POSTER

Leverhulme Research Centre for Forensic Science, School of Science & Engineering, University of Dundee, Dundee UK

γ -Cyclodextrin-immobilized ceria-doped iron oxide nanoparticles for the colorimetric detection of triacetone triperoxide

The ease of production and the corresponding high explosive power of triacetone triperoxide (TATP), makes it an explosive of choice for criminals and terrorists alike. The absence of a notable absorption spectrum for TATP, generally make its detection challenging. In this work, we have developed a highly selective and ultrasensitive catalytic colorimetric sensor system for TATP using γ -cyclodextrin-immobilized ceria-doped iron oxide (Fe_3O_4) nanoparticles. Ceria-doped Fe_3O_4 nanoparticles were first synthesised via the hot-injection pyrolysis of metal precursors and organic ligands and thereafter coated with an amphiphilic polymer to stabilize the nanoparticles and make them biocompatible. γ -Cyclodextrin, a macrocyclic receptor, was immobilized on the nanoparticle surface to aid affinity to the target TATP and enhance the assay sensitivity. Under optimum reaction conditions, TATP was selectively and sensitively detected based on the catalytic oxidation of 3,3',5,5'- tetramethylbenzidine (TMB) by hydrolysed H_2O_2 (from TATP) in the presence of the γ -cyclodextrin-ceria-doped Fe_3O_4 nanoparticles and hemin. In general, a peroxidase mimetic colorimetric assay was developed for TATP in which γ -cyclodextrin-ceria-doped Fe_3O_4 nanoparticles acted as the artificial catalyst, TMB as the substrate, hemin as the signal amplifier and hydrolysed H_2O_2 (from TATP) as the oxidant and target analyte. The developed peroxidase mimic colorimetric nanosensor was successfully applied for the detection of TATP in soil, river water and tap water.



31 May

Abstract no: PP021



Jo Dawkins

| POSTER

University of Leicester, Leicester, UK

Fingermarks on paint – seeing the bigger picture

Practitioners find it increasingly difficult to recover quality fingermarks from walls in crime scenes. This may be due to changes in paint composition (from solvent to aqueous bases) owing to changes in EU Legislation limiting VOCs. It may also be due to the large number of contemporary paint types that are now available (i.e. bathroom/kitchen) in addition to traditional matt/silk. The UK Fingermark Visualisation Manual provides guidance on how best to recover marks on matt/silk painted substrates, but there is a gap in knowledge relating to newer paint types. This issue is amplified by a lack of published research.

This study sought to address the gap in knowledge by determining which fingermark processes are most efficient at developing latent marks on contemporary painted walls. A number of methodologies were employed, beginning with a survey of practitioners to gauge the current practices in use across the UK. These results then informed the experimental work, exploring variations in paint types and brands. This research highlighted that practitioners rarely consider the texture/composition of a painted wall before attempting to develop latent fingermarks. Our results show that there is a distinct topographical/constituent difference between matt paints and other non-matt paints and therefore should be processed differently. This research culminated in a proposed set of guidelines designed to assist fingermark practitioners in creating fingermark recovery strategies. The guidelines have been constructed upon rigorous scientific evidence and should significantly increase the quality and quantity of latent fingermarks being developed 'in situ' on painted walls.



31 May

Abstract no: PP5001



Raychelle Burks
American University

| POSTER

Benzoic acid derivatives as visualization agents of latent fingerprints

To enable a single-step cyanoacrylate ester (CA) fuming—staining process for the development of latent fingerprints, a selection of fluorophores has been developed as sublimation dyes in CA fuming. A greater array of such luminescent sublimation dyes would allow users greater flexibility in selecting a particular dye—CA combination to best suit their processing needs. We explored six benzoic acid derivatives for use as luminescent sublimation dyes under elementary CA fuming conditions, identifying two new dyes – 2-hydroxybenzoic acid (2-HBA) and 2-aminobenzoic acid (2-ABA). Using image and statistical analysis, the fluorescence intensity and stability of prints produced via the sublimation of CA with 2-HBA and 2-ABA was evaluated.



31 May

Abstract no: PP5008



Aneta Lewkowicz

| POSTER

Faculty of Mathematics, Physics and Informatics of the University of Gdańsk, Poland

Spectroscopic fluorescence proofs of 1,8-diazafluoren-9-one aggregates – first reports for Friction Ridge Analysis

Fluorescence performs an appreciable role as a physical phenomenon during fingerprint visualization. One of the known chemical compounds used to visualize fingerprint marks is 1,8-diazafluoren-9-one (DFO), which is a fluorescent probe from the point of view of physicochemical properties. The work on the procedures used in forensic laboratories is very important because they are currently used in a very toxic environment. The aim of the authors of this presentation is to show preliminary results of studies on a non-toxic environment for DFO with the potential possibility of using the phenomenon of DFO aggregation for fingerprint trace visualization, the first reports on this subject have already been published [1,2,3].

[1] Lewkowicz A, Bogdanowicz R, et al. The Luminescence of 1,8-Diazafluoren-9-One/Titanium Dioxide Composite Thin Films for Optical Application. *Materials* 2020;13(13):3014-3025. doi: 10.3390/ma13133014.

[2] Zygadło P, Lewkowicz A. Structural-spectroscopic analysis of DFO/PVA films as potential materials used in revealing fingerprints on non-porous surfaces, *Issues of Forensic Science* 2021;312:32-40. doi:10.34836/pk.2021.312.4

[3] Lewkowicz A, Kantor M, Zalewski W, Bojarski P, Mońka M, Spectroscopic evidence of fluorescence by 1,8-diazafluoren-9-one aggregates – a prospective new ultrasensitive method for fingerprints trace detection, *Journal of Forensic Sciences* 2022, DOI: 10.1111.1556-4029.15039.

Funding information:

This research was supported by the grant: 2021/41/B/HS5/03250 (K.W.; A.L.) financed by National Science Centre.



31 May

Abstract no: PP022



Virginie Redouté Minzière

University of Lausanne, School of Criminal Justice, Switzerland

| POSTER

How to perform a combined analysis of inorganic and organic gunshot residues?

Two categories of compounds are produced during the discharge of a firearm, the inorganic, and the organic gunshot residues (I and OGSR). Nowadays, analysis of IGSR using scanning electron microscopy coupled with energy dispersive X-ray spectroscopy (SEM/EDS) is routinely carried out in forensic laboratories. The analysis of OGSR, for example with liquid chromatography-tandem mass spectrometry (LC-MS/MS), is still rarely performed although it could bring useful information. One of the main issues to successfully implement a combined analysis lies in the possibility of efficiently recovering both types of GSR.

This work aims at comparing two combined analysis protocols to select one that minimises the loss of both types of GSR. The GSR were simultaneously collected using one carbon adhesive stub and analysed in sequence: either IGSR detection first using SEM-EDX, followed by OGSR extraction and analysis using LC-MS/MS, or inversely first OGSR extraction followed by IGSR analysis.

The sequence IGSR/OGSR represents an interesting approach if there is a minimal loss of OGSR during the first analysis (SEM/EDS). The reversed analysis OGSR/IGSR is particularly promising if IGSR are neither lost nor displaced on the stub during extraction. Results showed that the reversed sequence OGSR/IGSR protocol allowed the collection of more OGSR and did not displace the IGSR on the adhesive if the extraction was carefully performed. Moreover, this protocol allows to safeguard IGSR particles on the adhesive for further analyses.

Research findings also demonstrate that there is no correlation between IGSR and OGSR, indicating the potential added value of a combined protocol in practice.



31 May

Abstract no: PP023



Phuritpach Nantasitangkool

Royal Thai Police, Bangkok, Thailand

| POSTER

Quick guide to classify qualitative and quantitative performance of SEM/EDS and ICP-OES for gunshot residue analysis

The investigation of inorganic gunshot residue (iGSR) aimed to detect the existing particles or elements, which is containing antimony (Sb), barium (Ba), and lead (Pb) on a sample. The iGSR can be determined via either destructive or non-destructive techniques. Especially, iGSR analysis laboratory must be passed assessment competency, which is also known as proficiency test (PT). At present, PT in iGSR analysis identified two types based on ISO 13528. To illustrate, type I of iGSR PT scheme (I-iGSR PT) claimed the results of qualitative information of GSR particles. Next, type II of iGSR PT scheme (II-iGSR PT) desired the results of appearance or absence of characteristic iGSR particle on PT sample. However, selection of type of PT scheme depended on actual performance of individual instruments of each laboratory to avoid both wasting budget and unnecessary time-consuming. In this study, the Royal Thai Police cooperated with networking laboratory to propose a quick guideline for performance estimation of scanning electron microscope with energy dispersive x-ray spectrometer (SEM/EDS) and inductively coupled plasma – optical emission spectrometer (ICP-OES) by using standard deviation index (SDI). The results revealed that SDI values were nearly zero intimated actual performance of SEM/EDS or ICP-OES was proper for participating in both types of GSR PT programs. SDI value of >1 pointed out those instruments might be a persuadable performance for qualitative testing. Thus, observation of SDI value will be a preliminary tool for iGSR analysis laboratory to estimate instrument efficiency before making a decision selected subscription PT for the first or continued round.



31 May

Abstract no: PP024

**Carina Högberg**

| POSTER

The National Forensic Centre, Swedish police Authority, Linköping, Sweden

Evaporation of flammable liquids from clothes

A common question from clients, lawyers and courts is how long flammable liquids remain on clothes. The question of time duration is often difficult to answer unambiguously, given that various flammable liquids evaporate at different rates. In addition, several variables such as temperature and movement of ambient air will affect the evaporation. The clothes might also be protected from evaporation in various ways, e.g. by folding or some sort of containment.

The purpose of the study was to investigate the rate of evaporation for three flammable liquids. Several experiments were performed in controlled settings. Volumes between 25-100 mL of gasoline, biodiesel and bio lighter fluid were applied to jeans and t-shirts. After application, the fabrics were stored unfolded and exposed to evaporation or folded in open IKEA shopping bags under a bench. Room temperature was used in both cases. The sample change in headspace concentration were measured over time. Furthermore, the change in chemical composition of the liquids was investigated.

The poster will contain a description of the study design, and a summary of the results for the various flammable liquids will be tabulated for the different experimental setups. The change in chemical compositions will be described and exemplified by chromatograms. The poster will also contain a conclusion section.



31 May

Abstract no: PP026

**Madeleine Joge**

| POSTER

The National Forensic Centre, Swedish Police Authority

Will lit cigarettes ignite flammable liquids?

In films, casually flipping a lit cigarette into a pool of flammable liquids instantly evokes a cascade of flames and explosions. In this study, this cinematic notion is challenged.

In cases of arson or general negligence, cigarettes can be a possible source of ignition. In this context, the question about cigarettes' ability to ignite flammable liquids arises from both judicial practitioners and the insurance industry. Experiments trying to ignite engine gasoline by using cigarettes has been reported in previous studies, and the present study focused on three other very flammable liquids – acetone, alkylate gasoline, and E85 (85 % ethanol in gasoline). Both filtered cigarettes obtained from commercial sources and hand rolled filter-less cigarettes were investigated. In total, 60 attempts were made to ignite the flammable liquids using cigarettes. After each attempt, an open flame was applied to the flammable liquid gas phase to test the flammability of the gas phase composition.

As in previous reported studies, the results were unambiguous. No combination of cigarette and flammable liquid led to ignition of the gas phase. Dropping the lit cigarettes into the liquids did not lead to ignition. Introducing an open flame to the gas phase led to immediate ignition of all liquids.

The poster will contain an introductory chapter on previous studies, a description and images of the experimental setup, a table of the results of the study and a discussion about plausible reasons for cigarettes' inability to ignite flammable liquids.



31 May

Abstract no: PP031

**Jolanta Was-Gubala***Institute of Forensic Research, Krakow, Poland*

| POSTER

Comparison of the effectiveness of various research methods in differentiating blue denim fibres

The microtraces in the form of blue cotton fibres coming from denim clothing are a problematic object of comparative study. It is related to the very high frequency of occurrence of these fibres on the clothing market and as environmental pollution. The comparable morphological features of blue denim fibres and the presence of similar dyes in them make it difficult to conclude the possible origin of such microtraces.

The study was conducted to evaluate the effectiveness of various research methods in differentiating blue cotton fibers coming from denim clothing available on the market. The research focuses on colour assessment, determination of the morphological features and the chemical composition of analysed fibres, with the use of routine and non-destructive, as well as less frequently used and destructive analytical techniques.

In the first stage, non-destructive techniques were applied for the analysis of fragments of the single fibres, i.e. high-power microscopy (HPM), fluorescence microscopy (FM) and microspectrophotometry (MSP) UV-Vis. Then destructive methods, i.e. thin-layer chromatography (TLC) and capillary electrophoresis (CE) were used for the study of blue denim fibres. In CE analysis, the differentiation was performed according to the electrophoretic profiles of textile additives.

The analysis of the obtained results showed that the effectiveness of differentiating examined fibers using non-destructive techniques was not sufficient but allowed for their partial discrimination. Differentiation of fibres characterised by a dark shade of blue was particularly difficult and in such cases the use of destructive methods such as TLC and CE is advisable.



2 Jun

Abstract no: PP027



Yoshinori Nishiwaki

Kochi university

| POSTER

Discrimination of PET bottle fragments using synchrotron radiation X-ray absorption fine structure spectroscopy

Synchrotron radiation X-ray fluorescence spectrometry (SR-XRF) is a valuable technique for forensic analysis of trace elements in microscopic samples nondestructively. On the other hand, synchrotron radiation X-ray absorption fine structure spectroscopy (XAFS) has been used in various fields to clarify the chemical state of elements. However, it has rarely been applied to the field of forensic science. The chemical state information of elements obtained from XAFS may be significant indicators for discriminating between different evidence samples. In recent years, recycled polyester obtained from the recycling of PET bottles has become widely used in clothing fibers. Also, when PET bottles are used as containers for explosives, forensic scientists sometimes analyze the fragments as evidence samples. PET bottles (polyester) contain polymerization catalysts such as Sb and Ge and ester interchange catalysts such as Mn, Co, and Zn. The chemical state information of the elements derived from the catalyst of PET bottles could be valuable primary data for discriminating polyester fibers in the future. This study performed synchrotron radiation X-ray fluorescence and XAFS analysis to discriminate PET bottle fragments. The SR-XRF and XAFS analyses were performed at Spring-8, the world's largest third-generation synchrotron radiation facility in Japan. Using SR-XRF, Ge, Co, and Zn were detected in 20 kinds of PET bottles for hot beverages. According to XAFS spectra, PET bottles can be roughly classified into two types based on the chemical state of Ge. The results showed that the discrimination of PET bottle fragments was more accurate than using only X-ray fluorescence spectra.



2 Jun

Abstract no: PP028



Victoria Lau

| POSTER

Centre for Forensic Science, University of Technology, Sydney

The Effect of Flowing Water on the Persistence and Degradation of Evidential Fibres on a Submerged Substrate

It is not uncommon for perpetrators to attempt to destroy evidence by discarding it in a body of water – therefore, there are multiple circumstances in which evidence may need to be recovered from a substrate that has been submerged for some time. Additionally, trace evidence is often essential in these cases, as other, more typical evidence types such as DNA and fingerprints are typically destroyed or degraded by even fairly short periods of submersion. To this end, this project seeks to model both the persistence behaviour of evidential fibres in varying flow conditions and the impact degradation effects may have upon the analytical workflow.

In these experiments, fibres were exposed to 3 flow rates, chosen to represent slow, intermediate and fast current conditions, in addition to a stagnant pool of water, for periods of time up to two months. Initially, the impact of this submersion on the analytical workflow used for fibres was assessed by comparing the visible light transmission spectra before and after submersion. Afterwards, the persistence behaviour of a single fibre species was thoroughly examined in a controlled context by seeding a set number of fibres onto a realistic substrate and submerging it for a period ranging from 6 hours to 2 months, at each rate of flow. This was then repeated using a more realistic fibre transfer model. Using this data to provide estimates, some additional experiments are planned to examine more specific scenarios, including the persistence of fibres in real-world bodies of water. Initial results indicate that while degradation is limited over 2 months, persistence behaviours are distinct from those of unsubmerged garments.



2 Jun

Abstract no: PP030

**Jolanta Was-Gubala**

| POSTER

Institute of Forensic Research, Krakow, Poland

Changes in cotton and polyester fabrics under the influence of sterilization, disinfection and DNA degradation agents

Damaged textiles are often the subject of forensic examinations, but identifying their specific degrading factor is a challenge for experts. Very often, a criminal wanting to hide, destroy or erase, e.g. traces of blood, uses commonly available agents for sterilization, disinfection, and DNA degradation. Consequently, experiments were carried out consisting in subjecting a total of 9 cotton and polyester fabrics action of 6 these types of chemical agents. The purpose of microscopic and spectroscopic studies of such altered materials was to identify changes occurring in them under the influence of the applied agents. On this basis, an attempt was made to differentiate changes in the physical characteristics (for example overall morphology, colour) and chemical composition (polymer, dyes) of fabrics and their fibres, due to the kind of sterilizing, disinfectant or degrading agent used. Additionally, for the purposes of these studies the possibility of extension routinely applied methods of forensic textiles and fibres analysis (different kind of optical microscopy, UV-Vis MSP, FTIR) to chromatographic ones (HPLC-DAD, UPLC-QTOF-MS) has been investigated.

All types of textiles and fibres analysed underwent different degradation depending on the kind of agents used. The observed changes did not affect both types of fibres to the same degree – cotton fibres, i.e. natural ones, were more susceptible to damage and discoloration.

Additionally, it has been proved that the identification of textile dyes, also partially degraded, using chromatographic techniques, may be an interesting complement to the spectroscopic techniques used so far for this purpose.



2 Jun

Abstract no: PP032

**Josephine Jones***The National Forensic Centre, Swedish Police Authority*

| POSTER

Fiberpop – a local database of background fibres sampled from the seats of three public venues

At NFC, Sweden we have compiled a database containing the generic characteristics of a representative sample of background fibres collected from the seats at three public venues in Linköping: a church; a cinema and a conference centre. In total 4220 coloured fibres, which had been sampled from a number of seats at each venue, were examined. Sampling was carried out in such a way as to avoid inadvertent fibre collectives skewing the results. Characteristics such as perceived colour, generic fibre type, approximate length and cross-sectional shape were recorded and entered into the text-based searchable database. The information stored in the “Fiberpop” database can be used as an aid in estimating the relative frequency occurrence of fibres with certain generic characteristics in the general background.

This poster presents interesting results and observations regarding the frequency occurrence of fibres with certain generic characteristics from the three different venues. By sampling from different venues the population study was effectively repeated three times which enabled verification of the findings. The observations from this study are also compared to those of similar fibre population studies that have been carried out over the last thirty years and where fibres have been sampled from a variety of places and surfaces. This shows that, on the whole, the observations that we have made are remarkably comparable to those carried out in other countries.



2 Jun

Abstract no: PP034



Hibiki Komatsu

| POSTER

Kochi University; RIKEN SPring-8 Center

Nanobeam synchrotron radiation X-ray fluorescence imaging for single wool fibers for forensic investigation

Commercially available wools are dyed by acid-mordant dyeing or metal complex dyeing, in which the metallic elements Cr and Co are used. Single wool fiber is known to be exceedingly difficult to discriminate. It would be extremely useful in forensic science if the dyeing process could be estimated from single wool fibers. This study performed attenuated total reflection Fourier transform infrared (ATR-FTIR) spectroscopic imaging and nanobeam synchrotron radiation X-ray fluorescence (SR-XRF) imaging on thin cross-sections of a single wool fiber prepared using a microtome. This study aimed to investigate the protein structure and Cr distribution and estimate the dyeing method from the single wool fiber. ATR-FTIR imaging of the amide bond-derived peak ($1710\text{--}1580\text{ cm}^{-1}$) clarified the shape of the wool cross-section. Imaging of the OH-derived peak ($3700\text{--}3100\text{ cm}^{-1}$) made clear the orthocortex, a protein in the wool cross-section. Nanobeam SR-XRF imaging showed that in mordant-dyed wool, Cr penetrated the interior and concentrated in the orthocortex. In the Cr metal complex dyed wool, the Cr did not penetrate the interior and concentrated in the cuticle region. The distribution of Cr was different depending on the dyeing method. It was suggested that the dyeing method of wool could be estimated from the distribution of Cr. Combining ATR-FTIR imaging and Nanobeam SR-XRF imaging is beneficial as the new wool differentiation method. In addition, this method will enable us to evaluate the dyeing condition of wool from a new viewpoint. Therefore, it can be applied to the quality control of wool and the development of new dyeing methods.



2 Jun

Abstract no: PP035

**Aleksandra Michalska***Institute of Forensic Research, Krakow, Poland*

| POSTER

When DNA tests fail to finger the culprit – Spectroscopic analysis of transfer evidence in a vehicle accident

Contrary to widely held assumptions, occasionally, microtraces can have greater probative value than DNA evidence. Such a situation was observed when solving the vehicle accident case during which one of the three persons died on site. Despite eyewitnesses, none of them could point out the driver since people involved in the event were monozygotic twins with identical appearances, likewise their DNA. Prior to the microtraces examination, which brought hope for determining who drove a car during the accident, there were numerous mutually excluding case-related information and expertise, which indicated that the matter would probably remain unsolved.

Within the presented study, the results of the microtrace examination will be discussed. The main focus will be on mysterious smears revealed on passenger and drivers' airbags, whose analysis was highly challenging. Establishing their potential origin based on spectroscopic techniques, including infrared spectroscopy, Raman spectroscopy, and microspectrophotometry in the UV-VIS range will be presented. Interpretation of these findings supported by examination of other microtraces like single fibers transferred to airbags' surfaces as well as smears revealed on suspects' clothing allowed indicating which monozygotic twins drove the vehicle during the event.



The image features a dark, futuristic digital interface. In the center, a black hexagonal button with a red border contains the text "DIGITAL EVIDENCE" in white, bold, sans-serif font. The background is a blurred, colorful grid of data points and lines, suggesting a complex digital environment. A large, curved, metallic object is visible on the left side, and a thin, glowing white line curves across the top right. The overall aesthetic is high-tech and digital.

**DIGITAL
EVIDENCE**



1 Jun

Abstract no: PP036



Rickard Gräntzelius

The Swedish Police Authority

| POSTER

ALFA – an automatic analysis tool for the Swedish police

Nowadays, large amounts of digital material are routinely collected in the context of criminal investigations. The sources of the material are varied: Footage from surveillance cameras, photos from traffic security cameras, media extracted from confiscated cell phones, and so on. Manually analyzing this steady increase of digital material is an insurmountable task, and as such, automating the analyses is an absolute necessity for expedient criminal investigations.

ALFA is an automatic analysis tool developed for use by the Swedish police. The framework incorporates artificial intelligence in various forms and platforms, and is designed for making the life of criminal investigators easier. In its current version, ALFA focuses on analyzing large quantities of videos and images using various algorithms such as face and text recognition, object identification and color comparison.

Currently, ALFA is used in primarily two ways:

- As an easy-to-use graphical user interface for police investigators working in the context of criminal investigations
- As a service for automating tasks, such as blurring passengers of speeding vehicles captured by traffic security cameras

We will discuss the technical framework of ALFA, how its flexible design makes ALFA suitable for a variety of different tasks, and how artificial intelligence can remove tedious and time-consuming tasks from police investigators and civil servants, freeing up their time to do what they are best at.



1 Jun

Abstract no: PP037



Paulo M. G. I. Reis

National Institute of Criminalistics, Brazilian Federal Police

| POSTER

A novel method for deepfake detection using DCNN-based facial similarity scores

We present a new method to detect face-swapped videos when the portrayed person in the video is known. The method was evaluated on Celeb-DF (v2) [1], a challenging dataset with 890 authentic and 5639 deepfake videos of celebrities.

We propose using a classifier based on similarity scores obtained from a Deep Convolutional Neural Network (DCNN) trained for facial recognition. We obtain a set of similarity scores between faces extracted from each questioned video and faces extracted from a set of authentic videos (usually 9 to 11 videos), used as reference material of the person depicted. The reference videos were either already present in the dataset or collected by the authors from YouTube. From each set of scores, we take the maximum score as input to a threshold-based classifier. The threshold is chosen to minimize the half total error rate (HTER), but other thresholds could be chosen using the Neyman-Pearson criterion, depending on the application.

Using a 10-fold cross-validation strategy on the entire dataset, we obtained an AUC of 0.995 +/- 0.006 (avg +/- std. dev.). Using the training and testing splits specified on the dataset, we obtained an HTER of 0.020 and an AUC of 0.988, surpassing the most robust approaches against this dataset [2].

References:

[1] Li, Yuezun, et al. "Celeb-DF: A Large-Scale Challenging Dataset for DeepFake Forensics". 2020 IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR), IEEE, 2020, p. 3204-13.

[2] Tran, Van-Nhan, et al. "High Performance DeepFake Video Detection on CNN-Based with Attention Target-Specific Regions and Manual Distillation Extraction". Applied Sciences, vol. 11, n° 16, Aug. 2021, p. 7678.



1 Jun

Abstract no: **PP038**



Tim Brodin

| **POSTER**

Swedish National Forensic Centre, Linköping, Sweden

Estimation of 3D positions from images with uncertainty analysis using camera calibration and Monte Carlo simulations

Images from CCTVs, cellphones and other cameras are often a part of the investigations carried out at the National Forensic Centre in Sweden. In a lot of those cases questions arise regarding the position of the camera but also positions of objects, found in the image, that are no longer there. In a 3D environment, such as a point cloud of a scene, it is possible to get a good understanding of objects positions and their relation to each other, but to directly translate a point given in image coordinates into the three-dimensional space is not always an easy task.

In general it possible to make rough approximations of where objects were by observing the depicted scene and its surroundings, however the uncertainty of such approximations are difficult and sometimes impossible to define. Thus, a way to both estimate the position of an object, as well as analyzing the uncertainty of said position has been developed.

A camera model is estimated using 2D-3D correspondences between an image and a point cloud. Given a camera model, it is possible to find the 3D position of an image coordinate by re-projecting it into the scene. Furthermore, the camera model uncertainty is analyzed by modelling the input error as gaussian noise and let it propagate in simulations. This results in a statistical distribution of possible camera models, and hence an uncertainty distribution of re-projected points.



1 Jun

Abstract no: PP039



Linnea Bergsten

Swedish National Forensic Centre (NFC), Linköping, Sweden

| POSTER

Proposing guidelines for crime scene visualization in 3D

The introduction of 3D technologies in the legal system and the use of crime scene documentation in 3D calls for an understanding of how it is interpreted and a formulation of guidelines to avoid misinterpretation. This study examines aspects that affect the understanding and acceptance of crime scene visualizations. It explores how added elements should relate to realism and level of detail, how uncertainty may be represented, how information merged from different sources can be expressed, and how color can be used as a carrier of information in the context of crime scene visualization.

This study consist of a set of data collections using different methods to gain insights that can be used to form guidelines for crime scene visualization in 3D, with a focus on the visualizations produced at the Swedish National Forensic Centre (NFC). Firstly, interviews and workshops were conducted identifying challenges and opportunities. Second, divergent sketching workshops were used to identify representation strategies of uncertainty and level of detail. Thirdly, closed reading sessions were used to gain insight about how these representations could be interpreted. Lastly, a survey was used to explore different aspects that came up during the previously mentioned studies.

Insights have been gathered in the different studies. Reoccurring topics have been the importance of defining the purpose of the visualization and always relying on facts. Equally important is to always explaining symbolic use of representations. Finally, it is of importance to consider the context and the prerequisites of the receiver of the visualization.



1 Jun

Abstract no: PP040



Kirsten Buße

| POSTER

University of Bern, Institute of Forensic Medicine, Bern, Switzerland

The Morphometric 3D Reconstruction of run over accidents

The reconstruction of traffic accidents with run overs can be a complex process. A close cooperation of the individual disciplines such as forensic experts, accident experts and forensic medical specialists improves the analysis of the case. The morphometric 3D reconstruction is a powerful tool in this process.

In order to illustrate the method, a morphometric 3D reconstruction of an accident with a subsequent run over between an agricultural vehicle and a cyclist will be presented. In this case, the presumed accident site and the involved vehicle were documented in 3D using photogrammetry and laser scanning by the police, the deceased as well as their clothes were documented using CT, structured-light scanning and photogrammetry by the forensic medicine. In a next step, all the documented 3D data was brought together in a virtual 3D space, where the specialist performs the reconstruction by using an animation software. During this process, the 3D models had to be moved and turned according to all conceivable probable accident sequences to find out which injuries, damages and traces match together. As a final point, the most probable accident sequence was visualized by using images, video and a virtual reality headset.

This example shows that the morphometric 3D reconstruction is an indispensable method, which allows an interdisciplinary approach in the evaluation of hit and run over traffic accidents. The possibilities of application of this method by means of 3D techniques are wide-ranging and can provide new, unexpected, and significant insights of otherwise unclear accidents.



1 Jun

Abstract no: **PP041**



Thomas Adolfsson

Swedish National Forensic Centre

| **POSTER**

An ISO/IEC 17025 accredited method for analysis of radio frequency jammers and a toolkit for automated measurements

Radio frequency (RF) jammers have during the last decade become commonly used in all kinds of crimes, e.g. thefts, burglary, self-protection against involuntarily detonations of IED:s, general disturbances of telecommunication, datacommunication, or of GNSS positioning tools.

A plain and easy method to confirm a RF jamming functionality is simply to power on the device and keep it next to a RF receiver, e.g. a mobile phone, GPS receiver or next to a car that uses a wireless car key. However, this might not only disrupt or negatively affect the surrounding RF environment, but it may also violate regulations, acts or laws.

Numerous countries have implemented legislation that disallows usage of devices that is functioning as RF jammers. The Swedish act "Förordningen om elektronisk kommunikation" (SFS 2003:396) also forbids a general possession of such equipment, where a minor of authorities are excepted.

Swedish National Forensic Centre (NFC) has a long history of manual and automated analysis of RF jammers and their frequency spectrograms. The wired or wireless measurement takes place in a Faraday cage solution to shield off the surrounding environment, and with a spectrum analyser for the RF characterisation.

Furthermore, NFC has developed and accredited an ISO/IEC 17025 RF measurement method, along a GUI operated tool for a automated analysis and reporting. The accredited method, spectrum analyser, Faraday cage, low-cost RF analysis tool, training and the Swedish Post and Telecom Authority's (PTS) official frequency plan are all key components for providing RF jammer determination and classification capabilities amongst the Swedish police regions.



1 Jun

Abstract no: PP043



Helen Carlsson

| **POSTER**

Swedish Police Authority; National Forensic Centre; Linköping; Sweden

Method for cleaning water damaged electronic devices

The first known water damaged device we received at Swedish National Forensic Centre (NFC) was in 2018. The item, a mobile phone, was found in a river where it had been laying for six months. NFC has since then completed a numerous of cases that involves mobile phones and other miscellaneous electronic devices that has been located in the sea, lakes or in tap water for various periods.

A major issue related to water damage is the contamination from dirt, particles and ions. Such may destroy, damage or negatively affect the functionality of the device when powered on. The amount of cases eventually implied a project in order to develop a qualitative, fast, safe and forensically sound method.

The development project was split into a preparatory part, a drying and cleansing part and an evaluation part. Motherboards and mobile devices were placed in sea, lake and tap water. Each of the test objects were individually dried or baked under various controlled circumstances, cleaned in different methods, and finally evaluated.

Result

The cleansing method for water damaged electronics that concluded to forensically works best, with regards to the project aims, is taken in production as a method at NFC. Even though the method works well, it is under constant evaluation due to new electronic devices that emerges on the market.

A close-up photograph of a microarray chip, showing a grid of small circular wells. The chip is mounted on a blue base. A central black hexagonal box with a red border contains the text "DNA/FORENSIC GENETICS". White wavy lines are overlaid on the image, suggesting data flow or analysis.

**DNA/FORENSIC
GENETICS**



2 Jun

Abstract no: PP044



Martina Nilsson

| POSTER

Swedish Police Authority, Stockholm Region, Forensic Section Stockholm, Sweden

Cleaning strategies for DNA decontamination

DNA decontamination efficiency has been evaluated of ten commonly used cleaning strategies. To simulate DNA contamination, cell-free DNA and blood of known concentration and volume were deposited on three different surfaces (plastic, metal and wood). Thereafter, the different cleaning strategies were used and the areas were sampled for DNA and quantified (comparing no-treatment controls with DNA amounts detected after cleaning). Quantification was performed of mtDNA, in order to be able to detect very low amounts of DNA left after using the different decontamination strategies.

The ten decontamination strategies evaluated were: ethanol, UV radiation, ethanol in combination with UV, fresh and stored household bleach, DAX Ytidesinfektion Plus, Rely+On™ Virkon®, Trigene®, DNA Remover®, and sodium hypochlorite.

The ability to remove the two sources of DNA contamination were found to differ to a great extent between the different cleaning strategies and the different surfaces. Despite the very high amount of DNA deposited (60 ng of cell-free DNA or thousands of blood cells), several of the cleaning strategies were very efficient in removing DNA, some leaving between 0 to 0.3% DNA compared to no-treatment controls from all surfaces.

In addition to the variance of cleaning efficiency, other factors such as simplicity, safety, and cost should also be considered when the most optimal decontamination strategy is chosen. As routine forensic DNA analysis is very sensitive, the choice of the most proper decontaminating strategy is highly important.



2 Jun

Abstract no: PP045



Nanny Wallmark

The National Forensic Centre, Swedish Police Authority

| POSTER

Comparing tape-lifting to other trace DNA recovery techniques

At the Swedish National Forensic Centre (NFC), DNA trace recovery is done by tape-lifting, cutting or swabbing. Tape-lifting is performed for approximately 11.5% of the more than 65,000 crime scene samples analysed each year. It is currently the method of choice for touch DNA and wearer DNA on garments as well as for airbags without visible traces. For touch DNA on garments, tape-lifting is considered the only alternative. The aim of this study was to investigate if swabbing or cutting could generate results comparable to tape-lifting for sample collection of wearer DNA on different clothing items and airbags. Being able to replace tape-lifting for these items would lead to a quicker analysis process with less manual work and possibly to a higher fraction of single-donor DNA profiles. Clothing items and airbags submitted to the lab were chosen for sampling. The garments chosen represent commonly submitted items. Trace recovery was performed on ten jackets, ten caps, twenty gloves and twenty airbags. All three sampling methods were applied for jackets and caps. For gloves tape-lifting was compared to either cutting or swabbing. For airbags, tape-lifting was compared to swabbing. Samples were extracted, quantified and amplified and the usability of the generated results was evaluated.



2 Jun

Abstract no: PP046



Åsa Jufvas

The National Forensic Centre, Swedish Police Authority

| POSTER

DNA vs. fingerprints on knife handles, explosive detonators and hand grenade levers

The combination of DNA and fingerprint examination on items is common in case work, resulting in compromises for both types of methods. Swabbing for DNA will ruin any fingerprint in the swabbed area and methods used in the fingerprint examination will preclude additional DNA analysis e.g. due to the deposition of chemicals on the surface. For some types of items, knowledge about the success rates for DNA or fingerprint examination has already made this evaluation unnecessary, both saving time and increasing the chance of success for the method of choice. We have conducted retrospective studies regarding the outcome of DNA and fingerprint examinations on knife handles, explosive detonators and hand grenade levers. Results from 95 case work knives examined between 2016 and 2018 were evaluated regarding the success rate of the respective method. All knives had been examined both regarding DNA and fingerprints. Useful DNA results were found on 20% of the knife handles while no fingerprints that could be used for identification were detected. However, useful fingerprints were found on 6% of the blades. 56 cases with explosive detonators and 128 cases with hand grenade levers examined between 2015 and 2020 were evaluated regarding the success rate of the respective method. Not all detonators and levers were examined regarding both DNA and fingerprints. Also, the number of detonators and levers differed between cases. Useful DNA results from explosive detonators were found in 29% of the cases and from hand grenade levers in 31% of the cases. No fingerprints that could be used for identification were found in any of the cases.



2 Jun

Abstract no: PP047



Georgina Meakin

| POSTER

Centre for Forensic Science, University of Technology Sydney, Australia; Centre for the Forensic Sciences, University College London, UK

Effect of swabbing technique and duration on trace DNA recovery

Various factors have been shown to affect performance of the conventional wet-dry double and single wet swabbing techniques to recover DNA, such as pressure and angle of application, volume and type of wetting agent, and swab type. However, casework laboratories in some jurisdictions employ different swabbing techniques that include wet-moist double swabbing and moist-dry single swabbing. Factors affecting the effectiveness of these recent techniques in maximising DNA recovery therefore need to be investigated. Here, we present a preliminary study that compared the traditional and recent swabbing techniques and investigated the impact of swabbing duration on DNA recovery. Ten μl aliquots of a known concentration of DNA extracted from human blood were deposited on pre-cleaned DNA-free cotton swatches (porous) and porcelain tiles (non-porous). Five swabbing techniques were used, of which three were double swabbing techniques: wet-moist, wet-wet and wet-dry, and two were single swabbing techniques: wet and moist-dry. For moist-dry, water was applied to one side of the swab, leaving the other side dry. Each swabbing technique was applied for two durations, 15 and 30 sec per swab, with 5 reps of each combination ($n=100$ plus controls). All samples were extracted and quantified, and a sub-set was profiled. The results showed that the wet-moist double swabbing technique with a swabbing duration of 30 sec maximised DNA recovery from cotton. From tile, a single wet or moist-dry swab maximised DNA recovery, but increasing swabbing duration from 15 to 30 sec had no impact. These data can be used to inform standardisation of DNA collection protocols across casework laboratories.



2 Jun

Abstract no: PP048



Linda Jansson

| POSTER

The National Forensic Centre, Swedish Police Authority, Linköping, Sweden; Applied Microbiology, Department of Chemistry, Lund University, Lund, Sweden

Evaluation and optimization of protocols for cell type determination by mRNA profiling

Identification of human body fluids through mRNA analysis is being increasingly applied in forensic casework. Different analysis processes including co-extraction of DNA and RNA, multiplex RT-PCR assays targeting cell-type specific markers, and amplicon detection applying capillary electrophoresis (CE) or massively parallel sequencing (MPS) have been developed and proven useful. However, there is currently no “gold standard” method or commercial kit available. At the Swedish National Forensic Centre (NFC), there is ongoing work to evaluate the performance and usability of different DNA/RNA co-extraction methods, applying the ABI 3500xL Genetic Analyzer instrument. Mock samples of blood, saliva, semen, and vaginal and nasal mucosa in different amounts were prepared. The recovery of DNA and RNA was compared between four different extraction protocols: 1) The mirVANA miRNA Isolation kit (Thermo Fisher Scientific) in combination with QIAamp DNA Mini kit (Qiagen), 2) the ReliaPrep RNA Miniprep Systems in combination with DNA IQ System (Promega), 3) the AllPrep DNA/RNA/miRNA Universal kit (Qiagen), and 4) the ZymoBIOMICS MagBead DNA/RNA kit (Zymo research). The DNA recovery was further compared to the in-house Chelex-based DNA extraction method. In addition, different post-PCR purification kits were evaluated concerning ease of use and ratio between specific and unspecific peaks in the CE analysis.



2 Jun

Abstract no: PP049



Anastasia Haratourian

Forensic Section, Stockholm Police Region, Swedish Police Authority

| POSTER

Evaluation of different storage milieus on their efficiency of preserving DNA traces on objects immersed in freshwater

When committing a crime, traces are often left behind on the crime scene as well as on the tools used in connection to the crime. In order to rid said objects of their forensically valuable stains, perpetrators commonly subject them to various harsh environments with the hopes of destroying any DNA left behind. With this born in mind, it is essential for police authorities to find more efficient ways of preserving DNA traces. The aim of this study is therefore to evaluate four different methods of storage; air drying in room temperature, freezing at -30°C , drying in nitrogen gas and incubation in freshwater, on their efficiency of preserving DNA that has been subjected to the detrimental effects of freshwater. Different kinds of biological material, such as blood, saliva, hair and touch-DNA were deposited on sheath knives, smartphones, garbage bags and tapes, and immersed in the freshwater of Drottningholm, Stockholm for three different time periods; 2 days, 7 days and 3 weeks, and later stored in various conditions. Results show that the DNA preservation varied significantly between different methods of storage, from good to very poor preservation. These promising results indicate a future implementation in the routine work of the Swedish police.



2 Jun

Abstract no: PP050



Martina Nilsson

| POSTER

Swedish Police Authority, Stockholm Region, Forensic Section Stockholm, Sweden

Improved touch DNA analysis by optimized sampling, extraction and amplification from explosions and sexual crimes

In most major crimes, forensic evidence is crucial why it is highly important that the most optimal methods are developed and implemented in routine casework. For analysis of touch DNA, often containing very small amounts of DNA, this might be even more important for the investigations. Evaluation has therefore been performed of the DNA sampling, extraction and amplification of minor amounts of DNA. Moreover, crime scene evidences often are degraded and contains various inhibitors, making successful DNA analysis even more complicated.

For optimal DNA sampling, different types of swabs and tape sampling approaches were assessed and for the evaluation of the most optimal DNA extraction different kits were evaluated. For cases involving improvised explosive devices there is also a great risk of having inhibitors within the DNA samples, making amplification even more difficult. To overcome the inhibitory effect, various DNA polymerases were evaluated to find the most efficient amplification of this type of samples. Also, this type of DNA sample often is degraded, presenting an additional challenge in forensic analysis.

To improve analysis of challenging samples, different DNA sampling, extraction and amplification protocols have been evaluated by analyzing DNA from different sources, including limited DNA amounts, degraded DNA and inhibitors. Comparisons were performed by real-time DNA quantification to demonstrate differences between the methods evaluated. The findings will be used to further improve DNA analysis of for example evidence from explosions in terrorist cases or sexual assaults, often associated with challenging DNA samples in forensic investigations.



2 Jun

Abstract no: PP051



Shirin Alex

The Netherlands Forensic Institute, The Netherlands

| POSTER

Phenotypic characterization using mass spectrometry based proteomics

Authors: Shirin Alex^a, Marcel de Puit^{a,b}, and Laura de Clerck^c

Affiliations:

a: Netherlands Forensic Institute, Laan van Ypenburg 6, 2497 GB Den Haag

b: Department of Chemical Engineering, TU Delft, Mekelweg 5, 2628 CD Delft

c: University of Ghent Laboratory of Pharmaceutical Biotechnology, Campus Heymans, Ottergemsesteenweg 460, B-9000 Ghent, Belgium

Abstract:

In forensic science, DNA analysis is regarded as the gold standard when it comes to the individualization of traces. However, some forensic applications cannot rely solely on DNA analysis, like identification of the biological origin of a trace which can play an important role in the reconstruction of events. Also, biological evidence, especially in older samples, regularly contains little, damaged, or no DNA. Therefore, mass spectrometry-based (MS) proteomics shows promising potential in forensics. MS-based methods can identify a single as well as mixtures of biological matrices from different species without any additional sample consumption, preserving the full trace for DNA extraction. This project represents the initial screening of phenotypic markers for gender along with other phenotypic features such as age and BMI.

Method :

Blood was collected via a fingerpick from donors (sample size = 100) and was transferred to an Eppendorf followed by a brief step of sonication and centrifugation to extract the proteins from the sample. The extracted proteins were digested overnight using Trypsin/LysC. The digested peptides were purified and analyzed using data-dependent acquisition (DDA) on the Triple TOF 6600 (Sciex).



2 Jun

Abstract no: PP052



Wisarn Worasuwanarak

| POSTER

Department of Pathology, Faculty of Medicine Ramathibodi Hospital, Mahidol University, Bangkok, Thailand

Study of the DNA Extraction from Nail by Spin Column-Based Nucleic Acid Purification

Background: Spin column-based nucleic acid purification is one of the DNA extraction techniques used to extract various kinds of biological samples and is useful for forensic samples. This study aims to extract DNA from the nail and evaluate the yield and quality of DNA.

Materials & Methods: Nail samples from 15 males and 15 females over 18 years old were extracted using GeneAll® Exgene™ Cell SV Mini Kit and resuspended in 30 µl in volume. The DNA concentration and purity were measured using Nanodrop Spectrophotometer, and the quality of DNA was assessed by PCR technique using primers specific for human growth hormone (HGH).

Results: The average yield of DNA was 0.816 µg (range 0.141 – 2.706 µg) was obtained from the average nail weight of 30.2 mg (range 22.2 – 40.0 mg). The average DNA concentration was 27.2 ng/µl (range 4.7 – 90.2 ng/µl), corresponding to 30 µl in volume. Almost all DNA samples (96.7%) had high purity (A260/A280 ≥ 1.80) and gave a band of PCR product of the HGH gene on agarose gel electrophoresis. Nail from males gave a slightly higher DNA yield than females and no difference among various age groups.

Conclusion: Spin column-based nucleic acid purification is recommended for nail DNA extraction because of its simplicity and high quality.



1 Jun

Abstract no: PP055



Lina Boiso

The National Forensic Centre, Swedish Police Authority

| POSTER

Efficient workflow for low template DNA analysis

Low template (LT) DNA analysis is more complex than standard forensic DNA analysis due to the higher risk of contamination and stochastic effects. At the Swedish National Forensic Centre (NFC), LT DNA samples are handled in designated areas, fewer samples are analyzed in each batch and duplicate analysis is performed for the extracts to allow for consensus evaluation. When NFC set up the first LT DNA workflow in 2004, 230 samples were analyzed corresponding to around 1% of the total number of trace samples. Since then, there has been an increased demand for DNA analysis including LT. During 2021, the LT samples (~3700) corresponded to approximately 6% of the total workload. The largest increase is seen for cartridges and cartridge cases, which now make up almost 50% of the LT samples. In order to handle the increased workload NFC has streamlined the LT workflow e.g. by applying quantity limits and parallel DNA-profiling (duplicate analysis) as well as simplified DNA extraction for cartridges and cartridge cases. The continuous search for and removal of bottlenecks in the workflow has enabled a higher analysis capacity in a resource efficient way, while maintaining the quality of the results.



2 Jun

Abstract no: PP053



Therese Hasselqvist

The National Forensic Centre, Swedish Police Authority

| POSTER

Activity level reporting of crime scene DNA evidence

The main part of the DNA reporting from the Swedish National Forensic Centre (NFC) is at sub-source or source level, while most of the questions arising at court are at activity level. Over the years, activity level questions have mainly been answered verbally in court, but since a few years a group of forensic experts offer a wider range of structured, written answers. Approximately 50-100 DNA activity level issues are handled by NFC per year. 10-20 questions are answered in writing and include general information regarding DNA transfer, a few in written statements and the rest are verbally presented in court. Main concerns regarding the reporting at activity level are the lack of data regarding DNA transfer and inadequate case specific information. The strength of the forensic result depends on two case specific propositions and the information under which they are evaluated. The formulation of relevant propositions is often difficult but of great importance since the propositions will affect the strength of the result. We will discuss the complexities in activity level issues, how to formulate relevant propositions and present casework statistics. Our future work in the field includes establishing in-house guidelines, conducting and participation in studies on DNA shedding and transfer.



2 Jun

Abstract no: PP054



Maria Martin Agudo

| POSTER

Department of Forensic Sciences, Oslo University Hospital, Oslo, Norway; Department of Forensic Medicine, Institute of Clinical Medicine, University of Oslo, Oslo, Norway

Comprehensive characterization of STR-MPS stutters

Interpretation of DNA evidence is complex in mixtures that contain, at least for one of the contributors, low amount of DNA. In these situations, artefactual stutter sequences observed from the major DNA contributor, may overlap with allele sequences from the minor contributor. Previous studies with capillary electrophoresis (CE) have shown that a linear relationship exists between stutter ratios and the longest uninterrupted stretch (LUS) of the parental allele. With the introduction of massively parallel sequencing (MPS), the block length of the missing motif (BLMM) has been found to be an even better predictor of stutter ratios than the LUS.

Modelling MPS stutters is much more complex than CE stutters. This is because models must take into consideration the sequence of the parental alleles. In this study, a beta regression model was used to investigate the relationship between the stutter proportion and candidate explanatory variables. In the final model, stutter proportions were explained by the length of the parental uninterrupted stretch, which is comparable to BLMM. Also, different stutter types (e.g., $n+1$, $n-1$, $n+2$, $n-2$, n_0) were analyzed separately per each locus. The fitted stutter models were then integrated into an extended probabilistic genotyping model based on EuroForMix (MPSproto). An illustrative minor/major mock mixture example is discussed. Evaluation of multiple types of stutters on a per locus basis greatly improved the probabilistic genotyping result as compared to the conventional EuroForMix model, using the LUS+ nomenclature.



2 Jun

Abstract no: PP056



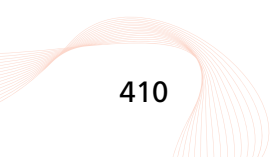
Staffan Jansson

The National Forensic Centre, Swedish Police Authority

| POSTER

In-house validation of DNAXs at the Swedish National Forensic Centre

Today's sensitive DNA-analysis systems have created an increased demand for software aided probabilistic interpretation. One such candidate is DNAXs which has been internally validated at the Swedish National Forensic Centre (NFC) according to ENFSI's best practice manual regarding probabilistic software. Among the parameters tested were: correct identity, repeatability, robustness and stability. DNAXs is a software suit for data-management and probabilistic interpretation of DNA results developed at the Netherlands Forensic Institute (NFI). For the probabilistic calculation DNAXs uses a module called DNAStatistX, based on a well-established statistical algorithm. The aim of the validation was to evaluate whether DNAXs is an appropriate tool for daily casework at NFC and to assess its possibilities and limitations. The validation was performed by calculating likelihood ratios (LR) using a dataset ranging from single donors to five-person mixtures from known contributors. The total number of LR calculations performed was 602, distributed between calculations for true contributors/non-contributors and correct/incorrect number of contributors (NOC) in the hypothesis. All LR calculations for a true contributor gave support for correct hypothesis or inconclusive. The inconclusive results could be explained by incorrect NOC in the hypothesis or missing information due to low amount of DNA from the contributor. An additional benefit was that the validation process resulted in protocols and instructions for the working procedure to be used once implemented. Overall, DNAXs was found to be user-friendly, robust and a valid candidate for use at NFC in everyday casework.





2 Jun

Abstract no: PP057



Georgina Meakin

| POSTER

Centre for Forensic Science, University of Technology Sydney, Australia; Centre for the Forensic Sciences, University College London, UK

Investigation of background DNA in a communal kitchen and its potential onward transfer

DNA deposited prior (background DNA), during and/or after an activity of interest may be present in a forensic sample. Better understanding prevalence of background DNA helps inform DNA evidence evaluation. Here, background DNA on surfaces in a communal kitchen was investigated, along with the potential onward transfer of DNA from examined surfaces. DNA swabs were taken from two floor, two table and one counter sites (n=25). Floor and table sites were chosen as close to potential offender entry/exit points (window/door). Cleaned plastic L-shaped scales were placed on un-sampled areas of two sites for 5 min and half of each scale was swabbed (n=6). The scales were then placed on a cleaned polycarbonate board for 5 min and each board was swabbed (n=6). Regularly-used handles of the door, refrigerator and kettle were also swabbed (n=9). DNA was extracted, quantified, profiled, and MNC determined. Samples were grouped according to surface category with median DNA quantities of 1.51 (MNC=4), 0.59 (MNC=2) and 1.35 (MNC=3) ng recovered from the floor, counter/table and handles, respectively. Significantly less DNA was recovered from the counter/table than the floor and handles, possibly due to more frequent cleaning, and a significantly higher MNC was observed for profiles from the floor than from the counter/table and handles. This illustrates the variation and complexity of background DNA on different surfaces within a communal room. Although DNA was recovered from the sites sampled, no DNA was detected on the scales or boards, supporting the idea that detectable DNA transfer may not occur when passive contact is made between non-porous surfaces containing only background DNA.



2 Jun

Abstract no: PP058



Linda Jansson

| POSTER

The National Forensic Centre, Swedish Police Authority, Linköping, Sweden; Applied Microbiology, Department of Chemistry, Lund University, Lund, Sweden

Shedder status variation and effects of external factors

The ability to leave DNA behind on touched items and surfaces differs between individuals, and is referred to as “shedder status”. The existence of “good” and “poor” shedders has been proposed, but studies have also shown that individuals may vary extensively in their ability to deposit DNA at different times and under varying conditions. We have recently shown that amounts of deposited DNA are highly associated with the levels of DNA on the skin of the forehead. This suggests that DNA may accumulate on hands due to touching or rubbing one’s face. Here, we investigate how the shedding ability of six males varies between different occasions ($n = 20$), and whether the deposited DNA amounts are correlated to DNA collected from the face and to sweat levels in both hands and face. Further, we study whether external factors such as seasonal variation, cold temperatures, physical exercise and hygiene routines have an impact on the shedder status of these individuals. Increased knowledge about factors that influence an individual’s shedder status may assist in the assessment of DNA results, for example concerning activity level propositions.



2 Jun

Abstract no: PP059



Bart Aarts

Netherlands Forensic Institute, The Hague, The Netherlands

| POSTER

Who was the driver of the car? Using experimental data to evaluate DNA findings at activity level

Cars that were used in a crime are often sampled for DNA to help identify the driver. When a person of interest has been linked to DNA collected from the car, a frequent question to answer is whether that person was the driver at the time of the offence. Alternatively, this person may have been present as a passenger or may have driven the vehicle at an earlier moment in time.

Evaluation of the findings given propositions at activity level requires experimental data on the transfer, persistence, prevalence and recovery (TPPR) of DNA. Previously we have presented data on prevalence of DNA within vehicles that are operated by a single driver, either with or without a regular passenger (Boyko et al., 2020, FSI 301: 110139; De Wolff et al. 2021, FSI 320; 110713). Here we have expanded on these data by examining cars where an incidental driver was introduced. In two laboratories, we have sampled DNA from multiple locations immediately after use by an incidental driver, and at two different time points after use by the incidental driver and subsequent use by the owner. These data inform the probabilities of persistence of DNA of both the owner of the vehicle, as well as that of the incidental driver and others.

Differences in experimental outcomes by the two different labs and their consequences for evaluation of findings given activity level propositions in casework are discussed.



2 Jun

Abstract no: PP060



Puneet Setia

| POSTER

All India Institute of Medical Sciences, Jodhpur, India

Analysis of gene expression of cardiac-specific gene Cardiac troponin I to estimate time since death

Background: The determination of time since death (TSD) is an essential and one of the most challenging part of legal medicine. There are several methods for estimating the TSD, including physicochemical, entomological, biochemical, metabolic, autolytic, and physical methods, which provide a wide range of time since death, but these methods are always questionable because they are affected by multiple factors. The idea behind the present study is to calculate the accurate PMI by using gene expression of cardiac-specific gene cardiac troponin I (cTnI).

Methods: 16 cadaver heart tissues were analyzed by using RtPCR within a time frame of up to 24 hours from the time since death, at different time intervals (0,6,12 hour) at room temperature. Fold change gene expression was determined and the data was analyzed using the value of average delta ct (Δ ct) value of assessed gene and housekeeping gene (GAPDH), and delta delta ct ($\Delta\Delta$ ct) value to calculate the fold change expression at the different 7-time group (0-6 hrs, 6-9 hrs, 9-12 hrs, 12-15 hrs,15-18 hrs,18-21 hrs, 21-24 hrs).

Result: The results obtained showed the fold change gene expression of cardiac troponin I was almost stable till 15 hours of PMI and then after 15 hours expression shows downregulation up to 24 hours after the death.

Conclusion: It is concluded that the fold-change gene expression of cTnI was almost stable for 15 hours. Thus, the estimation of PMI by analysis of the fold change gene expression of cardiac-specific gene cTnI is a new promising method in forensic medicine.

Keywords: Gene expression, Post-mortem interval, Cardiac troponin I, GAPDH, Molecular biology.



2 Jun

Abstract no: PP061



Marek Kowalczyk

Institute of Forensic Research, Kraków, Poland

| POSTER

Application of automated laboratory preparation methods in Cannabis STR markers analysis for forensic purposes

Hemp (Cannabis) is one of the oldest cultivated plants. Due to effortless cultivation, narcotic-type products are widespread and relatively easily available drugs. Drug-type hemp products are prohibited by law in many countries then it is important to distinguish between fiber and drug type. Routine method of Cannabis type distinction is physicochemical analysis of the tetrahydrocannabinol (THC) level. In case the quantity/type of material is insufficient or ineligible for toxicological analysis, genetic identification may be an alternative approach.

The aims of this research are:

- 1) Establishment of a method to include cannabis samples after toxicological analyses for automated DNA extraction with QIA Symphony SP workstation (Qiagen).
- 2) Development of scripts for Fluent 780 workstation (Tecan), designed to prepare amplification reactions for 23 Cannabis STR markers, based on the appropriate predilution scheme algorithm.

Dried plant extracts (various hemp parts), remaining after toxicological analysis, were tested. Obtained DNA quantification results indicate that developed extraction method modification provides sufficient DNA amount for STR markers analysis. Based on the developed script and the dilution scheme, the amplification of Cannabis STR markers was prepared using Fluent 780 workstation. For all tested samples balanced genetic profiles were obtained, proving the correct script and the dilution algorithm functioning. Automation of sample processing workflow significantly reduces analysis time, eliminates the risk of human errors and sample cross-contamination. The developed method is suitable for implementation in appropriately equipped forensic laboratories.



2 Jun

Abstract no: PP062



Merlyn Link

| POSTER

Estonian Forensic Science Institute, DNA department

Combined fingerprint and DNA joint examination

In many cases, police investigators may doubt whether to send the subject of the examination for a fingerprint or a DNA examination. Also, fingerprint experts often see tactile traces of objects that are not identifiable but could be sampled after fingerprinting them. At the same time, DNA experts frequently take samples from large objects intuitively and randomly, without knowing where exactly they have been touched.

Estonian Forensic Science Institute Fingerprint department and DNA department started a collaboration project with the aim of finding out whether the joint handling of expertise objects improves identification of traces. Feasibility of obtaining a genetic profile after fingerprint detection was studied. DNA profile quality was assessed after different fingerprint enhancement methods were used and the results are described. Visualization of fingerprints allows to see where finger and palm prints are located on the object, from which DNA samples can be taken. It is particularly important for the DNA expert on larger surfaces where it is not known where the person's DNA might be located. Knowing the location of fingerprints can reduce the number of samples and makes it possible to take a DNA sample from the trace of one donor, thus avoiding a mixture and improving the quality of the DNA result. Also, combined fingerprint and DNA joint examination allows to use good quality prints for both, fingerprint and DNA analysis and fragments of prints that are not suitable for fingerprint identification, can be used for DNA analysis.



2 Jun

Abstract no: PP063



Joséphine Gibert

| POSTER

French Gendarmerie Forensic Institute, Gendarmerie Nationale, Cergy-Pontoise, France

Comparison of MPS with CE-based genotyping using GlobalFiler STR amplification kits on degraded DNA samples

Current forensic analysis of short tandem repeat (STR) markers by capillary electrophoresis (CE) based genotyping is an efficient and well-known technique. Unfortunately, the genetic material collected on crime scenes has often suffered from harsh environmental conditions, causing numerous analytical issues and therefore limiting data interpretation. Emergence of new massively parallel sequencing (MPS) technologies in recent years within forensic laboratories has demonstrated their improved sensitivity in detecting complex samples and especially those with degraded DNA. In order to apply such technology to our analytical workflow, MPS on the Ion S5™ platform was compared with the current CE-based genotyping method. For this purpose, single source samples of SRM 2391c (NIST) were normalized to 1 ng of DNA and then artificially degraded during 2, 4, 8 or 12 minutes under UV light at 254 nm. When comparing only the 20 common autosomal STR markers targeted in both processes, a full DNA profile was obtained with MPS up to 4 minutes of UV exposure (slight degradation, Degradation Index (DI) \approx 10) while only 60% of the markers are still complete with the routine method. This difference was also seen after 12 minutes of degradation (very strong degradation, DI = 86) where the Ion S5™ system still enabled 71% of the common markers to be observed, compared to 25% with CE-based genotyping. Overall, the MPS was then able to significantly increase the amount of information available on the profile by up to 180%. This technology is therefore particularly interesting to implement in the case of challenging samples such as human bones or in cold cases.



2 Jun

Abstract no: PP064



Yann Chovory

| POSTER

Forensic science institute of the french gendarmerie, cergy-pontoise, france

Development of software for the analysis and interpretation of electrophoregrams via an artificial neural network

Electropherograms are produced in large numbers in the laboratories of the Forensic Science Institute of the French Gendarmerie in the context of daily criminal cases. Before the results of these electrophoregrams can be used, they must be examined by analysts to determine the alleles and artifacts. A technique that lends itself well to such a task of classification in the face of vast amounts of data is the use of artificial neural networks as demonstrated by Dr Duncan Taylor in his publications.

All expertise rendered by our experts are used here to form a strong learning based on their experience.

The interpretation as well as the visualization and annotation of the electropherograms will then be proposed in a web application allowing an aid to the analysis and the interpretation in this judicial context where the error is not conceivable.



2 Jun

Abstract no: PP065



Mari-Ann Piht

Estonian Forensic Science Institute, Tallinn, Estonia

| POSTER

Evaluation of the ForenSeq MainstAY Kit

Improvements in massively parallel sequencing (MPS) technology have made it a useful tool in forensic DNA analysis, making it possible to gather more detailed information than is possible with conventional sequencing methods. The Estonian Forensic Science Institute acquired its first MPS platform – Illumina’s MiSeq FGx – in 2019. Since that time, however, the platform has seen less use than we would have hoped for in the beginning. The reasons behind it are the high cost per sample and not enough benefits when compared to the traditional methods, which produce good results for regular casework samples for a much lower price.

The ForenSeq MainstAY Kit is a recent addition to the toolbox of DNA analysis methods in the Estonian Forensic Science Institute and is expected to be a solution to that issue. This kit is much more affordable while providing the simultaneous analysis of 52 genetic markers – 27 global autosomal STRs (including CODIS and European Standard set) and 25 Y-STRs (including minimum set for the Y Haplotype Reference Database (YHRD)). The set of markers abundantly covers the needs of most forensic DNA applications. However, before implementing it fully, it is important to compare the kit with the methods currently in use to determine the benefits and possible drawbacks of using it in everyday casework. In this study, the results of the comparison are described.



2 Jun

Abstract no: PP066



Siri Aili Fagerholm

| POSTER

The National Forensic Centre, Swedish Police Authority, Linköping, Sweden

Formulating intelligence reports based on forensic DNA phenotyping

DNA phenotyping is a field of forensic DNA analysis where intelligence information is provided, such as assessment of an individual's hair and eye colour or biogeographical ancestry. Following in-house validation of the ForenSeq system (Verogen) and extensive evaluation of persons with known phenotypes and ancestries, we here report on our work on formulating forensic intelligence reports for investigators. Our developed framework includes instructions on how to report the predicted traits consistently and using clear verbal statements rather than probability measures. For biogeographical ancestry, we found that running SNP data through several available software (Universal Analysis Software, GenoGeographer, Structure and Snipper) and then combining the results provided an added value. We evaluated our framework by performing a blind study. Twenty-two persons were chosen to provide variation in appearance and biogeographical ancestry, including mixed ancestry. DNA analysis, interpretation of results and formulation of forensic intelligence reports was performed for each blinded sample, and the outcome was compared to self-reported values. In summary, correct eye colour was reported for 21 of 22 (95%) persons and correct hair colour for 16 of 22 (73%). For 18 of 22 (82%) persons, correct biogeographical ancestry was reported.



2 Jun

Abstract no: PP067



Melina Olstedt

The National Forensic Centre, Swedish Police Authority

| POSTER

Sixteen years with a fast and efficient system for analysis of forensic DNA reference samples

In January 2006, a new Swedish legislation on obtaining DNA reference samples and uploading of the subsequent DNA profiles in the national DNA database gained legal force. This allowed buccal swabs to be taken and DNA profiles to be stored from suspects of offences that could result in imprisonment. To handle the expected increase in number of samples, a semi-automated workflow with a per annum capacity of 50,000 samples was built up. The system utilises DNA collection cards and integrates digital requests, logistics, digital data transfer, automatic evaluation of DNA profiles, LIMS and laboratory automation. Here we present the continuous improvement of the workflow since 2006, e.g. incorporation of direct amplification, further automation regarding sample transfer and LIMS development. The improvements have led to significantly reduced hands-on-time and turnaround time. The sample processing is initiated when the investigator sends a digital request for analysis to the LIMS. When the samples are delivered to the laboratory in the morning, they are automatically registered in the LIMS using OCR scanning. The samples are analysed twice in parallel batches and the DNA profiles are automatically evaluated using the LIMS. Sample registration, PCR, capillary electrophoresis and automated result classification are performed on the day of arrival. The DNA profiles are searched against the DNA database and in the event of a match a hit report is automatically generated and sent by e-mail. During 2021, NFC analysed approximately 33,000 reference samples. The turnaround time is currently 1-2 days but can be as low as 2.5 hours for highly prioritized cases.



2 Jun

Abstract no: PP069



Sonja Menges

Bundeskriminalamt, Wiesbaden, Germany

| POSTER

Two years of practical application of the SmartRank software in Germany: a status report

SmartRank is an open-source software tool developed by the Netherlands Forensic Science Institute as part of an EU project. It allows searching national DNA databases with complex DNA profiles. In order to explore the option of using SmartRank in Germany, the DNA division of the BKA Forensic Science Institute adopted the SmartRank software and initiated a pilot project starting with a validation study. Based on our promising results, it was decided to put the software into practical use. Since it is currently not possible to integrate SmartRank into the German DNA database, a concept for a provisional practical application has been developed that enables federal and state police investigative agencies to have SmartRank searches carried out.

In the framework of this interim solution we have processed nearly 600 SmartRank queries since March 2020 and have performed the corresponding database searches for mixed DNA traces. Here we present our findings and experiences and also describe some challenges we have faced. One of the most important practical aspects concerns the usefulness of the search results for the investigations, i.e. the question of whether or not the SmartRank search provided useful investigative leads. Based on the feedback of the investigators our general conclusion is that SmartRank is a useful and powerful tool for everyday policework. We observed striking differences in the success rate of SmartRank searches by different local laboratories. As a possible explanation for these differences, the chances of success might be strongly influenced by the selection and quality of the traces.



2 Jun

Abstract no: PP5002



Abdulla Albastaki


| POSTER

General Department of Forensic Science and Criminology, Dubai Police G.H.Q., Dubai, United Arab Emirates

Design and development of novel single multiplex system incorporating 26 rapidly mutating Y-STRs; 26 RM Yplex

The male-specific part of the human Y chromosome is widely used in forensic DNA investigation through the analysis of special repetitive units called the Y-short tandem repeats or the Y-STRs. These Y-STRs are normally passed down through the paternal lineage in an identical manner, making their analysis very useful in forensic cases, paternal kinship, and genealogical examination. Rapidly mutating (RM) Y-STRs have shown to increase the differentiation between of male relatives. A single multiplex system was developed to simultaneously amplify 26 rapidly mutating (RM) Y-STRs; 26 RM Yplex. The markers comprised in this multiplex include: DYF1001, DYS724, DYF1000, DYR88, DYF1002, DYF403S1a, DYF399S1, DYF404S1, DYF387S1, DYS570, DYF403S1b1/b2, DYS627, DYS612, DYS518, DYS712, DYS1007, DYS1003, DYS626, DYS685, DYS1010, DYS1012, DYS449, DYS547, DYS576, DYS526b, and DYS688. A sequenced allelic ladder was constructed for the assay to confirm the calling of alleles at each locus. The system was evaluated for its performance in various tests, such as sensitivity, DNA mixtures, stability, reproducibility, and species-specificity. The novel multiplex assay generated complete profiles down to 0.125 ng of male template DNA and showed to be human-male specific. The multiplex has successfully typed all allelic calls up to 1:3200 ratio of male/female mixtures, whereas in male/male mixtures full profiles were detected up to 1:9. Full profiles could be obtained when humic acid concentration was 1500 ng/ μ L, and tannic acid was 400 ng/ μ L. The 26 RM Yplex has proved to generate robust results in many pre-validation tests and showed great potential for the use in forensics and research studies.





**FORENSIC
MEDICINE AND
TOXICOLOGY**



31 May

Abstract no: PP070



Lydia Kahn

| POSTER

Department of Oncology-Pathology, Karolinska institute, Stockholm, Sweden

17-month-old baby nearly strangled by human hair when co-sleeping with the mother

Hair tourniquet syndrome occurs when hair become tightly wrapped around an appendage, when it involves the neck, death can occur within minutes. It is of importance to assess injuries in relation to other findings to distinguish between accidental and non-accidental cause.

A 17-month-old child was brought into the ER via ambulance after an episode of apnea and unconsciousness. The mother was co-sleeping with the child and woke up because she thought the child pulled her hair. The child was found with the mother's hair wrapped around its neck. The child was unconscious, and the father cut the hair. EMS was called and when they arrived the child was conscious. The child's vital signs were normal. On forensic physical examination, a linear, circumferential light red mark on the neck was noted. Numerous petechiae were seen in the skin above the circumferential mark and a cluster of skin hemorrhages was seen on the right side of the neck. Older bruises were noted on the forehead, arm, back, and legs bilaterally. Whole body x-ray was normal, with no evidence of previous or acute fractures. The circumference of the child's neck was 25.5 cm. Upon investigation, the mother's hair was confirmed to be 40 cm long and the cut hair, found on the bed, was 35 cm long. In the end the case was considered an accident.

It is essential to consider child abuse. However, rare injury patterns in children can be difficult to assess. In such cases, it is extra important to have an intradisciplinary approach and carefully evaluate the findings from the scene investigation and forensic physical examination based on the provided history, as well as investigate signs of previous physical abuse.



31 May

Abstract no: PP071



Aime Riikoja

Estonian Forensic Science Institute

| POSTER

Drugs in used syringes from Estonian cities Tallinn and Narva: results from the pilot survey 2021

This report summarizes the results of a survey investigating injected substances by chemically analysing the residual content of used syringes. Syringes were collected in the spring of 2021 by the harm reduction centres of Tallinn and Narva. This is the first time in Estonia to use chromatographic and spectroscopic methods to obtain a regional overview of injected drugs. The study was coordinated by the Institute for Health Development and the chemical analysis was performed by the Estonian Forensic Institute. Based on the syringe residues analysed in Narva and Tallinn it can be stated that in addition to regional differences there were also differences between harm reduction centres in the same region. In Narva the vast majority (92%) of the analysed syringes contained only one narcotic substance. The predominant narcotic drug in syringes was amphetamine (52%) followed by buprenorphine with naloxone (34%) and methadone (12%). Both buprenorphine and methadone are used in opioid substitution therapies and findings of these substances in used syringes points to the misuse of substitution therapy drugs. In Tallinn 67% of the syringes tested contained traces of only one drug. The dominant substance was amphetamine (64%) followed by α -PVP (25%) and methamphetamine (22%). In Tallinn more different substances were detected compared to Narva. Only one fentanyl and one carfentanyl finding in separate syringes in Tallinn confirmed the low prevalence of fentanyl and its analogues in Estonia. Compared to Narva Tallinn's syringes contained more α -PVP (25% vs 3%) and isotonitazene (13% vs 1%) which are considered to be the substitutes for the missing fentanyl market.



31 May

Abstract no: PP072



Omar Ashour

| POSTER

School of Medicine, The University of Jordan, Amman, Jordan

Estimation of sex from measurements of foramen magnum region in a contemporary Jordanian population: A CT study

Several studies have shown variability in basicranial measurements between populations. Therefore, each population should have specific standards to optimize the accuracy of identification. The aim of this study was to evaluate the sexual dimorphism in foramen magnum and occipital condyles measurements using 3D multidetector computed tomography (MDCT), and to assess their utility and reliability for sex estimation in a Jordanian population by means of discriminant function analyses. A total of 500 MDCT scans (288 males and 212 females) were used and a total of 8 basicranial measurements were studied (3 measurements were derived from foramen magnum, and 5 measurements were derived from occipital condyles). Significant sexual dimorphism was found in all basicranial measurements. The most dimorphic variables were length of occipital condyle and maximum bicondylar distance. Including all variables, multivariate and stepwise functions gave an overall accuracy of 77.8% and 78.6%, respectively. However, the multivariate analyses conducted separately for measurements derived from foramen magnum and occipital condyles gave lower overall accuracy of 68.6% and 70.0%, respectively. Basicranial measurements derived from foramen magnum alone predicted males with relatively higher accuracy but were poor at predicting females in the sample (82.6% were males, 49.5% were females, sex bias 33.1%). Adding occipital condyles measurements to the multivariate analysis increased the percentage of correct sexing in females and reduced considerably the sex bias (78.8% male, 76.4% female, sex bias 1.4%). Discriminant function analysis can be utilized to estimate sex in our population.



31 May

Abstract no: PP073



Jannika Norlander Arvidsson

M.D. National Board of Forensic Medicine, Lund, Sweden

| POSTER

Hanging deaths with fabrics as ligature: demographics and injuries in neck structures

We retrospectively analyzed the autopsy records of the Swedish National Board of Forensic Medicine between 1992 and 2018 to document the characteristics of suicidal hangings with a ligature made of fabric.

Among the 146 identified cases the compression mark was most often > 2 cm (65.1 %) in width, V-shaped (80.8 %) and localized at the front/right/left side of the neck (57.5 %). The skin at the compression mark was most often parchment-dried (78.1 %), grooved in (52.1 %) and/or abraded (50.0%).

Petechial bleedings were observed more often (54.8 %) in comparison to the results of studies on unselected hangings (23-46 %). In cases of underweight and obesity a non-conclusive negative association were observed with petechial bleedings, in comparison to normal weight, using an univariate logistic regression model.

Fractures of the hyoid bone and/or the thyroid cartilage were just as common (31.5 %) as in studies on unselected hangings (20-47 %). In a logistic regression model a conclusive association were observed between fractures and increasing age and a non-conclusive association were observed between fractures and increasing BMI.

In suicidal hangings with a ligature made of fabrics, the compression mark was most often > 2 cm in width, parchment dried and in about half of the cases it was grooved in and/or abraded. Also, petechial bleedings tended to be more common, while fractures was just as common as in unselected suicidal hangings with different types of ligature. Following this, findings may indicate that body size and ligature material influence the development of petechial bleedings and fractures.



31 May

Abstract no: PP074



Iris Sluis

| POSTER

Maastricht University, Maastricht, The Netherlands

Important findings regarding the estimation of the time since death of small-sized remains

Objective

On average three times a year, the remains of babies are found in the Netherlands, making knowledge on the decomposition rate and pattern of small cadavers important in order to be able to estimate the Post-Mortem Interval (PMI). Scoring models and PMI formulas for decomposition used are based on the remains of adults and there is limited literature about small-sized human remains. Since estimating the time since death from decomposition stages is one of the methods used by a forensic physician, gaining knowledge on the decomposition rate and pattern of children's bodies is important.

Method

To investigate this, a decomposition study was conducted with small pig carcasses as a proxy. The main findings of the study were compared with the international literature to determine the similarities and discrepancies with decomposition studies in other contexts and whether the findings are specific to small cadavers or the Dutch context.

Results

The results showed that there were findings, regarding the decomposition rate and pattern of small cadavers, specific for the Dutch context as well as for small cadavers. This is related to the internal variable weight, and the external variables temperature, season, rainfall and entomology.

Conclusion

When estimating the PMI, these results must therefore be considered in order to avoid under- or overestimation of the PMI. Follow-up research into the decomposition rate and pattern of small cadavers is recommended to gain more knowledge and insight and to ultimately be able to apply this in forensic practice and subsequently in the judicial system.



31 May

Abstract no: PP075



Andreas-Christian Hade

Estonian Forensic Science Institute, Tallinn, Estonia

| POSTER

Low-cost perfusion system for postmortem CT angiography

Extravasation of contrast medium allows precise tracking of vascular injuries in post-mortem computed tomography (PMCTA). In addition to a CT-scanner, controlled perfusion of contrast medium requires a dedicated pump. Perfusion systems for PMCTA can be expensive and out of reach. Here, we describe a self-made perfusion system using a bottle connected to an aquarium air pump and perfusion lines. Vascular access was achieved via femoral artery and vein. The pump was programmed to keep perfusion pressure of 90 mmHg. Contrast agent (Omnipaque) was dissolved in 1% PBS and polyethylene glycol was used to reach viscosity preventing contrast medium from leaving the vascular system and causing edema artifacts in histological investigations. We demonstrate the ability to perfuse almost the whole corpse and visualize contrast media extravasation in a case of vascular injury.



31 May

Abstract no: PP076



Nantapong Chansaengpetch

| POSTER

Department of Pathology Faculty of Medicine Ramathibodi hospital, Mahidol University, Bangkok, Thailand

Methamphetamine induced profound rhabdomyolysis and myoglobin cast nephropathy: a case report and review literatures

A 46-year-old male with a history of substance abuse was found dead in custody after 30 hours of incarceration for a minor offense. The scene showed the body lying in a prone position in the cell room that was locked from outside. No sign of violence or bloodstain was found. The external examination showed no significant injuries except multiple old minor contusion and abrasion wounds. The autopsy showed only a moderate degree of bilateral pulmonary edema. No internal injury was found except old fractures of three lower left ribs. Interestingly, dark reddish-brown urine was found in the urinary bladder. A further histological study displayed diffuse tubular injury with intraluminal eosinophilic granular casts. The myoglobin cast shows pale PAS staining with a granular appearance, the Masson Trichrome staining shows fuschinophilic deposits on the casts, and the immunoperoxidase staining for myoglobin is strongly positive in casts (the images will be displayed). Blood myoglobin and creatine kinase levels were exceptionally elevated. These findings revealed profound rhabdomyolysis, which is caused by many factors. Finally, blood toxicology subsequently revealed lethal levels of methamphetamine and amphetamine. Clearly, all of the findings were consistent with methamphetamine-induced severe rhabdomyolysis. Therefore, the forensic pathologist should carefully search for gross and histological findings and thorough laboratory investigation to diagnose this condition for complete medicolegal examination.



31 May

Abstract no: PP077



Lydia Kahn

| POSTER

Department of forensic medicine, The national board of forensic medicine, Stockholm, Sweden; Department of oncology-pathology, Karolinska institute, Stockholm, Sweden

Method for documentation of defects in the cranium following gunshot to the head

Introduction: Gunshot injuries have become a more common medical-legal issue in Sweden during the last decade. Gunshot injuries to the head are associated with high mortality and are seen in both suicide and homicide cases. It is essential for the practicing forensic pathologist to be able to distinguish between the entrance and exit wound, determine angle of entry as well as identify findings that are typical for a particular weapon, ammunition, and manner of death. We have noticed an increased need to be able to determine the bullet caliber based on the defect in the skull.

Aim: The aim was to determine the value of extensive documentation with computer tomography (CT), standardized photography, measurement, and casting of the defects in the cranium following gunshot to the head to determine the caliber of the bullet. The study includes fatal and non-fatal cases of suicide, homicide, and attempted murders.

Results and discussion: The size of the circular entrance defect in the cranium cannot be used alone to determine the bullet caliber. However, elimination of certain calibers may be possible based on the characteristics of gunshot injuries identified by extensive documentation of the defect in the cranium. It is essential to use computer tomography (CT) techniques in combination with detailed autopsy findings (suicide, homicide) or clinical findings (attempted murders).



31 May

Abstract no: PP078



John Gall

| POSTER

Department of Paediatrics, University of Melbourne; Victorian Forensic Paediatric Medical Service, Royal Children's Hospital and Monash Medical Centre; and Era Health, Melbourne, Australia

Minimisation of DNA contamination from a clinical forensic medical perspective

Forensic DNA testing has had a significant impact upon the investigation of crimes and the process has attained infallibility status in the minds of many involved in the medico-legal system. This has led to some significant miscarriages of justice. DNA fingerprinting, despite becoming increasingly sensitive, is not infallible and is open to error at numerous points during the process of specimen collection, testing, interpretation and application. It does not replace competent crime investigation and the question of 'how did it get there?' remains in relation to any DNA found at a crime scene. To minimise the risk of unintentional contamination of biological specimens collected, contamination that may affect the successful identification of alleged offender DNA profiles, the clinical forensic medical practitioner needs to ensure that appropriate cleaning and DNA decontamination has been undertaken of clinical examination areas and of the equipment used during any clinical examination. Mindful that cleaning, sterilisation and DNA decontamination are each different processes, a generic DNA decontamination process is presented that is applicable across jurisdictions and in both dedicated and non-dedicated forensic clinical examination suites. This process is based on the understanding that, in the clinical setting, DNA contamination may only be minimised, not eliminated.



31 May

Abstract no: PP079



John Gall

| POSTER

Department of Paediatrics, University of Melbourne; Victorian Forensic Paediatric Medical Service, Royal Children's Hospital and Monash Medical Centre; and Era Health, Melbourne, Australia

Point of care (POC) toxicology screening – does it have a place in clinical forensic medicine?

Clinical forensic medical practitioners are regularly called upon to examine persons in a variety of settings including police detention and those presenting for assessments post physical and/or sexual assault. These examinations are not always in clinical settings and may be remote from hospitals where rapid drug and alcohol screening may be undertaken. For those people in police detention, drug and/or alcohol (DOA) affected persons may be unfit for interview by police and equally unfit for detention. They may equally have some other medical condition that results in their appearing to be DOA affected. Similarly, persons presenting for clinical forensic medical examinations post physical and/or sexual assault may declare that they have consumed an amount of DOA or may appear to be so affected. But their declaration may be misleading. Beyond a clinical assessment, knowledge of the actual nature of DOA consumed may indicate whether these persons are competent to consent to any form of forensic examination. Further, rapid receipt of information with respect to alcohol and drug screening may be highly beneficial to the immediate criminal investigation. Irrespective of the setting of the clinical examination, the receipt of rapid DOA screenings from hospitals or police laboratories is generally unavailable. There are point of care (POC) drug screening devices for both saliva (which provides a more current indicator of drug classes consumed) and urine, and accurate handheld breathalysers. These devices will be discussed in relation to screening and their assistance in the provision of clinical assessments undertaken and advice to police.



31 May

Abstract no: PP080



Hendrik Stigter

| POSTER

Maastricht University, faculty of law and criminology, Maastricht, The Netherlands

Practical application of postmortem mechanical stimulation of skeletal muscle, a field study

Supravital muscle reaction (SMR) is an idiomuscular contraction of skeletal muscle based on the storage of glycogen and adenosine triphosphate (ATP). SMR is provoked by mechanical stimulation and has been observed up to 14 hours post-mortem in earlier studies.

A field study was performed with the aim to investigate whether a reflex hammer is usable for triggering SMR, to establish if the outcome of SMR differs between stimulating of the musculus brachioradialis or the musculus biceps brachii in case of the same body, and to determine if a forensic physician has to conduct a learning period to trigger SMR using a reflex hammer.

Four forensic physicians used a reflex hammer to stimulate the musculus brachioradialis and musculus biceps brachii. In total 316 cases were included with a PMI less than 24 hours. The cases were in chronological order divided in clusters of 10 cases. The percentage of number of cases of present/ total cases was used as outcome to test whether a reflex hammer is an appropriate tool to trigger SMR. Logistic regression was used for detecting a significant ($p < 0,05$) learning period between the chronological clusters per forensic physician to identify a possible learning curve.

In 175 of the 316 included cases (55,4%) SMR could be provoked following mechanical stimulation. No significant difference was observed between the learning curves of the participants. The outcome of SMR after stimulating the musculus brachioradialis was comparable to the outcome of SMR after stimulating the musculus biceps brachii. A reflex hammer to trigger SMR is usable.



31 May

Abstract no: PP082



Lianne Dijkhuizen

| POSTER

*Dept. of Criminal Law and Criminology, Maastricht University, Maastricht, The Netherlands;
GGD IJsselland, Zwolle, the Netherlands*

Salivary Cortisol in Forensic Medicine: a simple parameter reflecting the level of stress around the time of death

Introduction: The biomarker cortisol is an objective reliable and valid parameter for the determination of experienced stress. With the possibility to measure cortisol in saliva with liquid chromatography tandem mass spectrometry (LC-MS/MS), a non-invasive, sensitive method has become available for use in forensic science. The aim of this study is to investigate whether it is feasible to determine salivary cortisol reliably in the deceased. In addition, the differences in measured levels of salivary cortisol in postmortem cases categorized according to the manner of death (natural vs non-natural) was studied.

Materials & Methods: A consecutive number of postmortem cases registered for routine forensic investigations were included (n= 133) in the period February 2020 and May 2021. During these examinations saliva sampling was performed. Salivary cortisol was subsequently determined by LC-MS/MS.

Results: In 100 out of the 133 cases salivary cortisol could be determined (75%), ranging from 1 – 2755 nmol/L. The remaining 33 samples contained an insufficient amount of saliva. There was no significant difference in postmortem salivary cortisol between people deceased by a natural (38 nmol/l (range 1-1818)) compared to a non-natural cause of death (111 nmol/L (range 2- 2755)).

Discussion: There was no significant difference in salivary cortisol in cases of natural compared to non-natural death. As this study indicates the feasibility to measure the level of salivary cortisol around the time of death, future research can explore the use of this method to investigate the potential relation of cortisol concentration with the different pathologies underlying the dying process.



31 May

Abstract no: PP083



Lianne Dijkhuizen

| POSTER

IJsselland, Zwolle, the Netherlands; Faculty of Law, Maastricht University, Maastricht, the Netherlands; Maastricht University Medical Center+, Maastricht, the Netherlands; Nederlands Forensisch Instituut, the Hague, the Netherlands

Sudden death during physical restraint by the Dutch police

Background: and goal: The Police is sometimes confronted with the death of a subject during physical restraint. In most of these cases a clear Cause of Death (COD) cannot be determined by the Pathologist. The goal of this research is to find and clarify a pattern and pinpoint a clearer COD.

Method: The research group is compiled of 38 closed police case files from the NPIID (National Police Internal Investigation Department) between 2005 and 2016. The control group is compiled of cases involving excitation and restraint, without leading to death. 148 cases were included from the NPIID between 2005 and 2016 and the Violence Registration Database of the Dutch National Police between 2014 and 2015. Case files of both the research and the control group were systematically analyzed and compared.

Results and conclusion: The observed pattern shows that subjects dying during physical restraint are mostly males between 30 and 40 years old with a BMI above 30 kg/m². Both BMI and age are remarkably lower in the control group. Subjects were encountered in a state of excitation mostly attributed to (multiple) drugs. The physical restraint portrayed a pattern of escalation with restraint being mostly face-down, hands cuffed to the back, receiving thoracic pressure, resulting in a high total amount of force used. In the research group 44.7% (17/38) of subjects were encountered (partially) unclothed versus 4.1% (6/148) in the control group. Cause of death in these cases seems to be multifactorial and is comprised of both personal factors and factors during and after the struggle. The end effect is that the subjects end up in a fatal spiral.



31 May

Abstract no: PP5003



Magnus Olin

Thermo Fisher Scientific, Stockholm, Sweden

| POSTER

Tox Explorer – Screening of drugs in biological fluids using quadrupole-orbitrap High Resolution Mass Spectrometry

The Tox Explorer kit is developed for screening of drugs in biological fluids using hybrid quadrupole-orbitrap high resolution accurate mass (HRAM) spectrometry. It is a targeted screening method containing a specified column and mobile phases, a database and a spectral library covering 1519 compounds. The database contains information about retention time, chemical formula, accurate mass and fragments while the library contains experimental spectra. The biological fluids used can be, but are not limited to, blood, plasma, serum, saliva and urine. Sample preparation can be protein precipitation, SPE, LLE, dilute and shoot or Turboflow chromatography. Separation is performed on an Accucore phenyl-hexyl reversed phase column. The compounds are detected by a HRAM spectrometer (QExactive or Orbitrap Exploris). The mass spectrometer is operated in polarity switching mode to cover compounds that ionize both in positive and negative polarity. The compounds are detected in Full Scan – Data Dependent MS/MS mode using an inclusion list. Data dependent MS/MS matches the accurate mass of a peak detected in full scan mode to entries in the inclusion list and if the accurate mass is present it triggers a MS/MS scan. Evaluation is based on a peak found in the full MS scan with correct m/z at the correct retention time. Isotopic pattern, fragments and library matching further increases the confidence of the identity. Detection limits are compound dependent and can be in low ppb-levels. The method has been evaluated with very good results. This presentation shows more details of Tox Explorer, how data is evaluated and results obtained while testing the method.



31 May

Abstract no: PP5004



Same Ratshonka

| POSTER

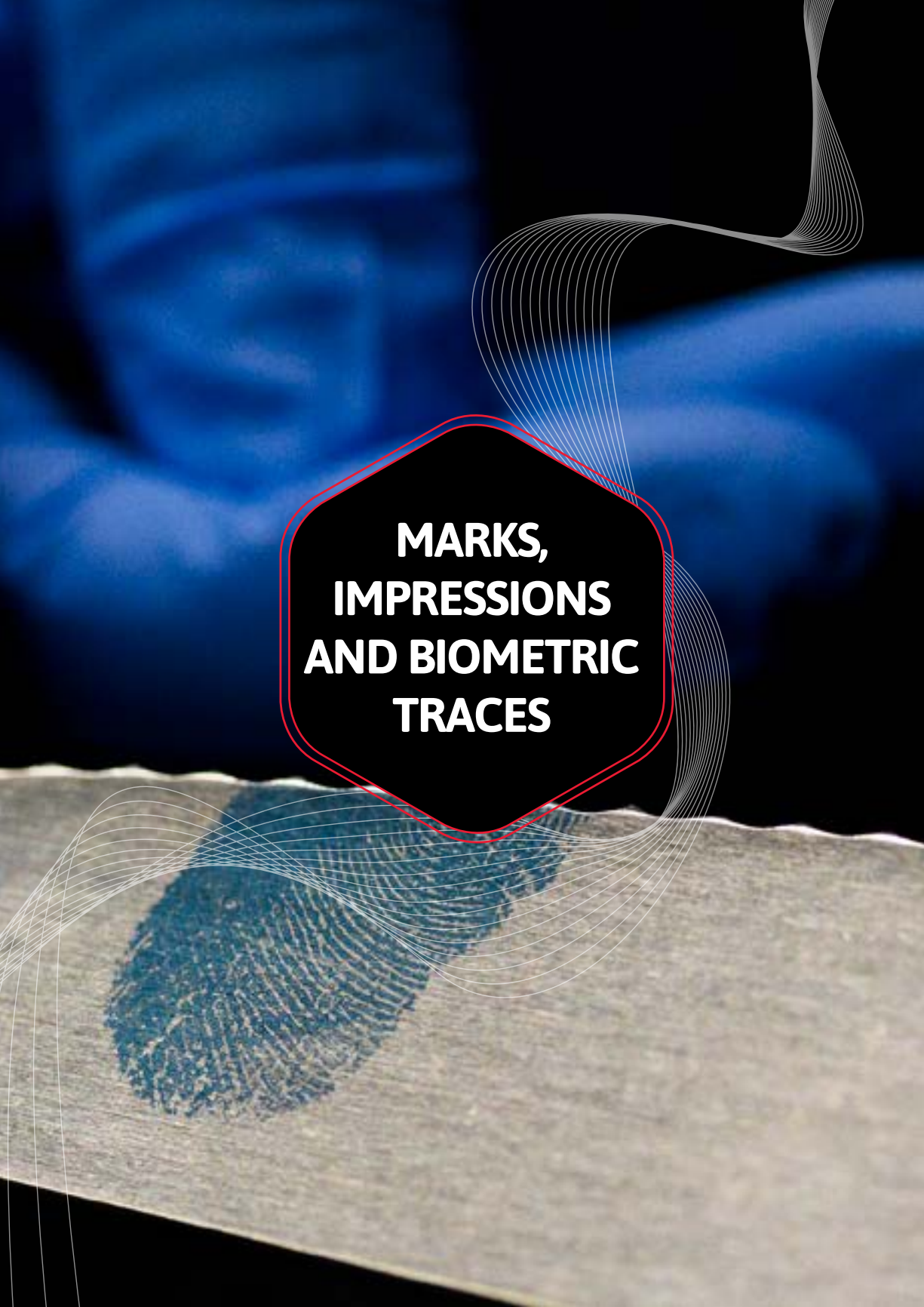
Anglia ruskin university, Cambridge , United Kingdom

A critical evaluation of the statistical methods used in heroin comparison

The objective of this study is to determine the validity of statistical methods used to compare heroin samples. Even though much work has been undertaken on heroin profiling, the validity of statistical analyses applied to heroin to link samples by chemical profiling has not been reported. In this study, the assumptions around the validity of the statistical methods were tested and applied to the profiling of heroin samples following GC-MS analysis of street samples of heroin seized by Cambridgeshire Police.

The results obtained show that the concentration of some drug pairs in heroin are correlated – for example (diamorphine/acetylcodeine) whilst others eg. caffeine/diamorphine, are not significantly correlated. Where there is correlation the use of distance methods, for example Euclidean distance, is not valid. The assumptions around Euclidean distance methods are not met by the heroin samples used in this research due to outliers, and the correlation of some variables. Conversely, PCA is appropriate because the underlying assumptions are met. Therefore, this means that if Euclidean distances are used to link heroin samples, there is a need to always check which drug sample pairs are correlated and which are not. For PCA, the reverse is true. If a pair is always correlated, that pair can be used test for the assumption underlying the chosen method.

Reviewing and comparing with the literature, the same sample pairs are not always correlated. On this basis it is necessary to test for correlation of variables for each set of heroin samples each time a comparison is made, rather than making assumptions about the relationships between drug concentrations in a heroin sample.

The image features a close-up of a blue ink fingerprint on a light-colored, textured surface. A red hexagonal border frames the text in the center. White, wavy lines flow across the image, connecting the fingerprint to the text box and extending towards the top right corner. The background is a blurred blue and black.

**MARKS,
IMPRESSIONS
AND BIOMETRIC
TRACES**



1 Jun

Abstract no: PP084



Salvador Martínez Cañavate

| POSTER

Director of the forensic laboratory Abelsa judicial expert opinions. Cartagena, Murcia, Spain

L’Affaire Dreyfus and the intervention of experts in questioned documents. Know the mistakes to avoid repeating them

I am a criminologist and expert in questioned documents of the Courts of Justice of Spain, for 25 years I have directed a forensic laboratory for the analysis of signatures and doubtful documents.

I have specialized in the famous L’Affaire Dreyfus, one of the most important events in the world and in the intervention of forensic handwriting experts who analyzed the bordereau (the most studied document by experts of all time). This issue marked a break in France and Europe, anti-Semitic hatred arose and caused disturbances in the country, especially affecting politics, the military, religion and culture.

I have managed to put together a private collection of about 1000 pieces, with more than 300 original newspapers from the end of the 19th century from different publishers and from various countries (France, Spain, England, the United States, Italy, etc.), I have one of the most important collections in the world.

I am doing exhibitions at International Forensic Congresses (Mexico, Argentina, Colombia, Spain ...). Of the 300 original periodicals, the most prominent ones are chosen (according to the salon), the covers are digitized and are presented in high quality forex format 50x70. The exhibition also contains caricatures, satirical photographs, postcards, manuscripts and several original articles from the finales of the 19th siglo.

As a complement, I present orally the interventions of the experts in questioned documents in the L’Affaire Dreyfus, its techniques, ethics and importance in the analysis of handwriting.

I share the exhibition website: <https://affaire-dreyfus-expo.com/>

I am at your disposal to clarify any questions.

Thank you!



1 Jun

Abstract no: PP085



Iva Bogdanović Radović

| POSTER

Division of Experimental Physics, Ruđer Bošković Institute, Zagreb, Croatia

MeV SIMS – new accelerator based analytical technique with potential for forensic document examination

For forensic document examination, it is important to know if the document being examined, such as bank check, will, or contract, has been altered in any way after it was created. Sometimes it is important to know if the ink used on the document is the same or different, or to know the order of deposition of inks where they overlap. In the present work, intersections of inks were investigated using nondestructive techniques, optical techniques and micro Raman Spectroscopy, that are standardly applied for the examination of questioned documents at the Ivan Vučetić Forensic Science Centre, as well as accelerator-based ion beam analysis (IBA) technique, called Secondary Ion Mass Spectrometry using MeV ions (MeV SIMS), applied at the Ruđer Bošković Institute. MeV SIMS is a relatively new analytical technique whose potential has yet to be fully exploited and is unknown in the forensic community. It detects molecules from the uppermost layers of the sample and is therefore suitable for determining the order of deposition. MeV SIMS can be used to produce two-dimensional images of the sample with a lateral resolution of several micrometres, containing information about the chemical composition in each part of the image. Studied cases were divided into those where the optical techniques can distinguish between the inks used and those where inks were completely optically indistinguishable. However, some differences were found in mass spectra of two inks. Those very small differences in combination with advanced and objective analytical models were sufficient to resolve correct deposition order with MeV SIMS. Obtained results were compared and discussed.



1 Jun

Abstract no: PP086



Eduardo Acevedo Arreguin

| POSTER

Perito auxiliar del Tribunal Superior de Justicia del Estado de Queretaro, Mexico; Perito auxiliar del Poder Judicial de la Federacion, Mexico; Presidente del Colegio Nacional de Peritos Forenses, Mexico

Quality of comparison elements Individual Graphic Pattern Range of Variability Stroke direction-Stroke quantity amount

The variations that we can find in a writing or in a signature, generally correspond to the transformations that take place in the neural architecture of the brain, and these variations will be less or greater depending on the quality of its plasticity and its constant repetition.

The signature is the maximum automatic representation of a person, because the calligraphic pressures to which we are obliged to the calligraphic model do not intervene in it, this obligation is given from the school regulations that make us repeat constantly, precisely to achieve a high degree of automaticity. Once the signature model has been chosen, the continuous repetition in time and throughout the person's biography acquires stability in its reproduction. In this way, the neural circuits that are generated are very robust and the internalized image that is normally executed has little variability.

This work proposes the development of a technique through the processing of digital images using angular filtering in order to analyze the habits and motor developments of an individual that are reflected in the development of a signature and that these represent the automation process that has been carried out. generated throughout learning. time of a person, and if they are executed in a skillful, spontaneous and natural way, they represent an INDIVIDUAL GRAPHIC PATTERN, which in turn allows us to establish a RANGE OF VARIABILITY, depending on the amount of authentic elements available.

This method is based on Fourier spectrum analysis. For a square image, structures with a preferred orientation generate a periodic pattern with an orientation in the Fourier transform of the image.



1 Jun

Abstract no: PP087



Kristina Söderström

The National Forensic Centre, Swedish Police Authority

| POSTER

A likelihood ratio model for features of duct tape scrim

Duct tape is used in many different types of crime from theft and abduction to murder. Fitting the torn pieces together can provide an important link between a crime scene and a suspect. Sometimes all examined parameters of the tape pieces are alike but the edges contain few distinctive details and therefore the likelihood ratio for a physical fit is low.

The aim of our study was to create a complement to the conventional physical examination of duct tape, by examining the loop-breaking pattern of the knitted warp in the scrim/weave. Each loop along the tape edge is either open or closed and the loop-breaking pattern consists of sequences of open or closed loops. Although scrim-count has long been included in our physical tape examinations we have not previously looked at the loop-breaking pattern of the scrim. An experiment was set up with 10 different rolls of duct tape, all with knitted warp, torn by five different people.

We propose to consider unbroken sequences of open or closed loops as evidential features. Whenever the loops shift from open to closed, or vice-versa, this is considered to be the start of a new feature. The dependence of the features is investigated and a model for calculating an overall likelihood ratio of the loop-breaking pattern is proposed. This model can be used as a complement when evaluating the likelihood ratio. The poster will contain an easy to use mathematical model for assessing the likelihood ratio of the loop-breaking pattern of duct tape with knitted warp in the scrim.



1 Jun

Abstract no: PP088



Matthias Weber

| POSTER

*Institute for Forensic Sciences, Landeskriminalamt Nordrhein-Westfalen (LKA NRW),
Duesseldorf, Germany*

Comparative Study of Silicone Casting Materials in the Forensic Sciences and Archaeology

The common method of securing tool marks is by casting using silicone rubbers. Casts are a non-destructive and quick method for preserving the topography details of marks. Consequently, a range of silicones with varying properties such as crosslinking mechanism, colour, resolution or accuracy is available. This project addresses how impression material selection affects the qualitative and quantitative analysis of surface topography.

Joining forces with archaeology we compared five addition curing materials and assessed their resolution, accuracy, visual contrast and durability. Topographic features of casts were compared visually and their suitability for light microscopy and 3D-scanning was assessed. Dimensional changes were extracted from repeated 3D scans and results were correlated with weight changes. For quantitative assessment, the surface topography was measured with a laser-scanning confocal microscope. A comparison of the nominal surface roughness (R_a) was performed. By assessing the difference in R_a between roughness standards and casts (R_a), a performance gradient is observed between products and, additionally, in dependence on the roughness standard moulded. However, the material with the lowest R_a performs less favourably when using incident light microscopy. Depending on the colour of the silicones, qualitative assessment of contrast and resolution differs. While a dark coloured silicone provides the highest image quality for 3D scanning, it appears less suitable for light microscopy. In sum, the choice of the casting material should consider surface topography as well as the requirements for any subsequent analytical procedure to be carried out.



1 Jun

Abstract no: PP090



Karolina Bäck

Chemistry and technology, National forensic centre, Sweden

| POSTER

Individual and subclass characteristics on bullets and cartridge cases fired in original/converted Walther PPQ pistols

Several Walther PPQ pistols have recently been examined at the National forensic centre in Sweden. Some of these pistols show signs of having been converted to 4 mm or 6 mm Flobert (rimfire) and then converted back to their original caliber of 9 mm Luger (9x19 mm, 9 mm Parabellum). Marks on bullets and cartridge cases fired in Walther PPQ pistols have a limited amount of individual characteristics that can be useful for the forensic firearm examiner. The origin of these marks is discussed and whether there is a risk for subclass carryover. Drag marks on the rim of the cartridge case, marks from the chamber and marks from the firing pin aperture are however likely to be individual with limited risk of subclass carryover, whether the pistol is original or converted. Bullets fired from pistols converted back to their original caliber also have coarse marks that originate from the muzzle of the barrel which are likely to be individual, facilitating the potential for an identification or elimination.



1 Jun

Abstract no: PP091



Edward Adach

| **POSTER**

Forensic Identification Services, Toronto Police Service, Toronto, Ontario, Canada

Resurrecting buried footwear and tire impressions in snow: a simple and easy method

The tell-tale signs of a suspect's steps in snow, after additional snowfall, appear much like a trail of tiny indented clandestine graves. Unlike lost souls these sole impressions can be resurrected. Footwear impressions and tire impressions buried in snow have widely been considered as lost or destroyed. Now the humble leaf blower can be used to resurrect these preserved impressions.

The concept of recovery is surprisingly obvious. A footstep (or tire) compresses the snow into an ideal firm mold. A subsequent layer of snow gently blankets that impression, preserving it. The top layer of uncompressed snow is simply removed to reveal the original impression.

Simply approach the filled-in impressions with a cordless leaf blower. While standing comfortably, direct the forced air towards the impression, waving the blower back and forth. How close you get, how fast you maneuver, and so forth, is for each forensic investigator to determine and practice. The new layer of snow can be easily blown out of the mold without causing harm to the impression, much like fingerprint powder is brushed out of furrows. As the seemingly fragile fingerprint withstands the sweeping motions of the brush, the footwear impression survives the clearing of the loose snowflakes with a leaf blower.

This new quick, easy, and effective method of recovery will hopefully encourage forensic scene examiners to appreciate and collect this buried treasure trove of evidence.



1 Jun

Abstract no: PP5005



Michael Gorn

Federal Bureau of Investigation, Quantico, United States

| POSTER

Adolf Schallamach; The man, his research and the benefit to forensic science

Schallamach patterns are a characteristic which can be used to identify a shoe as having made a crime scene impression. They form as a result of the abrasive forces between the outsole rubber and the underlying substrate. But who was Mr. Adolf Schallamach? This poster will take a look at his life, from enduring personal pressures during World War 2, to his research on tire rubber and how these ideas gained traction in forensic science.



1 Jun

Abstract no: PP092



Pawel Korzeniewski

The National Forensic Centre, Swedish Police Authority

| POSTER

Ethanol as an Alternative Solvent for Fingerprint Development Using Natural Yellow 3

Natural Yellow 3 (NY3) can be used to develop fluorescent sebaceous fingerprints on dark non-porous substances. The currently used formulation is based on an article by Perry and Sears (2015), in which 1-methoxy-2-propanol (PGME) is used as the solvent. This was proposed as a less flammable alternative to ethanol which was used earlier. The occupational exposure limits for ethanol are however much higher than the corresponding values for PGME. Choosing a solvent may therefore partly be directed by which hazard is prioritised higher – the flammability or the health hazard.

The PGME-based formulation used by the Swedish National Forensic Centre contains a surfactant (n-dioctylsulfosuccinate, DOSS) to facilitate rinsing of the materials, and sodium chloride (NaCl) to increase the resulting fluorescence. This study aimed to modify the ethanol-based solution in a similar manner. In a preliminary test of the new solution, including DOSS resulted in a slight reduction of background fluorescence. The inclusion of NaCl had no notable impact on the results.

The main study compared the accredited PGME-based solution to an ethanol-based NY3 solution modified with DOSS. 360 fingerprints in total were deposited in a factorial experimental design. It involved 3 ageing times, 5 non-porous materials, 2 formulations, 6 donors, and 2 replicates. The fingerprints were examined by two persons using an 11-level Likert scale, and analysed by a multifactor ANOVA. The two formulations have performed very similarly, and the other factors had greater impact on the overall result. This suggests that the two formulations can be considered to be equivalent performance-wise.

Friction Ridge Skin



1 Jun

Abstract no: PP093



Johanna Nordfors

National Bureau of Investigation, Forensic laboratory

| POSTER

Implementation and Validation of New ABIS System in Police of Finland

Police of Finland is replacing current AFIS system with a new Multibiometric Identification and Information Management (ABIS) system during 2022. Project started in 2017 with a survey of the providers and defining requirements of the new system. System was chosen with competitive dialogue including quality and financial instruments. Thales group was chosen as a new supplier.

In addition to implementation project, NBI Forensic laboratory saw a need for an additional supportive project. This project focuses on effects of the new system within Forensic laboratory and Crime scene units. In this project processes are reviewed, all guidelines are written, training is planned and required changes are done to the LIMS system.

Aim of the validation is to ensure that accuracy of the new system is at least as good as in the current one. Validation plan has been prepared to assure suitability of the system. During the validation at least 60 latent prints and 10 tenprints will be searched with both systems and the results will be compared. Both autoencoding and manual encoding will be used according to vendors' best practices. Reviewing of the results will concentrate on candidate ranking and comparison of scoring. Validation will be done before implementation of the system at the beginning of 2022 and results will be reported to the Finnish Accreditation Services (FINAS). FINAS will evaluate the results and the process of the validation in May 2022. The purpose of this study is to enlighten the validation and implementation process of the new ABIS system.



1 Jun

Abstract no: PP094



Melinda Andersson

| POSTER

National Forensic Centre, Swedish Police Authority, Linköping, Sweden

Implications of the European interoperability framework from the perspective of the Swedish national forensic centre

In 2019, two European Union (EU) regulations were adopted to establish an interoperability framework (IO) for EU information systems containing information about third-country nationals (TCN) in EU. The purpose of IO includes 1) to prevent illegal immigration, 2) to combat terrorism and serious crime, and 3) to improve the identification of persons that are unable to identify themselves in the event of e.g. a natural disaster. To achieve these purposes, the EU information systems included in the IO will be made searchable to 1) aid in the identification of unidentified persons, 2) combat identity fraud, and 3) aid in the investigation of serious crime. In these cases, when the involvement of a TCN is suspected, a search may be initiated using fingerprints, facial images or alphanumeric data. If a match is found, data about the matching person may be retrieved from the EU information systems to be used in the identification process or the investigation.

In Sweden, the National Forensic Centre (NFC) performs biometric searches in criminal investigations using fingerprints and facial images, searching against the national fingerprint and "mug shot" database. With the exception of NFC, the Swedish police force is prohibited by national law to perform biometric searches. Consequently, the biometric expertise in the Swedish police force is found at NFC. With the IO, biometric search functionality will become more available to the Swedish police force as a whole. This new availability will come with both benefits and challenges. Here, we present some of these benefits and challenges as well as how to best utilize NFC's expertise in the field of biometrics.

Friction Ridge Skin



1 Jun

Abstract no: PP095



Eva Haggren

IT department, Swedish Police Authority, Linköping, Sweden

| POSTER

Possibilities and challenges regarding our improved ability for identities based on biometrics

The identity concept of ABIS makes identity conflicts visible. The conflicts can be investigated to find out what identity is the correct one, but still keep the alias history intact and visible. We expect to find more conflicts with ABIS (compared to our old system) and even more conflicts when the EU interoperability systems are used.

The new ABIS displays identity conflicts and keeps track of aliases used. This information is valuable to the entire Police Authority. Since not all users are authorized to use ABIS, we are developing an IT system to present information about identities, aliases and performed searches.

Identities (names, fingerprints and facial images) are structured in ABIS in a way which makes it possible to add support for other biometric technologies, such as DNA and iris. Legal aspects are being looked at regarding collecting more biometrics at the same occasion.

In 2021 AFIS was replaced with ABIS, adding facial recognition abilities to fingerprints. In conjunction with the replacement more information was added to our identity concept. Each booking have alphanumerical information (name, birth date, etc) in addition to the biometric information. Bookings with biometrics coming from the same person (based on biometric information) are gathered in one identity record. Adding alphanumerical information to the identity record makes it possible to keep track of different aliases used in different bookings in a structured way. The information from the booking can remain unchanged, while the identity record is updated with identity information determined to be the correct identity.

Speaker Recognition



1 Jun

Abstract no: PP096



Laurianne Georgeton

Service National de Police Scientifique

| POSTER

Performance of ECAPA-TDNN architecture on duration ranges in a forensic voice comparison context

One of the main criteria of feasibility of automatic forensic voice comparison is the duration of the recordings to compare. Below a given duration, the result of a voice comparison is not reliable and no investigation can be done. The threshold depends on the system used by the experts. Meanwhile, speaker verification techniques has gained huge progress with the development of new architectures. One of the most recent approaches is based on ECAPA-TDNN and outperforms the x-vectors architecture. In this paper, we assess the performance of the ECAPA-TDNN architecture on 9 duration ranges (from 1-7 seconds and up to 25-31 seconds). The ECAPA-TDNN architecture is evaluated on the PTSVOX database, using the microphone recordings of spontaneous speech (male and female speakers pooled). We compare two different models, trained on VoxCeleb (7000+ speakers) on the one hand, and on the ESTER, ETAPE and REPERE databases (1600+ speakers) on the other hand. Performance is evaluated using both models on all duration ranges. The performance varies based on the model. The results show good performance using the VoxCeleb model for 4-second long recordings and higher (EER = 2.5% for the 4-10 seconds range), whereas using model ESTER-ETAPE-REPERE, the performance is good for 7-second long recordings and higher (EER = 3.75% for the 7-13 seconds range). In an accreditation process conducted by forensic laboratories, it is important to outline the limits of the system used (architecture and model) especially to determine the minimal duration where a comparison is possible. In addition, it emphasizes the need to define the best practices to build a coherent model for the test data.

A photograph of a crime scene in a kitchen. The scene is dimly lit, with a bright light source from a window on the left. In the foreground, a dark wooden table is covered with various items, including a white plate, a glass, and some debris. A black hexagonal overlay with a red border is centered in the image, containing the text "SCENE OF CRIME" in white, bold, uppercase letters. The background shows a dark wall and a window with a view of the outdoors.

**SCENE
OF CRIME**



1 Jun

Abstract no: PP098

**Alessandro Previero****| POSTER***Belgian Defence Laboratories (DLB), Peutie, Belgium*

Non-destructive decontamination and modification of traditional forensic methods in a CBRN facility

Within the current context of fight against terrorism, the forensic investigation of CBRN (chemical, biological, radiological and nuclear) related crime scenes is becoming increasingly important to help identify hazardous substances and the persons involved. At present, forensic laboratories are not able to deal with CBRN contaminated items. They are hampered by a lack of suitable decontamination methods, infrastructure and training in carrying out analysis on these unusual samples. To overcome this gap, the Belgian Defence Laboratories (DLB) have started a new study, which aims to look both for possible non-destructive CBRN decontamination procedures and for the employment of forensic techniques in CBRN facilities. On the one hand, decontamination methods will be tested to remove contaminants from items while preserving forensic traces. As a result, items could subsequently be safely analysed in traditional forensic laboratories.

On the other hand, processing contaminated items in dedicated facilities and with specific equipment, such as a glove box, will be investigated by modifying traditional forensic methods. This approach avoids the degradation of traces due to the decontamination stage and ensures to handle these items following the standard procedure for CBRN samples. The focus will be on fingerprints, DNA and digital traces, which are especially useful to identify perpetrators (or victims). The research will take place at the Federal Orientation Laboratory (FOL) of the DLB. The FOL is the designated Belgian laboratory to receive samples related to CBRN terrorism, to screen for CBRN agents and to transfer the item to the appropriate specialized facility.



1 Jun

Abstract no: PP099

**Marcus Andrade***Brazilian Federal Police, Belo Horizonte, Brazil*

| POSTER

Technical approach of a multidisciplinary forensic work carried out at 'B1' Dam Break in Brumadinho / MG – Brazil

The aim of this paper is to present the most relevant technical aspects of a complex and multidisciplinary case, carried out after the breaking of the tailings dam called 'B1', belonging to the mining company VALE/S.A., located in Brumadinho, Minas Gerais, Brazil. Aspects related to the forensic work carried out are presented, highlighting the range of multidisciplinary exams required, institutional cooperation between public agencies, fast mobilization of personnel, as well as laboratory network support.

In the tragedy, approximately 11 million cubic meters of mining waste were released in an immediate area of 273 hectares, causing the destruction of the entire administrative structure of the Mine, private homes, infrastructure components such as bridges and streets. About three years after the tragedy, 163 people were identified killed by the wave of tailings, with 7 people still missing. The expert work also pointed out that there was a spread of mining waste over more than 200 km along the Paraopeba River, causing exposure of the local population to the toxic effects resulting from contact with the material carried.

The methodology used in the various tests, the practice of multidisciplinary work, as well as the fast mobilization of logistical resources, generated a significant critical mass of knowledge for future similar forensic casework. Moreover, it revealed the need to develop a forensic fast-response team to be employed in environmental disasters and to map our forensic professional staff, necessary equipment, and methodologies.



1 Jun

Abstract no: PP100



Pietro Maida

| POSTER

Raggruppamento Carabinieri Investigazioni Scientifiche-Messina, Italy

Unconventional forensic cases: the importance of a proper experimental design to reach the solution. Two case reports

In forensic cases it is important to characterize the crime scene functionally and usefully in order to best find the useful samples to support and follow the investigative process on a case-by-case basis [1]. For this purpose, Locard's Principle is fundamental: it implies the importance to identify the nature of such traces, using appropriate procedures. Analytical chemistry plays an essential role as a tool able to provide useful information, for investigative purposes, in the characterization of traces and the crime scene [2-3]. In the ever-changing society of nowadays the forensic services face new challenges: some crime scenes can be complex and unconventional due to the location where they take place or the chemical nature of the evidences collected on the scene and carried to the lab service. In this situation, the laboratory forensic analyst's capabilities, versatility, imagination and resourcefulness are fundamental and critical to grant the more effective approach to the evidences to discover the truth of the facts. According to this, in our forensic department every analyst needs to know how to juggle between samples of different nature and complexity. Based on this, the aim of this work is to represent two interesting and challenging real cases for which a traditional laboratory approach wouldn't have given satisfactory answers. The cases were solved with a specific experimental design and refer to:

- physical injuries to a woman inside a supermarket due a contact with acids;
- physical injuries to a woman caused by an inexplicable explosion of a softdrink bottle.



1 Jun

Abstract no: PP101



Eva Ljungkvist
ENFSI FEIWG Chair

| POSTER

Fire and Explosion Investigation Working group

Fire and explosion Investigation is a multilayered and multi-disciplined activity. The field involves the investigation of the scene of an incident and often incorporates complex chemical and physical analysis of items and debris recovered from incident scenes.

Scene investigation poses specific technical and logistical challenges and can involve small and complex events. Included in this are incidents associated with fatalities and mass disasters. This brings the added challenges of working within multi-disciplinary groups, including police investigators and/or experts from other forensic disciplines. Fire and explosion investigation also requires considerable interaction with first responders from the fire services who's interaction with the scene of an incident is often critical to the successful final resolution of origin, cause and understanding of fire/explosion development.

Explosions require an in-depth understanding of the nature of the explosive event, including the potential causes and effects of such an event on the built environment. As such, a thorough understanding of the built environment is essential.

Laboratory analysis of recovered fire debris involves an added dimension of complexity. In cases of suspicious fires, the goal is to recover and identify the presence of ignitable liquid residues. This is not a trivial task and can be challenging in several ways, including understanding and addressing complex background matrix interferences.



1 Jun

Abstract no: PP102



Rastislav Hrcka

Forensic Science Institute Slovakia

| POSTER

Fire investigation – Theory vs practice

Fire investigation is defined as a very specialized activity, the aim of which is to determine the place of origin and the cause of the fire on the basis of objective facts. The basic methodology of the fire investigation rely on the use of systematic approach and attention to all relevant details.

In Slovakia, during large fires, we participate directly in the investigation at the crime scene, where we try find fire patterns, collect samples and then analyze the samples in the lab. This activity extremely high demands on scientific theoretical knowledge as well as practical experience of the expert. Theoretical knowledge can be obtained from the literature, such as. various mechanisms of flame development, chemistry of burning fire traces, sampling, analysis of samples. In practice, we then try to transfer this knowledge directly to the crime scene. Our task is to answer two simple questions: Where? and why? In real cases, I will show you what the most important traces of a fire look like, such as burns in the shape of the letter V, A, in the shape of an hourglass, demarcation lines, clean burn, etc. Further how to analyze and interpret fire debris and finally how to create a hypothesis. In conclusion, you will find that answering simple questions is not easy in practice. In addition to theoretical knowledge, it is important to have a lot of experience and sometimes a little bit of luck.



1 Jun

Abstract no: **PP104**



Zohra Linder Ben Salah

| **POSTER**

Stockholm Police Authority, Forensic Section, Forensic group 7, Stockholm, Sweden

Forensic archaeology within the Forensic section in Stockholm, Sweden

Forensic archaeology within the Forensic section in Stockholm, Sweden

The intention is to increase the quality of investigations of forensic nature primarily concerning investigations outdoors where deceased persons, and/or parts, found on or in the ground, either open or hidden, as well as burials.

A workgroup of forensic archaeology (AFFA) was formed at the Forensic section in Stockholm in 1991, consisting of Crime Scene Investigators with the main task of investigating scenes that are the subject of police investigation.

The group has specialized expertise. In addition to the purely forensic education in the group, there are also trained archaeologists and anthropologists and members of the police's DVI.

An important function for AFFA is to provide support and resources for other Crime Scene Investigators.

Our main goal is to educate the importance of forensic archaeology. In doing so we have, together with Stockholm University, created a course in forensic archaeology called "The Pig Project".

Six pigs were shot and buried with associating objects. These pig burials are the nearest form of a body farm we can come in Sweden due to ethical reasons. The graves are very similar to a real burial site with a buried murder victim.

The Forensic section/ AFFA held our first Forensic archaeology course in 2013 together with Stockholm University for Crime Scene Investigators were the participants conducted a forensic archeological excavation under supervision and guiding. A second course will hopefully be held.

We are very proud for this scientifically known project and our collaboration with Stockholm University and The Swedish Defense Research Agency.



1 Jun

Abstract no: PP105



Kirsten Buße

| POSTER

University of Bern, Institute of Forensic Medicine, Bern, Switzerland

From Big to Small: 3D documentation in archeology and forensic anthropology

3D documentation and reconstruction techniques are increasingly applied in archeology and forensic anthropology casework. A proper documentation approach offers a virtual, full extent preservation of a site or specimen, e.g. a subsequently changing site or shape. To cover different types of scenarios, various equipment and methods should be used; each specialized for certain ranges and with individual benefits. Our aim is to show which potential techniques can be suitable applied in which context. Therefore, we cover a widespread requirement area from our casework. Our specimen comprise e.g. scattered human skeletal elements from an outside setting, archaeological or further objects to bone fragments. We present different techniques, such as drone-based photogrammetry of large scaled settings to high-level structured light scanning. Thereby, we highlight benefits and limitations of each approach in the workflow.

An accurate 3D documentation facilitates a following reconstruction or investigation, even if the location or specimen has altered in a later stage. Therefore, it is crucial to know the different approaches in this rapidly developing field. We would like to present guidelines which state-of-the-art 3D documentation can be applied in archeology and forensic anthropology contexts.



1 Jun

Abstract no: PP106



Anelize Rumbelsperger

Federal University of Paraná

| POSTER

Grief – A Case Study of the use of Stable (CNO) Isotopes in solving disappearance cases in Brazil

Every year, around 63.000 people are reported missing in Brazil. Although these numbers do not take into account people that are found or return, there are still thousands of persons whose whereabouts remain unknown. Furthermore, in a country that displays high rates of homicides, there is a real possibility that a person missing for more than 48 hours might be dead and buried in a clandestine grave with no identification. Whereas the exact number of unidentified deadly remains in Brazil is unknown, data compiled by the Integrated Network of DNA Databases indicates that there are over 20.000 skeletal remains waiting for analysis in Brazilian medical institutes. Even though DNA, anthropology, odontology and fingerprints have evolved as gold standards for identification of human remains, there is a growing interest in newer techniques to address this humanitarian problem. Among such techniques, the use of stable isotopes has produced promising results, helping to provide information such as dietary discrimination and geolocation. The goal of this research is to use isotope studies that can be used nationwide to help identify thousands of missing persons. Stable Isotopes (C&O&N) is an emerging technique worldwide with promising results in identifying missing persons. Through this project, we hope to provide another option to help the identification process, with increased speed of analysis, especially in cases where other methods are inconclusive. The development of a Geolocation Map with Isotopes for the State of Paraná would also be the first step to understand the difficulties and challenges of constructing a similar map for the rest of the county.



1 Jun

Abstract no: **PP107**



Kenza Laplace

| **POSTER**

Department of Forensic Medicine, University Hospital of Montpellier, Montpellier, France

Time since death based on post-mortem ear temperature: can it be used by police officers (PO) at the scene?

The estimation of the time since death can be crucial in some cases. Reference methods are based on body cooling and require measurement of cadaver temperature to be done, at the scene, without moving the corpse, as soon as possible; as most general practitioners do not know how to collect and use post mortem temperature, PO who are often the first to reach the scene, might be of considerable interest for that purpose.

Post mortem rectal temperature, that is the traditionally used method, is influenced by the production of heat in the thigh muscles in the event of pre-mortem physical activity, but also by excessive weight or thickness of clothing... and is therefore unreliable. Moreover, it needs to take the clothes off and to manipulate an area of particular forensic interest in case of sex crimes.

The external auditory canal has therefore been proposed as an alternative site for temperature measurement by several authors. We will present our two most recent studies supporting the interest of this method. Our main findings were consistent with up-to-date literature, suggesting that methods for estimating early PMI based on ear temperature measurement are as reliable as those based on rectal temperature. It was also concluded that current PMI estimation algorithms, which were initially developed for probe thermometers, should not be applied to infrared (IR) ear temperature measurement.

We are currently designing a tool integrating algorithms suitable for IR ear temperature measurement. Our preliminary results will be presented, and the possibility and practicality of PO using an IR thermometer at the scene to determine PMI will be discussed.



1 Jun

Abstract no: PP108

**Bridget Thurn**

| POSTER

Centre for Forensic Sciences, School of Mathematical and Physical Sciences, University of Technology Sydney, Sydney, Australia

Use of electronic nose technology to locate missing persons and monitor the rate of decomposition over time

Discovering human remains is critical for forensic investigations. Cadaver detection dogs are currently the best tool for locating the deceased, to do so they use the scent or volatile organic compounds (VOCs) emitted from these victims. Despite their successes, there are several limitations associated with their use, including cost and handler error. The use of an instrument approach is therefore desirable. Currently methods for VOC collection and analysis rely on a two-step process whereby samples are collected in field and analysed in the laboratory. Due to time and monetary constraints, portable technology-based solutions, such as electronic noses (e-noses) are becoming attractive alternatives. E-noses are portable technologies that mimic olfaction using multisensor arrays and are far cheaper than their laboratory counterparts. This research determined the utility of an e-nose for the detection of VOCs released from a surface human donor at the Australian Facility for Taphonomic Experimental Research. E-nose samples were collected from four locations (the torso, face, 1m, and 3m upwind) periodically until day 75 post-placement. The results were compared to samples analysed by two-dimensional gas chromatography time of flight mass spectrometry. The e-nose detected decomposition VOCs on most days. An increased sensor response was observed during the latter part of fresh and active decay, particularly for alkanes, alcohols and sulfides. These initial results show the utility of e-nose technology for the detection of human remains. Further work with additional donors and scenarios is required prior to the implementation of e-noses as a detection tool.



2 Jun

Abstract no: PP5006



Rosario Guerra

| POSTER

Department of Physical Anthropology, University of Granada, Granada, Spain; Panacea Cooperative Research S. Coop., Ponferrada, Spain

Computer-aided Craniofacial Superimposition: an international validation on a historical mass grave

At the beginning of 2017, human remains of the 21 executed leaders of the anti-Russian uprising of 1863-1864 were uncovered at the Upper Castle of Vilnius. Systematic archaeological excavations, together with historical and forensic anthropological investigations were carried out. The identification process included cross-matching analysis of post-mortem (PM) data – burial artifacts, age, stature, signs of execution, antemortem lesions – with ante-mortem (AM) data – date and mode of execution, age and other information extracted from historical archives. A genealogical search for live and dead relatives was conducted, and genetic identification (comparison of data of individuals from the site and samples taken from exhumations of relatives' graves) was performed.

Simultaneously, craniofacial superimposition was performed by 5 inexperienced researchers, different to those working over all AM and PM data. These researchers were only granted access to the anthropological profile information, the 3D scanned skulls of 18 out of the 20 human remains and 14 photographs of 11 different candidates. To tackle the 11 AM cases vs 18 PM cases cross-comparison problem, Skeleton-ID™ software tool, developed by Panacea, was used. The agreements of MEPROCS EU project were followed as a methodological approach. In this way, a blind validation of both the methodological framework and best practices defined by MEPROCS consortium has been carried out on a real identification case report. For the first time, information provided by an automatic algorithm based on Artificial Intelligence has been considered within the decision making process led independently by the 5 anthropologists.



1 Jun

Abstract no: PP109



Anna Barbaro

| POSTER

Universidad de Alcalá, Departamento de Química Analítica, Madrid, Spain; Studio Indagini Mediche E Forensi (SIMEF), Italy

Age estimation of oral fluid stains by infrared spectroscopy (ATR FTIR)

Oral fluid evidence plays an important role in forensics, especially in cases involving sexual assaults. Non-destructive identification and age estimation of oral fluid stains is a relevant issue since it can provide important information on the temporal aspects of a crime event. The ability to identify the sample age represents a powerful tool since it allows to collect and analyze only samples directly related to the criminal case, reducing laboratory costs and efforts. The aim of the present research is to extend previous knowledge by identifying the spectroscopic signature of oral fluid either in fresh or in aged samples, in order to be able to identify an unknown sample as oral fluid independently of the age of the sample.

We analyzed 20 saliva stains (10 from a woman donor and 10 from a female dog) onto different white and colored substrates. Stains were stored at room temperature (25°C) to simulate the crime scene conditions and then tested at different time intervals since the deposition.

The spectral range of 3100-900 cm^{-1} was studied and data were processed using the Unscrambler X 1v. 0.4 (CAMO Software AS) and SIMCA v. 14.1 (Sartorius) softwares. The OPLS-DA models showed that oral fluid stains could be differentiated by their age. This is promising, as unknown samples could be dated using these models.

To our knowledge, there are not published articles that focus on the study of the aging of oral fluid stains from a forensic perspective using ATR FTIR.

This study is part of the Real-time on-site forensic trace qualification project (RISEN, SU-FCT02-2018-2019-2020-883116), which is funded by the European Union's Horizon 2020 research and innovation program.



1 Jun

Abstract no: PP110

**Rafał Borusiewicz**

| POSTER

Institute of Forensic Research, Krakow, Poland

Differentiation of oleoresin capsicum sprays, based on their capsaicinoid profiles

Pepper sprays contain a solution of capsaicinoids, obtained by extraction from peppers. Quantitative relations of natural capsaicinoids depend on the plant material, they were extracted from. Pepper spray is a non-lethal weapon that should only be used for self-defense, but is often used by criminals to attack and incapacitate victims. Evidence related to these types of incidents, such as containers, clothes of victims or suspects, as well as traces of substances found at the scene, are submitted to the forensic laboratory. The purpose of the analysis is to identify the ingredients of the preparation (especially active components) and compare the traces found on objects from the victim or the scene with the preparation from the can or traces found on objects related to the suspect.

The study aimed to investigate the possibility of differentiating OC gases based on capsaicinoid profiles recorded in GC-MS analyses.

Sixty-four gases from 12 different manufacturers were purchased and tested. The likelihood ratio (LR) approach was applied to the data expressing the relative capsaicinoids contents computed by integrating GC-MS signals. Two hypotheses were assumed that stated either common or different origins of the samples. Several LR models have been developed, and their performance has been controlled by the number of false positives and false negatives as well as empirical cross entropy.

The research results showed that differentiation was very successful, with more than 90% of correct responses. The results obtained show that OC sprays may be distinguished, even if they were produced by the same producer presumably if produced using different batches of pepper extract.



1 Jun

Abstract no: PP111



Anna Barbaro

| POSTER

Universidad de Alcalá, Departamento de Química Analítica, Madrid, Spain; Studio Indagini Mediche E Forensi (SIMEF), Italy

Human and Animal oral fluid stains differentiation by infrared spectroscopy (ATR FTIR)

The ability to identify bodily fluids recovered at crime scenes is a crucial aspect of any forensic investigation. Oral fluid is one of the most common fluids that can be found on different types of evidence and it can be very useful in identifying a victim or suspect. Animal and human oral fluid are identical to the naked eye, but they are different at a biochemical level. Since animal samples may often be found at the scene of a crime, it is particularly important to be able to differentiate the origin of a biological fluid as human or animal.

In the present study, we evaluated the suitability of attenuated total reflection Fourier transform infrared spectroscopy (ATR FTIR) to differentiate human and animal (canine) oral fluid stains on 20 different white and colored substrates. In addition, liquid human and animal saliva were tested as control samples.

Spectral range of 3100-900 cm^{-1} was studied and data were processed using the Unscrambler X 1v. 0.4 version (CAMO Software AS.) and SIMCA v. 14.1 (Sartorius) softwares. The OPLS-DA models showed that using ATR FTIR, human and dog oral fluid stains can be distinguished based on their principal spectral components.

The ability to differentiate the origin of a sample (human or animal) directly at the crime scene (using a portable ATR FTIR) can be very useful, as it could be used in situ, allowing the investigators to collect only samples relevant for the forensic investigation and to speed up investigations.

This study is part of the Real-time on-site forensic trace qualification project (RISEN, SU-FCT02-2018-2019-2020- 883116), which is funded by the European Union's Horizon 2020 research and innovation program.



1 Jun

Abstract no: PP112



Sarah Evans

University of Portsmouth, Portsmouth, United Kingdom

| POSTER

Expertise in Crime Scene Investigation: investigating the impact of training on the reliability of CSI decision-making

There is a growing acceptance that a greater and more holistic understanding of human factors is crucial to ensure robustness and transparency of a forensic investigation. Increased empirical knowledge of the human factors associated with crime scene examination is vital at this key early stage in the forensic process. The nature of expertise is acknowledged to be complex and the role of a crime scene examiner is multifaceted and, therefore, is likely to involve many different types of expertise including investigative expertise, scientific expertise, and perceptual expertise.

The present study looked to explore the varied nature of expertise within complex crime scene investigation and assess the impact of training on various areas of performance. An experiment was set up that established the performance of military crime scene investigators in areas connected to different types of expertise pre and post training. The influence of training on decision making and activity at the scene was explored. Observations of performance in a crime scene environment were used to map the key elements of expertise across the investigation of a complex scene. The data contributes to a model that looks to quantify aspects of expertise, through numerically defining the objective and subjective elements that collectively create the social concept of experts within the field of crime scene investigation.

The findings of the study are presented and discussed in terms of their impact for better understanding expertise and the role of human factors within crime scene investigation.



**EUROPEAN
PERSPECTIVE**





2 Jun

Abstract no: PP113

**Andreia Vieira****| POSTER***Forensic Science Laboratory – Polícia Judiciária – Lisboa – Portugal*

A new approach to best practice in forensic handwriting examination

Forensic Handwriting Examination is a discipline in which human factor plays an exceptionally important role. It is therefore particularly important in this field of forensic science to implement measures that foster objectivity, such as a quality assurance system, standardisation, verification of results, participation in competence tests, or following relevant guidelines, which can take a form of Best Practice Manuals- BPM.

The European Network of Forensic Handwriting Experts-ENFHEX, an ENFSI working group, has recently extensively revised and expanded its BPM as part of the AFORE project. The document has been structured around the ACE-V approach and new Appendices have been created to guide users through the key stages of the examination process. The Comparison Appendix explains in detail how to systematically confront each handwriting feature in questioned and known samples and how to document the results. The Appendix on Evaluation presents a practical application of the process of evaluative reporting, i.e. how to evaluate all findings as a whole with competing propositions (hypotheses) in such a way as to obtain the value of evidential strength. The Sampling Instruction provides a procedure for collecting reference samples, both request and from the course of business. A set of useful forms has been prepared which can be easily adapted to the needs of individual laboratories and, as a result, contribute to the standardisation of examinations within ENFHEX.

The presentation will detail the ideas behind the BPM, its content, and interactions of the Project Team with the Working Group, which included collecting information through surveys and reviewing the document.



2 Jun

Abstract no: PP115

**Sami Huhtala****| POSTER***National Bureau of Investigation, Forensic Laboratory, Vantaa, Finland*

Environmental Forensics – a Questionnaire to ENFSI Laboratories

The Forensic laboratory of the National Bureau of Investigation (NBI-FL) in Finland, as well as colleagues in several other European countries, have observed a growing interest in questions associated with environmental forensics. At the same time, public awareness of environmental issues has grown.

NBI-FL executed a study covering forensic processes related to environmental crimes in Finland. In November 2021, a Webropol questionnaire was submitted to 73 ENFSI laboratories in order to find out how matters related to environmental crimes are processed in other forensic laboratories in Europe. The information collected covers different types of expertise and examinations e.g. forensics used in the investigation of environmental crimes (type of cases, legislation, actors, etc.). As part of the questionnaire, the level of interest in collectively developing this area of forensic science was gauged.

In this presentation, we summarize the results of the questionnaire. In total, we received 30 answers and the response rate was 42 %. In most countries, the issue of environmental crimes was taken seriously, but a need for improvement in the approach to the issue was identified. Most laboratories participated at some level to the forensic processes related to environmental crime cases. The most common tasks performed in forensic laboratories were the analysis of environmental samples and interpretation of the results. Only three countries had case coordination services related to environmental forensics. Majority of the respondents (67 %) saw a need for collaboration and education in the field of environmental forensics.



2 Jun

Abstract no: PP116

**Benedikt Pulver****| POSTER**

State Bureau of Criminal Investigation Schleswig-Holstein, Kiel, Germany; Institute of Forensic Medicine, Forensic Toxicology, Medical Center – University of Freiburg, Freiburg, Germany

Review on five years of NPS analytics and the impact of the EU-funded project ADEBAR in the forensic sciences

Novel substances for which none or limited analytical data are available constitute a challenge for Police and Customs forensic laboratories. The time-consuming process of structural elucidation and acquisition of analytical data has been centralised in the ADEBAR project in Germany, co-funded since 2017 by the EU's Internal Security Fund. The competence network consists of the Federal Criminal Police Office, seven State Bureaus of Criminal Investigation and the German Customs and the two universities. The project aims to comprehensively characterise substances relevant in the forensic-toxicological casework within the analytical competence network. The analytical datasets are distributed digitally through European and (inter-) national channels.

Additionally, pharmacological evaluation allows for estimating *in vivo* potency and potential harm required as scientific evidence for legislative amendments. The samples (seized or purchased) are characterised using spectroscopic and spectrometric techniques (GC-MS, (N)-IR, GC-sIR, NMR, LC-(HR)MS and Raman). The results are published in reports available through (inter-) national channels (forum of the GTFCh, EDND of the EMCDDA and NPS Data Hub). The analytical datasets are published free of charge and shared in universal formats importable to databases by forensic practitioners worldwide. The ADEBAR project contributes to the availability of analytical data of new substances relevant to the daily work of Police and Customs laboratories. Since the inception of the ADEBAR project, 578 samples have been analysed, 297 substance reports notified to the EMCDDA, and 3184 mass spectra accumulated.



2 Jun

Abstract no: PP117

**Isolde Wagner***Federal Criminal Police Office of Germany – Forensic Science Institute*

| POSTER

The Methodology of Forensic Speaker Comparison – Best Practice Manual developed as Part of the AFORE Project

One of the most important tasks in the field of forensic speech and audio analysis is the comparison of questioned speakers to one another and/or to suspect reference samples. The traditional and still widely used approach besides technological innovations of automatic processing consists of auditory phonetic-linguistic analyses combined with acoustic measurements and statistics of the speech signal. This traditional approach has been gradually developed over the past decades. There is a huge variety of research and publications on different aspects of speech, e.g. regional or foreign accents, pitch, voice quality, tempo, disfluencies etc. With the increasing importance of quality assurance and accreditation there have been more and more requests for harmonised and standardised documentation of the procedure as a whole. The use of a consistent methodology and the production of comparable results will facilitate interchange of data between laboratories. Within the European Network of Forensic Science Institutes (ENFSI) and the current project Accreditation of Forensic Laboratories in Europe (AFORE) supported by the 'European Union's Internal Security Fund – Police' experts were encouraged to produce so-called Best Practice Manuals (BPMs). Best Practice Manuals are aimed to provide a common framework for procedures, quality principles, training processes and approaches to forensic examinations and are intended for experts in the field. One of the deliverables of the AFORE project is the BPM for the methodology of forensic speaker comparison. A revised draft version of this document will be presented and discussed for further improvement.





**FORENSIC
MANAGEMENT**



31 May

Abstract no: PP118



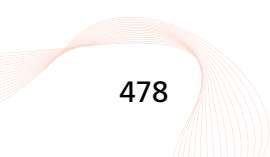
Ana Flavia Belchior De Andrade

| POSTER

School of Human Sciences, College of Science and Engineering, University of Derby, UK

Forensic laboratory backlog: how much it costs and how can it compromise the evidence?

Forensic laboratories all over the world face great challenge to overcome waiting time and backlog on different areas posing an important challenge for forensic laboratory keep both quality and time of response within acceptable time period. In this study data from marijuana samples seized by the Federal District Civil Police in Brazil between the years 2013 and 2017 were tabulated and analysed to determine how delays can affect exam results. The data was analyzed to determine time elapsed between the seizure and the TLC analysis. Most of the TLC examinations were concluded not later than 30 days after receipt (76.4%), although some samples waited up to 36 months before being examined (0.65%). It is noticeable that if a marijuana sample is stored for over 18 months, the percentage of inconclusive results rises from 0.9% to 9.3%, and when storage exceeds 30 months, this increases to 26.9%. Statistical analysis shows a negative correlation between time elapsed and positive results ($-0.74, p < 0.05$) and a strong positive correlation between time elapsed since seizure and inconclusive TLC results ($0.86, p < 0.05$) confirming a tendency for inconclusive results to increase overtime. An inconclusive result triggers re-examination procedures that requires more work delaying the report at least one day. This situation can increase the running cost of a forensic drug laboratory leading to legal procedures to be delayed and unsuccessful prosecution. Delays may slow investigations and hamper the police's ability to eliminate suspects and make arrests quickly endangering public safety by giving criminals more time on the street to re-offend and contributing to a rise in crime levels.





31 May

Abstract no: PP119



Tetiana Tatarnikova

| POSTER

The State Scientific Research Forensic Center of MIA of Ukraine, Kyiv, Ukraine

Security in forensic activities

Security is a comprehensive and wide-ranging concept in everyday life that envelops us at every step: from being outdoors or using any machinery to the Internet and our mind. Man and all his inventions are not able to create a perfectly safe environment. Moreover, a completely safe environment will be the end for a human being. Let's pay attention to areas of forensics that require attention and security:

- 1) an expert (or any employee of a forensic institution): physical security; psychological security; corruption factors; influence of stakeholders (customer, manager, third parties); ecological security; the impact of legislation; medical support (life and health insurance, measures to reduce the impact of the pandemic, etc.);
- 2) objects of research (physical evidence) of various types (glass, ceramics, weapons, ammunition, wood, biological objects, objects that cannot be removed – a house, etc.): during detection, fixing, removal and packing at the place of inspection; during transportation to / from the forensic institution; during the examination; during storage;
- 3) documents (paper, electronic): from loss, damage, changes; during use, transfer, storage;
- 4) various type of information (text, electronic, etc.):when recording, saving, using, forwarding, archiving; providing authorized access; proper interpretation;
- 5) premises, territories (institutions, places of inspection, etc.):environmental conditions; Fire Security; safe use of chemical reagents, radioactive equipment, etc.

It is the minimum list of elements, ignoring which is unacceptable for the head of a forensic institution and related institutions.



31 May

Abstract no: PP120



Rafael Ortiz

| **POSTER**

Brazilian Federal Police, Porto Alegre, Brazil.; INCT Forense, Porto Alegre, Brazil

INCT FORENSE: a Brazilian project in scientific research and training of human resources in the forensic field

Developing research based on Brazilian reality consists in acquiring knowledge about particularities of local criminality in order to better understand, prevent and confront it. Based on this premise, the National Institute of Science and Technology in Forensic Sciences (INCT-FORENSE) was created. It is a national and international inter-institutional scientific cooperation network that started in 2017, in Brazil, after the project has been approved on a public notice by the Federal Government (Grant number 465450/ 2014-8). The main objective is to promote scientific advances in forensic sciences. To develop this project, it was proposed an integration between scientific police and universities in which forensic experts pointed out real problems as themes for academic studies and both work together trying to find the best solution. The basic structure of the INCT-Forense is composed by a Headquarter institution (PUC-RS), an associate Forensic Unit (Brazilian Federal Police – State of Rio Grande do Sul) and 19 Postgraduate Programs. Until now, 95.49% of the project was completed. To exemplify the results obtained, 120 pos-graduated students were trained; more than 200 international scientific articles were published; softwares to monitore drug traceability were developed; 300 lectures on the topic were ministrated. This is the first INCT-Forense in Brazil, it is on finais stage of execution and found success in all goals proposed. It is intended to continue this proposal so new international partners will be welcome. The project will help Brazil to become a regional reference in Latin America on forensic science.



31 May

Abstract no: PP121



Vincent Mousseau

| POSTER

School of Criminology, Université de Montréal; International Centre for Comparative Criminology (ICCC); Laboratoire de Recherche en Criminalistique (LRC)

Who wants to be a CSI? An exploratory study of Quebec's police recruits' interests toward the profession

For many years now, debates have persisted regarding the nature of the training that crime scene examiners should have: should these professionals be police officers trained in forensic science or rather civilians, with a scientific background, subsequently trained in policing on the job? While some international law enforcement organizations hire the former, some the latter, and some hire both, the issue remains relatively little studied by researchers. There are still few empirical studies that have truly measured the performance of these two groups of professionals. Similarly, to our knowledge, no study has looked at the professional aspirations of the main concerned actors, namely in Quebec, future police officers. As part of a larger longitudinal study on the professional trajectories of Quebec police officers, this presentation seeks to explore the interests of police recruits for the profession of crime scene examiner. To do so, a total of 522 students in Police Technology from twelve colleges in Quebec (Canada) completed, each year of their 3-year police training, a self-administered survey where they had to answer questions about their professional aspirations. The analysis suggests that only a limited proportion of police recruits would be satisfied working as crime scene examiners and that many other specializations seem more popular. By focusing on ambivalent police recruits and those with more categorical intentions, it also highlights how the interest in the crime scene examiner profession evolve as police training progresses. Our results thus invite a more in-depth reflection on crime scene investigation education and crime scene examiners selection.



31 May

Abstract no: PP5007



Fabio Casali

| **POSTER**

Centre for Forensic Science, Department of Pure and Applied Chemistry, University of Strathclyde, Glasgow, Scotland, U.K.

Delivering Educational Excellence at a Distance: Forensic Science Fundamentals

Devised by specialists, exclusively for on-line delivery, a premier international programme has been developed to enhance professional careers, or to launch new career pathways in Forensic Science. The carefully constructed programme will appeal to operational forensic scientists, and potential students, looking to upskill with motivating and purposeful study. Development of this programme has involved a range of innovative teaching practices based on lessons learned from the transition to remote learning due to the COVID pandemic.

A series of distance learning modules have been developed covering areas of fundamental forensic science, forensic biology and forensic chemistry. Using a combination of recorded lectures, digital workshops, interactive activities and innovative teaching strategies, can distance learning provide comparable levels of teaching engagement and/or practitioner training to on-campus teaching?

This poster will illustrate innovative advances in education enhancement to deliver immersive learning environments when learning/upskilling at a distance. Key topics in operational and practical forensic science are taught using virtual pedagogic tools:

- Virtual crime scene exploration using Google Earth and the mobile Crime Scene Assist Ltd. App.
- Forensic science operational training home kit
- Live forensic examinations using 360 cameras

The ability to undertake theoretical and practical modules at a distance, through an inclusive and flexible learning environment (eliminating barriers such as travel and accommodation costs, visa applications etc.), is key to promoting a new era in forensic science training and education for practitioners and scholars.



**FORENSIC
STATISTICS**



2 Jun

Abstract no: PP122

**Alicja Menżyk****| POSTER**

Forensic Chemistry Research Group, Institute of Chemistry, University of Silesia in Katowice, Poland; Institute of Forensic Research, Krakow, Poland

Adequate preprocessing of spectra as a tool for improving likelihood ratio models for forensic comparison tasks

Spectroscopic signals are frequently acquired for forensic evidence analysis. One of their applications involves discrimination/classification or comparison of the evidence materials to assist in the investigation process. However, successful discrimination is achievable only if data are properly preprocessed. This applies to denoising, smoothing, baseline correction, and normalization operations to remove unwanted variation, deteriorating effects (noise or baseline drift) and standardizing the signals. In the case of the discrimination task, the aim of the preprocessing is also to highlight the differences between the considered classes and minimize the differences within classes, i.e., the variation of the class means (B) should be greater than the average variation of the data in the classes (W).

The research aimed to verify if the parameter defined as the B/W ratio can be an objective measure of the goodness of the preprocessing strategies when the goal is to study the similarities between samples to establish if they may be members of the same class. The B/W was estimated from regularized MANOVA where the regularisation makes it feasible for finding the latent variables from highly multivariate data along which the classes are maximally separated.

Optimal preprocessing methods were found in grid search and via genetic algorithms. The adequacy of the procedure for finding the optimal preprocessing strategies was successfully judged in the studies aiming at comparing Raman spectra of blood traces to establish if they are of the same age or Raman spectra of car paints to conclude if they may come from the same car. The task was solved using the likelihood ratio models.



2 Jun

Abstract no: PP123

**Tatiana Trejos****| POSTER**

West Virginia University, Department of Forensic and Investigative Science, Morgantown WV, US

Assessing significant factors that can influence physical fit examinations of tape and textiles

A physical fit can demonstrate that two items were once the same object. The characteristics of the fracture are highly dependent on the material in question. However, only recently has there been an effort to define comparison criteria to standardize how forensic examiners perform these examinations.

This research developed and evaluated systematic comparison methods and quantitative criteria to assess the probative value of fracture fits. The most distinctive features were reported for 3000 duct tapes and 800 textiles. The probative value of physical fits was evaluated through similarity metrics, error rates, and score-based likelihood ratios, and an interlaboratory study.

Furthermore, two generalized linear models were proposed to quantify the effect of the factors of interest on the value of the similarity scores. For tape objects, the model considers the tape quality, separation method, stretching, and edge pattern. For textile objects, yarn composition, construction, print, and separation method were considered. The models used the logit link function to transform the dependent variable (similarity scores). Variable selection was used to determine which interactions between these variables were relevant for each model. The two models allow forensic examiners to understand the factors that can influence a physical fit conclusion.

This study is anticipated to strengthen current practice by providing harmonized material-specific examination protocols and decision criteria, effective mechanisms to ensure a transparent and systematic peer-review process, and a quantitative basis to determine the accuracy and reliability of forensic fracture fit comparisons.



2 Jun

Abstract no: PP124

**Xiao Wang****| POSTER***Department of Language and Linguistic Science, University of York, UK*

Crises of uncertainty, reproducibility, and replicability in forensic comparison

Forensic validation tends to focus on the overall performance of methods under casework conditions. This implicitly focuses the expert's attention on discriminability (see Smith & Neal 2021), with different methods chosen, or decisions made, based low values for the validity metric used. In this paper, we argue against this view. Rather, we believe that the expert's primary concern should be to reduce uncertainty (Morrison & Enzinger 2016, Ramos et al 2021), rather than maximising discriminability. This is because uncertainty is directly related to the probability of a miscarriage of justice, which should be the expert's ultimate concern.

In this paper, we present results from a score simulation study demonstrating the variability in validation results as a function of sampling variability and demonstrate how Bayesian calibration (Brümmer & Swart 2014) may reduce such uncertainty. We also highlight how this problem applies to all forms of forensic comparison (including those based on entirely human-based, subjective methods), and present a series of specific recommendations. Experts should:

1. Recognise that forensic comparison is a process involving numerous decisions which introduce uncertainty via both systematic and random factors
2. Be explicit about the decisions made at each stage of the process and the implications of such decisions for uncertainty in terms of the results LRs and overall method validity
3. Take steps to measure and minimise uncertainty

The focus on uncertainty also directly relates to issues of reproducibility and replicability. In this paper, we also consider the specific challenges these concepts pose for forensic sciences.



2 Jun

Abstract no: PP125

**Ana Alves-Pinto**

| POSTER

Zentrale Stelle fuer Informationstechnik im Sicherheitsbereich, Munich, Germany

Iterative Named Entity Recognition with CRFs and Bi-LSTM on German Texts

The digital processing and analysis of large amounts of documents for subsequent extraction of information and forensic evaluation of evidence can be supported by machine-learning methods. Automatic extraction of information is furthermore often based on the identification and detection of entities. The annotation of these is however a time- and resource-costly process. We have recently shown that an iterative procedure based on Conditional Random Fields (CRFs) and encompassing a self-learning and an active learning component can be used to speed up the recognition of entities in large amounts of German text documents (Alves-Pinto, Demus, Spranger, Labudde, Holey, 'Iterative Named Entity Recognition with Conditional Random Fields', Appl.Sci, 2022). The active learning component consisted in the manual annotation of sentences with the lowest probability of a correct prediction by the model. Although a model with an F1-Score of 0.885 could be trained in 11.4h, its accuracy varied for different types of entities, with performance decreasing for entities of the ENAMEX group. Here we seek to overcome this limitation and to reduce these differences by, in line with previous works, extending the model for NER and with a bidirectional Long-Short Term Memory Network.

A bronze statue of Lady Justice, the personification of the law. She is depicted as a woman with her eyes closed, wearing a crown of scales. In her right hand, she holds a sword, and in her left hand, she holds a pair of scales of justice. The statue is set against a clear blue sky with some light clouds. The image is overlaid with a black hexagonal shape containing white text, and several white, wavy, line-like graphic elements that sweep across the scene.

LEGAL & ETHICAL ASPECTS



2 Jun

Abstract no: PP126



Karen McGregor Richmond

iCourts, Copenhagen University, Copenhagen, Denmark

| POSTER

Between Fact and Opinion: The 'Sui Generis' Approach to Expert Witness Testimony in International Criminal Trials

It is a fundamental tenet of the law of evidence, spanning all jurisdictions, that witness testimony should ideally be delivered in open court by the individual who observed the event in question, or by the expert whose technical knowledge is relied upon. A notable exception to this principle has emerged in the field of international criminal justice, where courts and tribunals may allow 'summarising witnesses' to present a summation of witness testimony. In the case of *Ayyash et al.*, the Special Tribunal for Lebanon extended the principle, allowing voluminous expert opinion evidence to be presented in factual summation. This presentation analyses such approaches, utilising doctrinal methods alongside empirical Wigmorean analysis, to assess the probity of these *sui generis* practices. The results are placed in legal and theoretical perspective, demonstrating that international courts and tribunals are departing from an overarching obligation to integrate international and domestic standards. Furthermore, it is argued that there exists a legal requirement for the STL (and the ICC) to apply Dutch national law in relation to the appointment of experts, accreditation, and conformity with international standards in digital forensics, alongside a normative case for the imposition of international standards in alignment with UN resolutions, and—in respect of the ICC—the principle of complementarity. The integration of both regional ENFSI and international ISO standards will, it is posited, benefit the field of international criminal adjudication whilst ensuring that expert evaluations and reports are delivered to the highest quality standards regardless of forum or jurisdiction.



A man in profile is shown in a dark setting, looking at a computer screen. The image is overlaid with abstract white line art that flows around a central red hexagonal frame. The word "WORKSHOPS" is written in white, bold, uppercase letters inside the frame.

WORKSHOPS



30 May

WS001

**Pierre Esseiva***University of Lausanne, School of Criminal Justice, Switzerland***| WORKSHOP**

Decentralization of forensic laboratories, challenges and opportunities

The options for portable chemical analysis have developed significantly in recent years and contributes to the trend towards decentralization and the increasing need for rapid results to generate information for investigative and intelligence activities. The decentralization of forensic capabilities is an important challenge that all forensic laboratories have to face at some point. But just as digital transformation has brought about profound changes in our lifestyles, technological developments are not only bringing new analytical capabilities, they are also driving a shift in the scope of forensic disciplines and opening up new possibilities for interaction between forensic specialists. In this workshop we will first present some applications regarding the deployment of portable rapid, non-destructive methodologies for the analysis of illicit drugs, explosives and DNA. Then we will open discussion about the utilization of the results in an operational as well as in a judicial perspective. We will stimulate reflection within the participants regarding the implications of this transformation and the associated change of their tasks and roles. We will also discuss the different strategies of the utilization of the results and the new possibilities that these results enable.



30 May

WS006



Céline Weyermann

| WORKSHOP

Ecole des Sciences Criminelles, University of Lausanne, Switzerland

The role of forensic science in the investigation and monitoring of environmental security problems

The awareness and regulation of security risks posed by water contamination and pollution is rapidly increasing. Thus, law and governance systems need to commit (and are already committing) more resources to address and repress inadequate human behaviour resulting in harm to the environment. Based on our own (local and international) practical experience, the workshop will focus on the role of forensic science in monitoring contaminated surface waters and investigating pollution sources. The presentations and activities will address the following forensic concepts applied to environmental security issues: detection, sampling, analysis, comparison, evaluation and monitoring of the traces following pollution events. While water pollution problems will first be addressed in a general way, case examples will focus in particular on recurrent and invisible pollutions caused by micropollutants such as polychlorinated biphenyls (PCB), pesticides or pharmaceuticals.

1. Welcoming quiz – 15 min
2. Introduction to the theme and concepts (the offence: water pollution, the scene: trace detection & sampling) – 30 min
3. Interactive activity (problem-based learning using real case examples) – 30 min
4. Break – 15 min
5. The role of monitoring in the detection of cases – 30 min
6. Case investigation & evaluation – 30 min
7. Roundtable discussion on the role of forensic science – 30 min
Parts of this workshop have already been successfully tested through presentations and activities organised in French for forensic master students, law specialists, forensic scientists and environmental practitioners.



30 May

WS007

**Briana Capistran****| WORKSHOP***National Institute of Standards and Technology, The United States of America*

Application, Implementation, and Resources for the Adoption of Ambient Ionization Mass Spectrometry in Forensic Laboratories

As the need for rapid and accurate presumptive screening techniques for forensic analysis continues to grow, many laboratories are considering adoption of ambient ionization mass spectrometry (AI-MS), of which direct analysis in real-time mass spectrometry (DART-MS) is the most common. Ambient ionization techniques such as DART-MS are appealing because they offer a near-complete chemical profile of a sample in a matter of seconds with little to no sample preparation. As with any new technology, adoption and implementation can be challenging. This workshop will provide participants with the necessary knowledge base and resources to minimize these burdens. Topics that will be discussed in this workshop include the fundamentals and forensic applications of AI-MS, unique uses of DART-MS and its variants, discussion on how to validate and implement these techniques, and details on the wide range of resources that are freely available to the community to assist in implementation through data analysis. While the primary focus of the workshop will be on seized drug analysis, other forensic chemistry applications will also be highlighted.



1 Jun

WS022

**Adrianus Cornelis Van Asten****| WORKSHOP**

Chair of Forensic Analytical Chemistry, University of Amsterdam and Netherland Forensic Institute, The Netherlands

Novel strategies to meet the NPS challenge

Forensic illicit drug analysis laboratories are facing an increasing number of new psychoactive substances (NPS) in their annual case load. With minimal differences between isomeric psychoactive substances, the traditional approach of colorimetric testing followed by GC-MS analysis can potentially lead to a false positive result which can easily lead to an erroneous conviction. To prevent this undesirable situation laboratories have expanded their analytical capabilities mostly investing in GC-IR equipment. In addition, the academic forensic science community has recently explored a wide range of techniques and approaches to broaden the scope for robust NPS identification. In this workshop leading forensic scientists will explain a number of these novel strategies in short presentations with an aim to explain the basic principles and performance.



1 Jun

WS028

**Sami Huhtala****| WORKSHOP***Forensic Chemist, National Bureau of Investigation, Finland*

Chemometrics: easy to use tools for processing and interpreting data of forensic samples

The common practices of chemometrics were collected into a Guideline booklet (Guideline for the use of chemometrics in forensic chemistry) of the European Network of Forensic Science Institutes (ENFSI) in order to help forensic scientists to understand and utilize chemometrics in their everyday work tasks. The Guideline and ChemoRe software tool provide an easy starting point for a forensic chemist to apply chemometrics. They will support routine forensic work and help in creation of high quality measures and processes that authorities can rely on. An introduction to chemometric applications is given in theory and by practical exercises covering frequently occurring forensic questions related to illicit drugs. The workshop offers a guided tour to the development and application of selected chemometric methods. Topics covered are data pretreatment, selection of chemometric method, validation and application of the method by ChemoRe software tool. The participants will do the exercises with their own laptops. Guideline and ChemoRe were created within the Chemometrics Subcommittee of the ENFSI Drugs Working Group.



31 May

WS010



Jimmy Berggren

| **WORKSHOP**

Forensic expert in 3D Forensic Reconstruction & 3D Visualization, National Forensic Centre, Sweden

The forensic value of fused 3D data: combining terrestrial laser scanners and photogrammetry

There are many use cases when the fusion of 3D data would gain added value for forensic purposes. For example, when there is a time discrepancy in data collection, or when two or more sensors capture different information or resolution, and there is a need to combine data to create a full understanding of the crime scene.

This workshop will include a presentation from a world leading team in 3D capture who uses photogrammetry and laser scanners to achieve their results. They will show us how their work has been performed and refined over the last few years.

There will also be a presentation on how fusion of 3D data from terrestrial laser scanners and photogrammetry has been used in real cases.

Finally, there will be a group discussion focused on the forensic value of these methods. Topics to be discussed include:

What is the requested quality and resolution of 3D models for visualization purposes vs. forensic analysis?

How can we validate the accuracy of 3D models generated with photogrammetry, and how reliable are results when it comes to forensic value?

What would be the critical factors when fusing geometry from laser scanners and photogrammetry?

The workshop aims towards a common understanding of reliable methods for merging 3D geometry, and a unified European approach to the challenges of maintaining forensic value within this domain.



1 Jun

WS019



Jurrien Bijhold

| WORKSHOP

Lecturer-researcher, Leiden University of Applied Sciences, Lectorate Digital Evidence & E-discovery, The Netherlands

Virtual and Mixed Reality applications for Crime Scene Investigation, Reconstruction, Presentation, Training and Education

Along the time line of events in a crime investigation that start with detection of the crime and end with a court session, the presenters want to do a number of small live demonstrations of applications that are interrupted for discussions with the audience. The workshop will not be focussed on the technology but on the applications and issues like practical and legal problems, organization of workflow and information flow, data security and best practice. Special applications for collaborative exercises and proficiency tests will get extra attention.



1 Jun

WS020



Zeno Geradts

| **WORKSHOP**

Senior forensic scientist, Netherlands Forensic Institute, and chair Forensic Data Science at the University of Amsterdam, Switzerland

Challenges in Digital Forensics, mobile, AI en IoT

Within this workshop, we present an overview of state of the art and new research in Digital Forensics. The digital field is special due to the rate of change. Many new developments are seen in mobile forensics (such as side channel attacks) and the analysis of data from IoT devices. Furthermore, the use of AI in Digital Forensics is discussed, with for example, the analysis of activity of a person derived from data. Forensic big data platforms are presented, and solutions for handling the huge amounts of confiscated data. Several European projects (Starlight, UNCOVER and DigforAsp) are also brought to the table, as well as the goals of the ENFSI Forensic IT working group. Examples of the practical use of AI in digital forensic investigations are given, such as identifying life threats in millions of "encrochat" messages.



1 Jun

WS021



Forensic experts from the Software and Hardware Forensics Group

| WORKSHOP

National Forensic Centre, Sweden

Vehicle Forensics

The workshop consists of two parts. It is possible to sign up for just one part, or both.

Part 1: Extraction of data: Hands-on workshop (probing / soldering, how to find eMMC pinouts)

Part 2: Analysis of data: Tools and methods for analyzing data from vehicles, mainly using Linux and open-source tools.

Requirement: Bring your own computer, with Virtualbox or VMWare installed.



1 Jun

WS034



Ghennadii Konev

Product Specialist / TechSales

| **WORKSHOP**

MSAB Ecosystem: An all-round approach to Mobile Forensics

From capturing time-sensitive volatile data and accessing data from locked devices, to finding critical evidence among vast data sizes, modern Mobile Forensics can be a challenging discipline to deal with. Join us to see how MSAB Ecosystem tools and solutions help our Customers to face and address modern Mobile Forensics challenges in time and resource efficient ways.



1 Jun

WS035



Hans Henseler

| WORKSHOP

Digital Forensic Advisor Hansken at NFI and part-time professor Digital Forensics and E-Discovery at University of Applied Sciences Leiden, The Netherlands

Hansken the open platform for digital forensic investigation

Digital data and deduced digital traces play a continuously growing role in investigations and the furnishing of proof in crime cases. The volume, variety and variation of this data grow rapidly. As a result, there is a serious shortage of digital forensic knowledge and a growing need for new knowledge to handle this growth. Hansken is a Digital Forensics as a Service (DFaaS) platform that has been designed to give access to and insight in digital data and traces originating from seized and demanded material. In recent years, Hansken has been implemented at law enforcement and intelligence agencies in the Netherlands, Norway, Spain and pilots are in progress in various other countries. The workshop starts with an introduction to DFaaS concepts followed by a short demonstration of Hansken, an update on the Hansken Academy, Hansken Roadmap, Collaboration with Academia and the (growing) International Hansken Community. After the introduction the hands-on part of the workshop starts. We will explain the Hansken query language and trace model followed by a tutorial explaining the Hansken expert user interface. Participants will be provided with a laptop that is running a small Hansken demo system. Participants are asked to complete a number of simple exercises that involve investigating digital evidence. In the final part of the workshop we present advanced features of the Hansken query language and illustrate how Hansken queries can be formulated using embedded queries, regular expressions and entity value search.



2 Jun

WS040



Steffen Franz

| WORKSHOP

German Federal Criminal Police Office, Software Engineer@INSITU-Project, Germany

Smartphone-based crime scene documentation with INSITU – a hands-on workshop

European police forces continuously strive to implement a digitally holistic system for crime scene documentation.

This workshop will present the current status of the project INSITU (lat. in situ: "on site"). The aim of INSITU is to provide forensic personnel with a system that enables a smartphone-based digital crime scene documentation that ensures data consistency right from the start.

INSITU is a software system consisting of a smartphone app and a web application as well as a shared data model. With the help of the INSITU app, forensic personnel can document evidence and describe the crime scene topologically and geometrically. This gradually creates a digital, multimedia model of the crime scene that comprehensively captures the situation and assists the process from crime scene to court. With the INSITU web application, the recorded crime scene data can be visualized, searched and analyzed. Further data e.g. digital photos, videos, laser scans can be imported as well.

As part of a three-year research phase (2018 – 2021), a demonstrator system with all relevant core functions has been developed. The systems capabilities will be demonstrated during a hands-on workshop at the EAFS 2022 where participants will be able to experience the system themselves.



2 Jun

WS043



Freek Bomhof
TNO

| WORKSHOP

Data for forensics: Presentation of two European research projects (STARLIGHT and popAI)

The session aims to give an overview of challenges in digital forensics related to data exchange for AI.

The growth of artificial intelligence (AI) provides security opportunities and challenges for Law Enforcement Agencies (LEAs). The challenge is to grow LEA organisational knowledge, skills and capabilities to capitalise on AI in tandem with existing data to deliver better and more efficient solutions to counter major security threats whilst also mitigating against criminal use of the same AI technologies. LEAs should achieve this whilst also complying with legal, ethical and organisational constraints needed to safeguard the fundamental rights and freedoms of European Citizens.

One of the basic challenges here is data: exchange of data between actors is not straightforward because the data itself is highly sensitive and usually contains personal information, not only addressing the perpetrators but also unrelated individuals. Yet, the creation of AI applications requires a lot of data. How can good AI applications be built when there is no training data available? And how can data be used in operational situations when it has to be shared between AI applications that are used in different legislations?

Another key issue is human factors & the ethical, legal and societal aspects (ELSA) of use of AI and relevant data for Law Enforcement, what are the tensions and controversies around ELSA and investigation/forensic effectiveness?

Agenda

00:00 Opening (Freek Bomhof, TNO)

00:05 Anonymization and generation of data to address sensitivity issues (STARLIGHT)

00:35 Ethical, legal and societal aspects of data for AI in Law Enforcement (popAI)

01:05 Q&A

01:20 Closure



1 Jun

WS023



Christina Forsberg

| WORKSHOP

Senior Advisor, The National Forensic Centre, Swedish Police Authority, Sweden

Validation of forensic DNA analysis methods

What is validation really about? After all, it can be frightfully dull, and boring, and completely... completely wonderful. This workshop will cover general aspects of internal validation/verification of forensic DNA analysis methods and instrumentation. This includes validation principles, performance characteristics and practices. Special focus will be given to in-house validation of methods utilizing NGS/MPS technology. In addition, possibilities and limitations using flexible scope of accreditation will be covered. The workshop will be a mixture of presentations, discussions and interactive sessions.



1 Jun

WS033



Jord H.A. Nagel

| WORKSHOP

DNA-forensic scientist and reporting officer, Netherlands Forensic Institute, The Netherlands

What is a complex DNA-mixture? Complex DNA-mixture interpretation, statistical evaluation and the use of a supporting expert system

The aim of this workshop is to give the participants more insight in the interpretation of complex mixed DNA-profiles, perform comparative DNA-analysis and calculate evidential values of potential contributors. Although complex mixed DNA-profiles consist of the same building blocks as simple single source DNA-profiles the observed variation is much greater. The workshop is aimed at reporting officers who deal routinely with DNA-profiling in casework.

In this workshop complex mixed DNA-profiles are defined as low template mixed DNA-profiles and/or mixed DNA-profiles with three or more donors. Different aspects that make a DNA-profile a complex mixed DNA-profile will be addressed:

1. Stochastic effect, stutters, allele drop-in and drop-out
2. Why replicants (repeating the PCR of a DNA-extract) can be helpful
3. Determining the number of contributors
4. Biological variation, trisomers and primer binding site mutations
5. Calculating evidential values with different probabilistic models

To help with interpreting complex mixed DNA-profiles and calculating evidential values, the expert system DNAXs will be demonstrated in the workshop. The software suite DNAXs harbors tools for complex DNA-mixtures interpretation, determine the number of contributors and calculate evidential values using two different probabilistic models MixCal and DNASTATIX. The decision process in the interpretation of complex mixed DNA-profiles and the effect on the calculated evidential values of potential contributors with different probabilistic models will be discussed.



2 Jun

WS041



Charlotte Murphy

| **WORKSHOP**

Reporting Forensic Scientist, Forensic Science Ireland

Sampling strategy for the interpretation and evaluation of cases of alleged sexual assault

An evaluative approach to Forensic Science reporting using a Bayesian framework is recommended by ENFSI in their guideline for evaluative reporting. Many Forensic Practitioners wish to use the Bayesian approach in their casework and are familiar with the theory. However, applying the approach to real life casework can be challenging. We aim to help bridge the gap between theory and practice. A critical step in any case of an alleged sexual assault is identifying what analysis is required, what items to sample and how to sample. A poor sampling strategy can result in an inability to put significance on the results obtained and may lead to a lost opportunity to provide Forensic assistance. We have developed accredited sampling methodologies, which facilitate the robust evaluation of the results obtained, within a logical framework using available published data. The aim of our workshop is to provide a practical demonstration of these sampling methods. This will be a hands on practical workshop. We will provide various casework scenarios, items for examination and demonstrate how to consider the identification of multiple body fluids and DNA during the workshop. Following the workshop participants will be better placed to strategically approach cases of alleged sexual assault and robustly evaluate their results.



30 May

WS004



Maurice Aalders

| **WORKSHOP**

Chair Forensic BioPhysics group, Amsterdam UMC, University of Amsterdam, The Netherlands

Taphonomic research facilities – establishing, maintaining and creating possibilities for forensic science

The workshop will be presented and moderated by initiators and current directors of human and animal taphonomic sites in Europe, the Americas and Australasia. The goal of the workshop is (1) to provide information about all aspects involved in setting up a taphonomic site, and the aspects involved in maintaining the site; 2) to provide an overview of the ongoing research and training conducted at these facilities, as well as core research themes active in forensic taphonomy today, and 3) to determine research priorities and challenges for the future. The first part will be in the form of brief lectures by the organizers who will discuss the requirements (body donation programs, infrastructure, ethical frameworks etc.), legal and other permits required, public opinion and consultation, and other challenges they encountered when setting up a human or animal taphonomic site. The various ways of organizing research and training at the facilities will be discussed (e.g. as a university site or an open facility, for pure research only, or as a training facility for search, detection and recovery). The second part will provide an overview of the ongoing research at the various facilities, which will be followed by an active discussion with the audience to identify research priorities for the future, both for taphonomic facilities as well as the wider community of forensic practitioners, researchers and law enforcement who may use them.



1 Jun

WS029



Bela Kubat

| WORKSHOP

Forensic Pathology of the Faculty of Health, Medicine and Life Science, Maastricht University and Netherlands Forensic Institute, The Netherlands

Basic forensic neuropathology

The 3-hours' course will provide short information on the relevant cerebral anatomy and cut up methods. Furthermore, the necessary sampling and histological work up shall be addressed, as well as the macroscopic findings of traumatic lesions and the most frequent medical conditions. The main attention shall be paid to the interpretation of the microscopic findings including the age estimation of lesions and the differential diagnosis. The course will start with introduction lectures, followed by a discussion of exemplary cases. The level of the course is designed for the general forensic pathologist and forensic pathology trainees. In addition interested medical experts from other fields and legal experts can join in and learn what possibilities forensic neuropathology can provide. In order to offer more personal attention the number of participants is limited to 20. The learning objectives are:- to refresh the knowledge of the methods of brain tissue handling. To gain knowledge of the histology of traumatic changes, their differential diagnosis and the interpretation of the findings To gain information on the diagnostic possibilities, pit falls and quality requirements of forensic neuropathology.



1 Jun

WS032



Henrik Green

| WORKSHOP

Professor, Linköping University/National Board of Forensic Medicine, Sweden

Predictive in vitro models, case work and early warning system as tools for identification and classification of new psychoactive substances

According to the definition by the The European Monitoring Centre for Drugs and Drug Addiction (EMCDDA) a new psychoactive substance (NPS) is defined as 'a new narcotic or psychotropic drug, in pure form or in preparation, that is not controlled by the United Nations drug conventions, but which may pose a public health threat comparable to that posed by substances listed in these conventions. By the development of a structured network between various relevant authorities, Sweden has been successful in the early detection and rapid response for classification and prohibition of NPS emerging on the illicit drug market. Topics that will be addressed in the workshop are: – How forensic case work can be used for early detection of NPS. – Novel analytical techniques such as high resolution mass spectrometry used for determination of NPS. – In vitro models for estimation of drug toxicity and identification of metabolites. – Structured networking between authorities for a more rapid classification of illicit drugs. The workshop will be arranged with contribution from the different Swedish authorities involved in the classification process of prohibited drugs such as National Board of Forensic Medicine, National Forensic Centre, Public Health Agency, Medical Product Agency, and Custom Service.



1 Jun

WS036



Roelof-Jan Oostra

| WORKSHOP

Clinical anatomist, Dept. of Medical Biology, Amsterdam University Medical Centers – location AMC, The Netherlands

Identifying and interpreting cremated human remains

Burnt human bones are frequently encountered in forensic case work. Bones that are exposed to intense heat drastically alter in their physical and chemical properties. Depending on the exposure temperature, they shrink, deform and fragmentize but they can still be of use in assessing the victim's identity. After a short plenary introduction, the participants in this workshop will be given the opportunity to try and recognize cremated human remains and to interpret them with respect to age, sex, diseases, trauma, medical operations, etc. These remains are of known age and sex and they originate from the body donation program of the medical school of the University of Amsterdam. They are also used in physical anthropology practicals in various forensic science bachelor and master programs at Dutch universities.



30 May

WS008



Aldo Mattei

| **WORKSHOP**

*Laboratory director, Commander of the Latent Print Unit, RIS of Messina, Carabinieri Corps
Scientific Investigation Department (RaCIS), Italy*

Reporting findings of latent print comparison. Standardised conclusions and accreditation ISO/IEC 17025

For a century, fingerprint examiners expressed their findings in categorical terms with statements or implications of absolute certainty. In friction ridge analysis, it is widely accepted to report comparison process conclusions in three major categories, namely 'exclusion', 'inconclusive' and 'identification'. Over time, the term 'identification' conveyed to the trier of fact the information that a specific individual was determined to be the sole source of an impression. In the last decade, such claims have been highly criticized as unscientific by scholars and a number of governmental and scientific reports. Therefore, some forensic laboratories started considering the application of a probabilistic approach to the fingerprint comparison. An intense debate has resulted on the most appropriate way of reporting conclusions for latent print comparisons. This issue and the need to find a suitable standardised form to express such findings should be certainly regarded as a fruitful resource in an ISO 17025 accredited environment, easing transnational cooperation as established by the Prüm treaty. This workshop will give to the attendees the possibility to have a general overview of the state of art within ENFSI laboratories and of the attempts to standardise fingerprint conclusions. The discussion among the participants will be fostered in order to collect different needings and perspectives, paving the way to cultural shift in the fingerprint profession. The outcomes of the workshop may pose the basis for a common position within the ENFSI Fingerprint Working Group.



30 May

WS009



Maurice Aalders

| WORKSHOP

Chair Forensic BioPhysics group, Amsterdam UMC, University of Amsterdam, The Netherlands

A multimodal look at forensic evidence

On the crime scene and during the lab investigation of physical evidence, forensic experts use well-known approaches to visualize and detect forensic biological and chemical traces. These include the use of forensic light sources and filtered detectors to visualize specific (differences in) structure, absorption, intrinsic fluorescence and chemiluminescence of traces. Also, the increased ease of use and portability of other chemical analytical techniques such as Mass Spectrometry fueled the interest in using these techniques in forensic practice, even at/near crime scene investigations. The forensic value of these individual techniques will be further increased in the future by rapid scientific and technological developments. Further, there is great value in combining techniques such as infra-red spectroscopy and mass-spectrometry, as these are orthogonal methods; methods which are based on fundamentally different principles. Also the data interpretation of the individual techniques will be improved using data obtained with another technique. This idea is the basis of a recently started scientific project which aims to combine multiscale and multidimensional techniques for investigating forensic evidence. Using the chemical information provided by spectroscopic techniques such as MA-XRF (elemental contrast), NIR/IR and MS imaging (molecular contrast), Hyperspectral Imaging (HSI) in the UV-vis-NIR will allow maximizing contrast and accurate recording of trace patterns. 2D and 3D Visualization can be accompanied with information on the nature of the trace and its origin/donor. These new exciting forensic options of chemical imaging and visualization will be discussed in this workshop.



1 Jun

WS037



Nikolaos Kalantzis

| **WORKSHOP**

Bsc, MSc, FSSocDip, Expert & Laboratory Manager of Charitoularios Institute, Piraeus, Greece

Digitally Captured Signature visualizations through Namirial's FirmaCertaForensic software: a review of the range of natural variation in different representations

Digitally captured signatures (DCS) have been deployed worldwide and already cases with disputed DCS have started appearing in Forensic Handwriting Examination laboratories. This new medium can be subject to scientifically valid examination for determination of authorship (as mentioned in the recent literature), succeeding in conveying the same amount of information for the writing movement as its pen and paper counterpart by capturing 4 channels of information of the stylus tip, i.e. spatial coordinates X and Y, Force and time. These 4 types of data are then used to create various representations that assist the Forensic Handwriting Expert to apply the established methodology and it is the sum of these visualizations that can provide the full extent of the information present in the pen and paper signature (and much more). This workshop examines the various visualizations available through Namirial's FirmaCertaForensic software and explores the limits of natural variation of different signatures. The participants will be given different visualizations of DCS produced through the software to appreciate the different aspects that are highlighted with each one, and they will participate in exercises (questioned vs. known DCS). The material will be accessible digitally to the participants so active internet connection and a laptop or smart device to access the digital files.



30 May

WS005

**Madeleine de Gruijter****| WORKSHOP***Scientific researcher crime scene innovation, Netherlands Forensic Institute, The Netherlands*

Crime Scene Investigation: where to from here? A European perspective

This workshop focuses on crime scene investigation (CSI) methodologies and complexities. We will explore how different ongoing and proposed crime scene related initiatives in Europe contribute to the development and optimization of CSI methodologies. Most criminal investigations start at the crime scene. Choices made at the crime scene influence the relevance of further forensic analyses and therefore the strength of evidence in court. There is no agreement on which methods contribute the most to finding the relevant traces, making deliberate choices, considering multiple scenarios, minimizing bias and meeting the needs of criminal justice partners. Methodologies of CSI need further development and optimization in order to be of the greatest possible value to the investigation. Ultimately, new CSI methods combine criminalistics principles and criminological theories. During the workshop, we will study a regular crime scene investigation and use various practical exercises to focus on important aspects of the investigation. This workshop is aimed at practitioners and researchers related to or part of to the criminal justice system and crime scene investigations.



31 May

WS011



Eva Ljungkvist

Fire investigator, Danish National Police, Denmark

| WORKSHOP

Designing and using virtual Reality in crime scene investigation and training

This workshop will explore how Virtual Reality can be appropriately used for to record crime scenes using standard and specialised equipment. Critical is an understanding of the measurement uncertainties encountered throughout the capture, photogrammetry and user experience. The workshop will include a presentation from the Danish Police in the development of a 'virtual training village' involving complex crime scene scenarios. Outcomes will include (1) gaining a broad understanding of what is required to create accurate and reproducible VR products for training (2) gaining experience in the planning and delivery of a series of virtual crime scenes.



31 May

WS017



Sang-Hun Yu

PhD Student, University of Dundee, The United Kingdom

| **WORKSHOP**

Creating a virtual reality experience for crime scene investigation and training

This workshop will explore how Virtual Reality can be appropriately used for to record crime scenes using standard and specialised equipment. Part 2 is for those who already have practical experience in the use of VR and are exploring its use in crime scene reconstructions. This will include more technical aspects of photographic recording of a scene, the technical details of photogrammetry and optimisation of the user experience.



1 Jun

WS024

**Mike Groen****| WORKSHOP**

Forensic Archaeologist / Bioarchaeologist, Netherlands Forensic Institute / Leiden University, The Netherlands

Forensic Archaeology and Anthropology

The search, recovery and identification of decomposed or decomposing human remains require specialised knowledge and expertise. Forensic archaeologists and anthropologists are therefore often involved in European casework, helping investigators to determine the identity of the victims and to reconstruct the events that led to their death and subsequent deposition. This workshop is designed to give a broad introduction to forensic archaeology and anthropology from a practitioner's perspective and illustrate the importance of having such expertise in different forensic scenarios. It focuses on the scientific methods and techniques as related to the search for missing persons, outdoor recovery of decomposed or decomposing human remains and the skeletal analysis, as related to the cause and manner of death and the identity of the victim.



2 Jun

WS038

**Sophia Berkani****| WORKSHOP**

SHUTTLE Project Technical Coordinator, Institut de Recherche Criminelle de la Gendarmerie Nationale, France

The SHUTTLE Project Toolkit for Micro-trace Analysis

In this workshop, participants will get experience with the micro-trace analysis toolkits that have been developed during the project and learn about the achievements of the SHUTTLE project. Participants will: Have insight into SHUTTLE, an EU Horizon 2020 Pre-Commercial Procurement project. The consortium includes six forensic institutes which have contracted the design and prototyping of toolkits for micro-trace analysis according to their specifications. Have a detailed understanding of the various tools that constitute the toolkit, i.e. optimized tape lifts, an automated microscope, image processing software, and a searchable database with pattern recognition capabilities. Gain hands-on experience with the two toolkits, including the developed tapes, the instrumentation and the software tools. It is possible to bring own samples. Learn about the operational validation tests that have been carried out in the SHUTTLE partner forensic laboratories and have insight into the abilities and limitations of the toolkits. Learn from the contractors who developed the toolkits and how they can start implementing them in their own laboratories. Be able to evaluate the potential impact of implementing the developed toolkits in their own laboratories.

The workshop consists of a lecture 11.00 – 12.30 and toolkit demonstrations at 13.45 – 15.15.



2 Jun

WS042

**Robert Dowdall****| WORKSHOP***UCD Centre for Cybersecurity and Cybercrime Investigation, Dublin, Ireland*

INSPECTr: Intelligence Network and Secure Platform for Evidence Correlation and Transfer

The EU-funded INSPECTr project will integrate a range of high-tech approaches, including big data analytics, cognitive machine learning and blockchain technologies into a shared intelligence platform that will improve digital investigations and forensic capabilities, and reduce the complexity and cost of cross-border collaboration.

The platform has been designed through extensive collaboration with the law enforcement community, will incorporate privacy and ethics by design principles, and will take into account relevant national and international legislation. After the project, the platform will be freely available to the law enforcement community and adoption will be enhanced through training courses, webinars and workshops. Exploitation of the project deliverables will also be freely available to LEAs to further improve the platform beyond the scope of the project, through additional research and development activities.

This workshop will present the living lab approach adopted by the project and discuss the social, ethical, legal and technical challenges faced by the consortium. Also provided will be a demonstration of the platform's capabilities. The outputs of commercial forensic tools will be combined with the outputs of integrated "free" tools for analysis and correlation. In addition to showcasing various AI approaches to cybercrime investigation, including cross-case correlation, the workshop will illustrate our approach to evidence discovery and exchange with other jurisdictions.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Grant Agreement No 833276.

www.inspectr-project.eu



2 Jun

WS044



Peter Van De Crommert
DITSS, Netherlands

| WORKSHOP

First results of the CYCLOPES Project

CYCLOPES workshop scope:

To disseminate the first results of CYCLOPES project to a large spectrum of digital forensic experts and other stakeholders and reach out to other networks and projects funded by the European Commission as well as ensure efficient interaction with relevant potential CYCLOPES community partners.

Content of the presentation:

The presentation will include; an Introduction to the project and an overall presentation of CYCLOPES network community and methods of joining.

Outcomes from CYCLOPES practitioners' workshops and joint live exercise thus far along with identification of LEAs capabilities, needs and requirements in the area of fighting cybercrime as well as CYCLOPES activities in the area of standardization.

Topics/Agenda:

- Introduction to the project and network community (15 min.)
- First results from workshops held with digital forensics practitioners from Law Enforcement Agencies across Europe:
- Results from the First workshop Mobile Devices and Wearable Technologies. (15 min.)
- Results from the second workshop Remote Desktop Protocols and Similar Technologies. (15 Min.)
- Results from the third workshop Social Engineering to Enable Cybercrime. (15 Min.)
- Results from 1st Joint live exercise: digital forensics on mobile devices (15 Min.)
- Discussion with digital forensic practitioners on next years workshop topics (15 min.)



30 May

WS002



Rebecca Bucht

| WORKSHOP

Head of CSI services at the Finnish National Bureau of Investigation Forensic Laboratory, Finland

The principles of Forensic Science – towards a universal approach

In May 2021, an international group of forensic scientists published the Sydney declaration – a document that delineates forensic science through seven founding principles intended to underpin all forensic science endeavours across all specialities. (<https://iafs2023.com.au/virtualevent/>). We now seek to promote and encourage discussions concerning these principles as they are articulated in the declaration. As such, the purpose of this workshop is to create awareness of these principles through discussions and case examples. Specifically, the organizers and attendees will examine how these principles relate to the practitioner and routine case work as well as how they are linked to broader strategic decisions. Participants will also gain insight into how these principles guide efforts to develop a common forensic science culture, and influence forensic science education, training, and research and development. The goal of this workshop is to convey a "from principles to practice" shift in which participants explore how to integrate the principles into their daily practises.



30 May

WS003



Melissa Taylor

| WORKSHOP

Program Manager, Special Programs Office, National Institute of Standards and Technology, Maryland, The United States of America

The Process of Process Mapping in Latent Print, Handwriting, and Firearm Examination

The National Institute of Standards and Technology (NIST), through its Organization of Scientific Area Committees (OSAC) has been working with practitioners in various forensic science disciplines to produce process maps that identify key decision points in the forensic examination process. These process maps enable laboratory managers to better understand how their protocols compare with those of other laboratories and provide a framework for developing standard operating procedures, best practice documents, system-level validation, and quality assurance measures. In this workshop, we will discuss the development process and guide the participants through the steps involved in three forensic disciplines: latent print examination, handwriting examination, and firearms examination. At the end of the workshop, participants will understand the purpose and value of process mapping, how process maps can be used to inform contextual information management and cognitive bias reduction strategies, and how they can aid in the standardization of forensic processes and terminology.



31 May

WS012



Martin Josefsson

Business Developer, National Forensic Centre, Sweden

| WORKSHOP

Site strategies and planning for facilities suited for forensic work

Forensic investigations and laboratory work are organized both regionally and nationally. The access to well-designed and adapted premises is a prerequisite for high-quality forensic work. Design and construction of suitable facilities will be discussed especially with regard to material logistics and personal protection, e.g. protective ventilation, barriers to avoid contamination or other need requirements such as fire protection, protection from explosives or protection against intrusion. Special requirements regarding building construction, choice of materials, laboratory furnishings and other essential equipment will be addressed.



31 May

WS013



Lore George

Forensic Advisor, National Institute of Criminalistics and Criminology, Belgium

| **WORKSHOP**

Forensic Case Coordination – What is it? Who does it? And what can it do for you?

Attendees will learn the roles and responsibilities of the forensic case coordinator as well as the implementation of case coordination within forensic science systems. After attending this workshop, attendees will have a clearer image of the added value that case coordinators provide to the forensic science process. Case coordination includes coordination, which is concerned with managing the flow of information and items between the involved actors (intra/inter forensic service providers, prosecutors, defence, etc.), and advice, which involves the use of knowledge, expertise and experience to guide the forensic process. This advice is intended to be used by the various actors in the criminal justice system, including non-scientists, to make more informed decisions concerning forensic science and the traces encountered during the course of an investigation.

The workshop will begin with a general presentation defining and describing case coordination and the forensic advisor. The workshop organizers, members of a European Forensic Case Coordination Group that collaborate between several labs with dedicated case coordination functions, will then describe the implementation and roles of the case coordinators across their differing forensic science systems. Finally, attendees will actively engage in a case study with the workshop participants and organisers in order to address strategies, challenges and benefits of case coordination with the goal of demonstrating how coordinator functions can adapt to meet the needs of individual organizations.



31 May

WS016



Didier Meuwly

| WORKSHOP

Principal Scientist, Netherlands Forensic Institute, Netherlands and Chair of Forensic Biometrics, University of Twente, The Netherlands

Preparation for the Basic General Forensic Knowledge Examination

This workshop is proposed by the project team of the ENFSI Monopoly 2010-M2 "Basic General Forensic Knowledge Exam" (BGFKE). The BGFKE is the result of this ENFSI Monopoly project. It is an online examination proposed to the ENFSI laboratories to demonstrate the knowledge of their forensic practitioners in the field of general forensic science. It should help harmonization between ENFSI laboratories. This examination is available once every 3 years (or more often if needed) to all the forensic scientists and practitioners to demonstrate their competence in the field of General Forensic Science. The aim of this workshop is to help the candidates prepare the 2022 examination session of the Basic General Forensic Knowledge Exam. The 2022 online examination session is planned during the fourth quarter (October – December) of 2022. During this half a day workshop, the project team will first explain what is the Basic General Forensic Knowledge Examination, show the selected literature of the reader and provide explanations about the topics covered. During this half a day workshop, the project team will first explain what is the Basic General Forensic Knowledge Examination, show the selected literature of the reader and provide explanations about the topics covered. The first requirement for the participants is to register to the workshop sufficiently in advance to allow them to study the reader. This will enable the participants to set up their questions before the workshop. The reader will be dispatched freely by post. An access to the online web platform will also be sent to the participants, so that they can take the online demo quiz of 10 questions as required.



1 Jun

WS025



Jan-Eric Grunwald

Forensic Scientist, Bavarian State Criminal Police Office, Germany

| WORKSHOP

From textbook to e-learning – a new web-based training platform for forensic practitioners

In this workshop, participants will learn about the development of an exciting new e-learning concept for training forensic practitioners, developed by the ENFSI European Textile and Hair Group (ETHG). This modular and expandable virtual learning environment was created to illustrate the information described in the ETHG's Best Practice Manuals in an interactive and visually engaging format, and to supplement institution-based in-house training schemes with a cost-effective, unified pan-European training concept for fibre and hair examiners. The scope of the ETHG e-learning platform currently covers the key processes for the handling and examination of textile and hair evidence at the crime scene and their analysis in the laboratory, but will be expanded by further modules, most notably on interpretation of evidence. To begin the workshop, we will first give an overview of how the project was initially conceived, and outline the current training challenges faced by forensic institutions that the project sought to address. We will then discuss how that concept was planned, and then how we delivered the project over a three-year pan-European collaboration in the ETHG. In a hands-on session, the participants will explore the e-learning platform and actively participate in selected on-line course modules and other activities with the guidance of the organisers. Finally, we will interactively discuss plans for the future of ETHG e-learning, share learning points from our experiences and propose how this model could be utilised more widely by other forensic disciplines in ENFSI.



1 Jun

WS026



Cecilia Vahlberg

National Forensic Centre, Sweden

| WORKSHOP

Lessons learned from the covid-19 pandemic

A lot of equipment that is used within healthcare is also used by forensic laboratories. The same is valid for different kinds of personal protection equipment. As a forensic laboratory, we very early in the Covid-19 pandemic got severe supply disruptions of a large variety of products and materials that are necessary for our work. There are still some disruptions and long delivery times for certain products. There are a lot of lessons learned and it would be interesting and valuable to discuss how the work in different countries and at forensic laboratories was organized to handle this critical situation. The workshop will focus on for example – delivery times – cooperation, both internal and external – quality requirements – agreement and public procurement – suppliers – alternative methods and products – increase in cost for products – general experiences, positive as well as negative, and lessons learned.



2 Jun

WS039



John Butler

| WORKSHOP

NIST Fellow & Special Assistant to the Director for Forensic Science, National Institute of Standards and Technology, The United States of America

Scientific Publication: Reading, Writing, and Reviewing

Science benefits from effective communication of ideas. Research results are shared with others through publications and presentations. Scientific publication involves efforts in reading, writing, and reviewing the literature. Editors of peer-reviewed journals rely on input from scientific colleagues to judge the merits of submitted manuscripts. Knowledgeable reviewers providing timely feedback are important for a successful peer-review process. This workshop will share insights based upon editorial experience with Forensic Science International: Genetics as well as extensive writing practice in preparing six textbooks and over 180 research articles and invited book chapters. Reviewing manuscripts is a chance to provide an important service and to influence the scientific community for good. In addition to discussing approaches to reading, writing, and reviewing relevant literature, some recent articles covering forensic genetics will be considered and examined.



31 May

WS015

**Melissa Taylor****| WORKSHOP**

Program Manager, Special Programs Office, National Institute of Standards and Technology, Maryland, The United States of America

Human Factors in Forensic Science: Lessons Learned and Common Themes from the National Institute of Justice/National Institute of Standards and Technology Expert Working Groups

The National Institute of Justice (NIJ) and the National Institute of Standards and Technology (NIST) have partnered to sponsor a series of expert working groups to examine the role of human factors in forensic science. These Working Groups are charged with conducting a scientific assessment of the role and effect of human factors on their nominated discipline, with the goal of recommending strategies and approaches to improve practice and reduce the likelihood of errors. Each discipline-specific working group is composed of forensic scientists, statisticians, psychologists, researchers, and legal practitioners. To date, reports have been published in latent print examination and forensic handwriting examination. Efforts are ongoing in forensic DNA interpretation. This workshop will present common themes and lessons learned between the Expert Working Group on Human Factors in Latent Print Examination and the Expert Working Group on Handwriting Examination. Further, we will cover a range of issues affecting forensic science disciplines in the areas of work environment, training, emerging technology, research needs, and how to identify and manage errors.



31 May

WS018



Jan De Koeijer

| WORKSHOP

Expert Interdisciplinary Forensic Investigations, Netherlands Forensic Institute, The Netherlands

A practical approach to combining evidence in interdisciplinary casework

Currently, evaluation of forensic evidence at the so-called activity level is a major focus for the forensic community. Evaluation at this level brings with it possibilities for a more formal interdisciplinary approach to the evaluation and combination of forensic evidence. During this workshop, a methodology for evaluating and combining interdisciplinary evidence within the likelihood ratio framework will be proposed after which participants will be given casework examples to put their newly gained knowledge into practice. The contents of the workshop will consist of the following:

- The logical requirements for activity level propositions; avoiding common mistakes
- Dealing with scenarios; how to break down scenarios into working propositions
- Evidence schemes; graphical representations of evidence relations _ Theory of combining evidence; combining likelihood ratios of different types of evidence assisted by evidence schemes
- Conditional independence; what is it, how to assess it and how to take it into account?
- Interdisciplinary reporting; analyzing and discussing a reporting example



1 Jun

WS027

**Geoffrey Stewart Morrison****| WORKSHOP***Director of the Forensic Data Science Laboratory, Aston University, The United Kingdom*

Calibration and validation of likelihood-ratio systems

Publications such as Forensic Science Regulator (2021) “Codes of Practice and Conduct: Development of evaluative opinions” <<https://www.gov.uk/government/publications/development-of-evaluative-opinions>> and Morrison et al. (2021) “Consensus on validation of forensic voice comparison” <<https://doi.org/10.1016/j.scijus.2021.02.002>> have emphasized the importance of both calibrating and validating forensic-evaluation systems that output likelihood ratios. This workshop provides an introduction to both of these (related) topics. Participants will gain an understanding of how to conduct empirical calibration and empirical validation of likelihood-ratio systems, including: an understanding of the meaning of calibration and validation in relation to likelihood ratios; requirements for data used for calibration and validation; the use of statistical models (including logistic regression) to perform calibration; the calculation of the log-likelihood-ratio cost (Cllr) as a validation metric; and the use of Tippett plots to represent validation results and to support (or not) the likelihood-ratio value calculated for the comparison of the items of interest in the case. The workshop will focus on source-level comparison, but the principles can also be applied to other forensic-evaluation tasks. The workshop will focus on systems based on relevant data, quantitative measurements, and statistical models, but the principles can also be applied to systems based on human perception and subjective judgement.



1 Jun

WS031



Rolf Ypma

Netherlands Forensic Institute, The Netherlands

| **WORKSHOP**

A forensic practitioner's cookbook for building LR systems from data

In forensic science, there is a growing awareness that conclusions are preferentially based on empirical data. The Likelihood Ratio (LR) has been promoted as the proper way to express the value of forensic evidence, based on such data. In practice, however, forensic scientists have been struggling with the question: Given a dataset of measurements, how can we construct and validate an 'LR system'? A large set of methods and tools exists on this topic, but many papers are quite technical or written from an academic point of view. It is difficult to understand exactly when to apply which method or tool, especially since the literature is scattered over various (forensic) fields (biometry, chemometrics, statistics, machine learning etc.), each using their own vocabulary. Thus, many experts feel they lack overview and understanding when constructing LRs from their data. In this workshop we, statisticians and data scientists from the NFI, walk you through the steps we take in practice when building an LR system: from initial data exploration to final validation. We discuss the various choices open to a researcher in this process, and explain how to decide between these options. To make these steps concrete, we provide real-life forensic datasets and example code (python notebook). Participants are encouraged to bring their laptops (and optionally datasets) to have a hands-on experience.



31 May

1 Jun

WS014 + WS030



Heather Doran

| WORKSHOP

Public engagement manager of the Leverhulme Research Centre for Forensic Science at the University of Dundee, The United Kingdom

Do you understand what I am saying? A workshop on communicating forensic science

Clear communication of forensic science is essential for the fair administration of criminal justice. It has become an even more critical skill for forensic scientists during the COVID pandemic when many of our communication methods have seen continuous change. The communication of scientific ideas and principles in testimony can be especially challenging as the scientist has to convey complex ideas at the same time to multiple audiences of non-scientists, whether it is the jury, the judge or other legal professionals. Based on sound theory and proven methodologies, this workshop will begin by identifying where and how problems evolve in communicating with each of the audience types that are encountered within the justice process. Participants will be introduced to communication theory and practical tools to develop skills in science communication for both in-person and virtual settings. This workshop is developed based on principles of cross-cultural collaboration and will allow participants to explore, learn and practice ways in which they communicate with people in different professions, disciplines, or legal systems. The focus of the learning outcomes will be on the audience, allowing practitioners from any forensic science field to adjust their communication methods to ensure that their data and its meaning in the context of a case are expressed in a way that is understandable and clear.

Complete solutions for mobile forensics

The combined power of MSAB mobile forensics **software solutions**, **platforms** and **services** is the key to solving more cases with greater reliability at a lower cost.

We develop and provide high quality, easy-to-use mobile forensic software that enables and empowers our customers to fulfill their missions to make the world a safer place.

Our mobile forensic solutions have been instrumental in empowering many organizations worldwide to scale up their capabilities and decentralize their mobile forensic operations for increased efficiency, eliminating delays and device processing backlogs.

➤ Read more about us on [MSAB.com](https://www.msab.com)

MSAB

Trusted Partner in Digital Forensics

Aalders, Maurice	85, 88, 182, 240, 256, 261
Aanes, Håvard	409
Aarts, Bart	413
Abbott, Mia	56
Abdulhussain, Noor	81
Abdullah, Aanisah	401
Abel-Ollo, Katri	427
Acevedo Arreguin, Eduardo	444
Achetib, Nihad	88, 240
Adach, Edward	211, 448
Adegoke, Oluwasesan	62, 373
Adissa, Traore	126
Adolfsson, Thomas	395
Afxentiou, Maria	361
Agerås, Josefina	399
Aguilar, Guadalupe	375
Ahlner Andersson, Viktor	206
Ahrens, Björn	361
Aili Fagerholm, Siri	162, 420, 235
Aina, Olujimi	169
Aires Guerra Iria, Daniel	245
Aksorn, Jinakan	378
Albastaki, Abdulla	423
Albert, Michel	409
Albinsson Lind, Linda	453
Aleman, Jess- Cortez	169
Alewijnse, Linda	100
Alex, Shirin	405
Alexopoulos, Andreas	295
Alfsdotter, Clara	260
Alghafri, Rashed	423
Alkass, Kanar	180
Alkhatib, Ahmad	428
Alladio, Eugenio	335
Allen, Marie	398, 403, 404
Alm, Tommy	390
Almarri, Iman	423
Almheiri, Reem	423
Almirall, Jose	339
Almulla, Hanan	423
Alreyami, Afra	423
Alsalem, Mohammad	428
Alvarez-Balanya, Sergio	339
Alves-Pinto, Ana	487
Ambrósio, João Carlos	463
Ameen, Anaam	66
Amendt, Jens	183
Amornsaovapak, Ampaporn	378
Ampanozi, Garyfalia	177
Andersson, Melinda	452, 453
Andersson, Viktor	207
Andrade, Marcus	457
Andrani, Livia	363
Andrews, Zachary	485
Ansell, Ricky	162, 420
Apinis, Raimonds	239

Appleby, Niclas	108
Archer, Xavier	97
Ariëns, Simone	91, 129, 132
Armitage, Rachel	86, 204
Arqués Soldevila, Josep Maria	299
Arraiza Irujo, Juan	296
Arroyo, Luis	89
Ashour, Omar	428
Attenberger, Andreas	115
Atwood, Lauren	158
Augustine, Tanya	176
Augustyns, Benoît	456
Autere, Heli	143, 152
Auwärter, Volker	55, 474
Azaldegui, Christopher	375
Baaklini, Antoine	367
Bacci, Nicholas	176
Baccino, Eric	464
Bachliński, Robert	415
Badufle, Christel	190
Baechler, Simon	287, 189
Baiker-Sørensen, Martin	203
Balkefors, Jonas	180
Bam, Lunga	176
Bandey, Helen	374
Banemann, Regine	157
Bannwarth, Anne	173
Barac, Marko	443
Barbaro, Anna	467, 469
Barndök, Tarmo	427
Barnes, Geoff	265
Barone, Pier Matteo	259
Barron, Leon P.	90
Bartlett, Mark	364
Bas, Patrick	123
Bassi, Luisa	130
Bastisch, Ingo	46, 422
Basu, Nabanita	197
Bécue, Andy	87
Beek, Harm van	311
Bégué, Jean Marc	97
Belahcen, Mohamed	110
Belchior De Andrade, Ana Flavia	478
Ben Amor, Imen	229
Ben Terdayet, Insaf	97
Benavides Restrepo, Alejandra	74
Bengtsson, Johnny	118, 138, 395
Ben-Said, Najah	123
Benschop, Corina	145, 154
Benson, Sarah	314
Berger, Charles	291, 336, 195, 208
Berggren, Jimmy	125, 393
Berggren, Peter	125
Berghout, Abigail	154
Bergsten, Linnea	393, 125
Berkani, Sophia	100

Bermejo, Enrique	252
Berthelot, Anna	367
Besacier, Fabrice	74
Besson, Luc	249
Bezemer, Karlijn	82
Biasiotti, Maria Angela	114
Bijhold, Jurrien	243
Billet, Hannah	221
Biosa, Giulia	335
Bitzer, Sonja	321
Blake, Rowan	359
Blankers, Bart	147
Bleka, Øyvind	148, 409
Bloemen, Paul	240
Boccard, Julien	346
Bogdal, Christian	341
Bogdanović Radović, Iva	443
Boiso, Lina	407, 399
Boiso, Samuel	421
Boivin, Rémi	275, 481
Bojarski, Piotr	376
Bollé, Timothy	112
Bolton-King, Rachel	197
Bonastre, Jean-François	229
Bonetti, Jennifer	52, 53
Bonetto, Lucio	299
Bonicelli, Andrea	262
Borghys, Dirk	123
Borgsjö, Pia	365, 369
Borusiewicz, Rafal	468
Bosma, Wauter	129, 91, 132, 340
Boss, Dagmar	285
Botrè, Francesco	346
Bowerbank, Samantha L.	84
Boyko, Toni	413
Boztas, Abdul	116, 133
Bozza, Silvia	334
Brajković, Marko	443
Branco, Maria João	289
Breitinger, Frank	113
Breum Müller, Irene	361
Brodin, Tim	392
Broms, Mika	236
Brown, Amber	465
Brown, Kelly	57, 66, 359
Bruyninckx, Helena	123
Buccilli, Valeria	101, 372
Buchmuller, Helio	463
Bucht, Rebecca	277, 321, 342, 473
Buck, Ursula	394, 462
Budach, Dennis	474
Bugeja, Lyndal	309
Bulete, Audrey	74
Burks, Raychelle	375
Burnier, Céline	175, 270, 271, 273
Burton, Kathryn	62

BuBe, Kirsten	394, 462
Butler, John	150
Butler, John M.	48
Bäck, Karolina	447
Cadola, Liv	332
Cadwell, Zoe	251
Caman, Shilan	172
Camara, Daniel	117, 110
Cano-Trujillo, Cristina	467, 469
Cantaro, Valentina	372
Capistran, Briana	94
Carbonaro, Antonio Biagio	372
Carlsson, Helen	396
Carlsson, Linnéa	447
Carpenter, Katie	178
Cartier, Julien	130
Casaburo, Donatella	349
Casali, Fabio	482
Casey, Eoghan	44, 112
Castaing-Cordier, Thomas	74
Causin, Valerio	205
Chadwick, Scott	221, 364, 189
Champod, Christophe	40, 210
Chanclu, Anais	454
Chang, Yu-Hsiang	71
Chansaengpetch, Nantapong	432
Charest, Marina	332
Charvoz, Céline	74
Chiari, Massimo	170
Chichger, Havovi	168
Chirico, Roberto	239
Choromańska, Agnieszka	415
Chovory, Yann	418
Christensen, Ulla	459
Cinaglia, Giulia	318
Clerck, Laura de	405
Clover Ree, Lumikki	220
Cole, Michael	61, 440
Collins, Sharni	255
Colson, Bertrand	92
Conlan, Xavier A.	142
Coppey, Florentin	51, 80
Cornwell, Amy	265
Coulston, Jodie	223
Courts, Cornelius	157
Crispino, Frank	332
Cruz Delgado, Mikaela	322
Csatlós, Martin	426, 433
Cunha, Eugénia	181
Curci, Jean-Yves	155
Curran, James	89
Curty, Christophe	245
Czarnomska, Martyna	376
Czarny, Jakub	415
D'Oca, Caroline	463
Dago Casas, Pablo	123

AUTHOR (PRESENTING = BOLD)	PAGE	AUTHOR	PAGE
Dahlberg, Åsa	370	Druid, Henrik	180
Dahlén, Johan	73	Dubois, Damien	74
Dalen Krogsæter, Kaja	238	Dubois, Lena	70
Dalin, Erik	421	Ducloy, Edouard	117
Dalzell, Kourtney	89	Dufva, Charlotte	407
Damin, Alessandro	234, 484	Duijs, Francisca	154
Damm, Angela	474	Duijst, Wilma	179, 183, 256, 261, 430, 436, 437, 438
Dan, Lilly	186	Dunne, Simon	50 , 362, 369
Daniel, Runa	320	Dunnett, Jodie	56
Daniilidis, Ioannis	239	Durussel, Pascal	249
Danna, Jérémy	190	Duszyńska, Anna	415
Davadie, Philippe	327	Dziedzic, Tomasz	188, 289
Davidson, Alison	56	Dziedzic, Zofia	149
Davies, Christopher	168	Dørum, Guro	157
Davis, Mary	253	E. Ortega-Ojeda, Fernando	467
Dawkins, Jo	374	Earwaker, Helen	223 , 470
Dawson, Blake	263	Ebert, Lars	122, 177
de Beer, Frikkie	176	Eckardt, Regina	213
de Bie, Kim	132 , 129	Edelman, Gerda	182
de Boer, Hans	336	Eggert, Marius	137
de Bruin-Hoegée, Mirjam	64	Ehlerding, Anneli	294
de Figueiredo, Miguel	346	Ekberg, Kajsa	206, 445
De Jong, Jeroen	116, 154	Eleuterio, Pedro	135
De Maeyer, Hanne	398, 403, 404	Elgerud, Lucia	253
De Meulenaere, Katleen	456	Elmlund, Louise	362
DE MIRAS, Mikael	124	Engström, Philip	239
de Poot, Christianne	264 , 272	Enlund Åström, Isabelle	193
de Puit, Marcel	239, 272	Enriquez, Sarahi	375
de Ronde, Anouk	272	Enzinger, Ewald	231
De Smet, Patrick	120, 299 , 123	Eriksson, Helena	408
De Wael, Karolien	67	Eriksson, Malin	362
de Wolff, Tialda	413	Eriksson, Minna	236
De Vries, Annemieke	302	Esseiva, Pierre	51 , 60, 68, 69, 80, 119, 173, 363
Dean, John R.	84	Estoppey, Nicolas	76, 77
Dean, Nema	345	Evans, Sarah	470
Deckers, Dyon	312	Evelt, Ian	337
Dekker, Mabel E.	81	Fabiano, Maria Aurora	101, 458
Delémont, Olivier	249 , 69, 80, 96, 97, 173, 196, 245, 331, 363	Fabien, Loïc	270
Den Harder, Malou	210	Fagan, Rachel	358
Dennany, Lynn	59 , 57, 66, 359	Faiss, Raphaël	346
Deo, Alisha	254 , 465	Fantinato, Chiara	160
Dessimoz, Damien	249	Farinha, Cristina	239
DeTata, David	175	Farjon, Jonathan	74
Devaux, Ophélie	201	Farrugia, Kevin	86, 204
Devenson, Jelena	285	Faure, Eddie	126
Devlin, Ciara	189	Faxälv, Lars	390
Devlin, Joanne	253	Feeney, William	89
Dias, Johnny Ferraz	170	Ferguson, Leesa	374, 440
Dickinson, Mike	297	Ferrari Junior, Ettore	478
Diepstra, Julien	411	Field, Carole	158
Dijkhuizen, Lianne	437, 438, 438 , 436	Filko, Andrijana	443
Dobay, Akos	177	Fischer, Julia	270
Dogger, J.	95	Fischer, Manon	128 , 249
Dreiseitel, Wolfgang	474	Fischmann, Svenja	474
Dreuille, Nicolas	126	Flanagan, Keith	358
		Flavia Belchior de Andrade, Ana	368

Fock, Niclas	306
Fojtasek, Lubor	92
Fonnelløp, Ane Elida	160
Forbes, Shari	258
Forchheimer, Robert	306
Fossati Del Angel, Vanessa	205
Franca, Ian	276
Franckenberg, Sabine	177
Franke, Katrin	109
Franz, Steffen	267
Frey, Aline	190
Frömel, Tobias	366
Fudala, Anna	387
Fukami, Aya	127
Fuller, Fiona	265
Fursman, Harrison	364
Galais, Virginie	104
Galarza, Malgorzata	361
Gall, John	174, 434, 435
Gallidabino, Matteo D.	90, 84, 102
Gallusser, Alain	196
Garcia-Ruiz, Carmen	467, 469
Gassner, Anne-Laure	102, 377
Gautam, Lata	169, 168, 374, 440
Geiss, Otmar	83
Gelderman, Tamara	183, 179, 430, 436
Gendron, Annie	481
Genoe, Ray	110, 117
Georgeton, Laurianne	454
Geradts, Zeno	111, 123, 340
Gerber, Anna-Barbara	245
Geurts, Mathijs	240
Gibb, Caroline	217, 225
Gibert, Joséphine	417
Gibson, Aline	173
Gibson, Lorraine	482
Gill, Peter	148, 160, 409
Gimle, Peter	452
Girardeau, Patrick	74
Gits, Judith	154
Giuffrida, Alessandro	372
Giurghita, Diana	335
Glanzmann, Vick	77
Glardon, Matthieu	199
Glazener, Claudia	352
Główniczak, Iga	387
Gneisinger, Walter	446
Golominski, Raffael	177
González-Rodríguez, Joaquín	231
Gora, Paulina	381
Gorn, Michael	214, 449
Gosch, Annica	157
Gouet, Arnaud	246
Goupille, Anais	74
Greco, Valentina	372
Gréen, Henrik	73

Greif, Maximilian	366
Grela, Agatha	168
Grochocki, Rodrigo	463
Groen, Mike	250
Grol, Laurens	154
Grone, Friedrich	286
Growns, Bethany	218, 219
Grutters, Michiel M. P.	95, 99
Gräntzelius, Rickard	390
Guerra, Rosario	466, 252
Guggenheimer, Denise	172
Guillet, Fanny	190
Gulino, Antonino	372
Gunaratnam, Lawrence	92
Gunnar, Erika	400
Gupta, Anjali	343
Gupta, Vaibhav	167
Gurn, Kelly	276
Guzik-Makaruk, Ewa	415
Gyula, Judit	265
Haas, Cordula	157
Hade, Andreas-Christian	431
Hadrys, Thorsten	157
Haggren, Eva	453
Hakola, Elina	152, 236
Hales, Stephanie	158
Hall, Lisa	337
Hamann, Niklas	123
Handschin, Philippe	177
Hanniffy, Sarah	358
Hannigan, Tom	317
Haratourian, Anastasia	403
Hardi, Lukas	115
Hart, Andrew	265
Hartman, Dadna	320
Hasselqvist, Therese	408
Hedberg, Erica	191
Hedberg, Karin	153
Hedell, Ronny	410, 420
Hedman, Johannes	402, 407, 412, 420
Hehet, Petra	83
Heintz, Fredrik	45
Hemmer, Samuli	143
Hendrix, Andre	325
Henkel, Hartmut	239
Henseler, Hans	311
Herard, Philippe	367
Herlaar, Koen	202, 203
Hermelin, Anais	270
Heulard, François	323
Hilgert, Monika	238
Hillman, Rob	86, 204
Hintikka, Laura	65
Hirvas, Laura	152
Hitchin, Susan	161
Hlukhau, Ihar	217

AUTHOR (PRESENTING = BOLD)	PAGE	AUTHOR	PAGE
Ho, Yuet Lam	343	Johannesson, Mikael	198
Hobley, Eleanor	487	Johansson, Susanne	385
Hoffman, Jakobus	176	Johnston, Fraser	361
Hoffmann, Rachael	158	Jones, Josephine	385
Hoofs, Huub	129, 132	Jones, Nick	70
Hoogendijk, Francis	139	Joosten, Florine	67
Horsman, Graeme	113	Josefsson, Martin	365
Hovers, Pauline	154	Jufvas, Åsa	400
Hrcka, Rastislav	460	Junker, Klara	420
Hugh, Laura	237	Järvinen, Satu	143
Hughes, Deborah A.	142	Järving, Reet	416, 419
Hughes, Vincent	486	Kadyjewska, Ewa	415
Huhtala, Sami	277, 473	Kahn, Lydia	426, 433
Hui, Ruoyun	337	Kalbouneh, Heba	428
Huls, Robert C.	99	Kalman, Stefan	370
Hulsbergen, Annemieke	81, 82	Kalogiros, Costas	295
Hultman, Anna	284	Kanerva, Milja	400
Hultman, Johan	299	Kantor, Malgorzata	376
Hung, Chun-Hao	71	Karaghiosoff, Konstantin	83
Hung Nguyen, Viet	239	Karjalainen, Matti	451
Hunt, Hugh	176	Karlsson, Charlotte	390
Hutchinson, Kim	266	Karlsson, Daniel	390
Hänggi, Nadescha	157	Kavanagh, Yvonne	358
Härtelt, Marko	239	Kayser, Manfred	46
Högberg, Carina	379	Kelly, Maire	175
Iacobellis, Giuliano	239	Kerzan, Dorijan	347
Ibañez, Victor	177	Kesic, Blake N. G.	84
Ibañez, Oscar	252, 466	Keskitalo, Ari	451
Immonen, Kirsi	451	Keskitalo, Jarkko	451
Indra, Lara	462	Klasson, Niklas	191, 452
Inman, Keith	268	Klaver, Coert	297, 299
Irmiler, Robert	267	Kling, Daniel	163
Iwai, Takahiro	386	Knecht, Siegfried	474
Iversen, Katarina	125	Knepper, Thomas P.	366
Jackowski, Christian	394	Kneppers, Alexander	154
Jackson, Graham	337	Knijnenberg, Alwin	91
Jacobsen-Bauer, Andrea	474	Knock, Clare	237
Jacquemin, Denis	74	Knop, Sebastian	267
Jacquet, Maëlig	192	Kohler, Danny	134
Jalava, Kaisa	78	Kohlt, Caroline	446
Jangblad, Ann	407	Kohtamäki, Elisa	65
Jankauskas, Rimantas	466	Kohtla, Maile	419
Jansson, Linda	402, 412, 420	Kokshoorn, Bas	144, 147, 272, 413
Jansson, Sara	365	Komatsu, Hibiki	386
Jansson, Staffan	410, 408	Konradsson, Peter	73
Jantz, Lee	253	Kopitsis, Panagiotis	239
Jegers, Mariëlle	154	Korpinsalo, Tuomas	342
Jendly, Manon	318	Korzeniewski, Pawel	222, 450
Jennifer, Cheron	126	Kowalczyk, Marek	415
Jense, Ingrid	159	Kraetzer, Christian	123
Jetten, Katie	470	Kranenburg, Ruben	54, 72, 52
Jinghede Sundwall, Anna	244	Krap, Tristan	256, 261, 179, 183, ttt, 436
Jofre, Maria	344	Kriikku, Pirkko	171
Joge, Madeleine	380, 379	Krol, Malgorzata	381
Johannesson, Karin M.	360	Kruise, Dennis	154

Kukurin, Corina	91
Kulomaa, Verna	342
Kulstein, Galina	157
Kumirska, Jolanta	384
Kummer, Natalie	245, 331, 456
Kurbatova, Aljona	427
Kurmann, Astrid	177
Kusak, Martyna	354, 354
Kuuranne, Tiia	346
Küng, Céline	245
Källgren, Laban	390
Köke, Niklas	366
Laan, Nick	147, 312, 316
Labrador-Serrano, Beltrán	231
Ladroue, Virginie	74
Lafont, Isabelle	190
Laine, Olli	78
Laisney, Oceane	330
Lamb, Erin	465
Lampinen, Juha	319
Lapinkaski, Eija	152
Laplace, Kenza	464
Larsson, Håkan	125
Larsson, Magnus	92
Lasker, Justus	235
Lasmar, Marcelo	457
Latimer, Julie	364
Lau, Victoria	105, 383
Laurent, François-Xavier	161
Lausund, Rune	239
Lavallee, Catherine	332
Ledić, Andrea	443
Ledin, Maria	206, 207
Lee-Gorman, Marce	317
Leers, Mathie	437
Lefrançois, Elodie	60
Lehto, Johanna	236, 342
Leitet, Elisabet	191, 193
Leonardi Scomazzoni, Marco	205
Lepistö, Maija	143
Lepistö, Päivi	143
LEROY, Pierre	124
Lewkowicz, Aneta	376
Lind, Johan	392
Lindberg, Emilia	152, 342
Linder Ben Salah, Zohra	461
Lindner, Rene	239
Link, Mertlyn	416
Liu, Taoping	465
Ljungberg, Lisa	369
Ljungkvist, Eva	241, 459
Loeve, Arjo J.	166, 266
Longcamp, Marieke	190
Lootah, Reem	423
Lopez, Berenice	178

Lory, Martin	341
Lothridge, Kevin	309
Lozano-Díez, Alicia	231
Luck, James L.	299
Lugon Moulin, Solène	287
Łukomska, Agnieszka	238
Lynch, Brendan	358
Lång, Saara	152
Lösch, Sandra	462
Maccarrone, Giuseppe	372
Machado, Fatima	92
Madikeri, Srikanth	295
Madonna, Chris	375
Maestrini, Luca	255
Mahacharoen, Thiti	378
Mahafzah, Waleed	428
Maida, Pietro	101, 372, 458
Maillard, Crystel	249
Makowska, Żanetta	415
Mallett, Xanthé	122
Malmborg, Jonas	75, 445
Mannerskog, Susann	385
Manso, Marco	239
Manzalini, Valentina	205
Marcińska, Magdalena	415
Maresca, Olivier	246
Margot, Pierre	310
Mariotti, Kristiane	480
Marolf, André	273
Maroñas, Juan	339
Marreiros, João	446
Marsh, Nick	265
Martin Agudo, Maria	409
Martínez Cañavate, Salvador	442
Martos, Rubén	252, 466
Marttila, Sani	329, 342
Martyna, Agnieszka	234, 468, 484
Massonnet, Geneviève	273
Mattei, Aldo	216, 224, 226, 227, 288
Mattijssen, Erwin	194, 195, 208, 218, 219
Mattila, Rinna	143
Mattsson, Marianne	420
Matveinen, Katri	238
Matzen, Timo	91, 129, 132
Maynard, Philip	122
Mayrink, Rodrigo	457
Mazumder, Anjali	337
Mbo, Chloé	271
McCann, Niamh	84
McCarthy, Moya	413
M'charek, Amade	352
McHugh-Moran, Anita	358
McLennan, Lindsay	82
McNamee, Ciara	358
Meakin, Georgina	401, 411, 158

AUTHOR (PRESENTING = BOLD)	PAGE	AUTHOR	PAGE
Medeiros Bozic, Susana	119	Nic Daeid, Niamh	43, 62, 104, 373
Mei, Erik	416	Nichols-Drew, Leisa	86, 204
Memmo, Augusto	358	Nicoli, Raul	346
Ménard, Hervé	104	Niehoff, Anja	200
Mengali, Sandro	239	Niewohner, Ludwig	92
Menges, Sonja	422	Nilsson, Anders	328, 235, 274
Menking-Hoggatt, Korina	89	Nilsson, Martina	303, 398, 404, 304, 307, 403
Menzyk, Alicja	234, 484, 387	Nishiwaki, Yoshinori	382, 386
Merat, Nadine	100	Nixon, Ken	176
Merten, André	239	Nogel, Mönika	353
Mesejo, Pablo	252	Noort, Daan	64
Mestria, Serena	170	Nord, Kent	187
Meuwly, Didier	40, 122, 350	Nordfors, Johanna	451
Michalska, Aleksandra	387, 484	Norlander Arvidsson, Jannika	429
Michelet, Gaëtan	113	Nothnagel, Michael	46
Mickleburgh, Hayley L.	262	Nsuamani, Laura	373
Migeot, Matthias	213	Nunes Caetano, José Guilherme	83
Milisavljevic, Nada	281	Nurtjahya, Dita	343
Milne, Becky	470	Nys, Bart	93, 290
Miranda, Michelle	321	Odeh, Bilal	428
Mlynczak, Jaroslaw	239	Odoardi, Sara	170
Modi, Anupama	167	Ojanperä, Ilkka	171
Molnar, Petra	257	Olin, Magnus	439
Montalvo, Gemma	239, 467, 469	Ollikainen, Tiina	143
Montero Rodríguez, Ester	313	Olstedt, Melina	421
Moorthy, Arun	63	O'Malley, Shane	358
Moraleda Merlo, Ana	87	Ondracek, Thomas	325
Morelato, Marie	119, 158, 189, 364	O'Neill, Geraldine	358
Moret, Sebastien	189, 221	Oostra, Roelof-Jan	182, 256, 261
Morris, Jonathan	289	Opatz, Till	474
Morrison, Geoffrey Stewart	228, 197, 231	Ortega-Ojeda, Fernando E.	469
Morrissey, Joanne	168	Ortiz, Rafael	480
Mousseau, Vincent	275, 481	Ott, Colby	89
Mubarak, Nidaa	428	Otterlund, Tess	362
Muenkla, Hathaichanok	378	Ouellet, Frédéric	481
Mugge, Winfred	266	Ôuemets, Kelly	416
Murd, Anne	427	Oxley, Jimmie	82
Mäkelä, Tuukka	277, 473	Paillat, Jean-Luc	126
Möörk, Tony	328	Panto, Sebastiano	70
Nadort, Annemarie	221	Pappalardo, Andrea	372
Nagel, Jord H.A.	159, 154	Parag, Raymond	154
Naji, Mohammad	423	Parapanos, Louise	178
Nakanishi, Toshio	386	Parish Fisher, Casie	375
Nanjkar, Mugdha	343	Parrilla, Marc	67
Nantasitangkool, Phuritpach	378	Parson, Walther	46
Nawaiseh, Mohammad	428	Pasquier, Julien	212
Navarro, Fernando	466	Patsakis, Constantinos	300
Nawotka, Radostaw	415	Payne-James, Jason	178
Nehse, Kornelia	283	Pearse, Mark	325
Neocleous, Tereza	335, 345	Pelegrin, Pierre-Adrien	246
Neubauer, Jacqueline	157	Peltola, Johannes	239
Neumann, Cedric	485	Perez-Guzman, Ines	313
Neuteboom, Wim	309	Persson, Emelie	362
Neuwirth, Kevin	466	Peruchc, Michela	466
Neville, Sharon	158	Peschier, Leo	95, 99
Nevin, Maria	358	Petaras, Anja	260

Peters, Ron A.H.	81
Pettersson, Niclas	360
Peyron, Pierre Antoine	464
Pfeiffer, Fabienne	76
Philippou-Massier, Julia	157
Phillips, Chris	46
Piccolo, Sebastiano	489
Pietikäinen, Sanna	152
Piht, Mari-Ann	419 , 416
Pineau, Thomas	119
Piper, Thomas	70
Pirok, Bob W.J.	81
Pirttimaa, Markus	143, 152
Pitts, Kari	175
Plagellat, Cécile	77
Plotek, Marcin	415
Polastro, Mateus	135
Polewczyk, Johann	249
Posilskyi, Oleh	98
Pottier, Laurene	156
Poussard, Alexandre	155
Powierska-Czarny, Jolanta	415
Prainsack, Barbara	46
Previero, Alessandro	456
Prieto, Lourdes	148
Prins, Niels	154
Prior, Anne-Flore	80
Procopio, Noemi	262
Prongmanee, Worapot	378
Prusinowski, Meghan	485
Psallida, Margarita	402
Puit, Marcel de	405
Pulver, Benedikt	55 , 474
Purohit, Purvi	167, 414
Puttonen, Riina	451
Pütz, Michael	55, 83, 366, 474
QCC, The Quality and Competence Committee	282
Radgen-Morvant, Isabelle	245 , 456
Radosavljevic-Stevanovic, Natasa	361
Rais, Hervé	69
Ramírez-Hereza, Pablo	339
Ramos, Daniel	231, 339, 350
Randolph-Quinney, Patrick	176
Rasanen, Ilpo	171
Ratnarathorn, Nalin	378
Ratshonka, Same	440
Ratt, Katrin	416
Rautio, Tobias	73
Rawlins, Connor	368
Raymond, Jennifer	158, 189, 320
Redouté Minzière, Virginie	102 , 377
Regnery, Matthieu	134 , 136
Reif, Martina	130
Reinikainen, Tapani	238, 342
Reinikka, Mari	236
Reis, Paulo M. G. I.	391

Reither, Jack B.	146
Remmer, Sünne	431
Reymond, Naomi	77
Rhumorbarbe, Damien	196
Ribeiro, Rafael O.	391
Ribéreau-Gayon, Agathe	258
Richetelli, Nicole	209
Richmond, Karen McGregor	324 , 489
Riemen, John	225 , 88
Riikojä, Aime	427
Ritchie, Stuart	247
Rodriguez Lopez, Sofia	313
Romolo, Francesco Saverio	170 , 90, 239
Roos, Martin	182
Rosengren Holmberg, Jenny P.	370 , 360
Roseth, Arne	409
Ross, Alastair	309
Rossy, Quentin	119, 318
Rothschild, Markus A.	200
Roux, Claude	41 , 343 , 102, 105, 119, 122, 158, 308, 309, 310, 364, 383
Rudaz, Serge	346
Rumbelsperger, Anelize	463
Ruotsalainen, Daniel	70
Russel, Perle	413
Rådström, Birgitta	274
Rönkä, Elina	342
Röbler, Thorsten	366
S, Divya	256
Saari, Verner	65
Sabini, Sandrine	367
Sabo, Martin	239
Sacchetto, Ernestina	351
Sadam, Maarja	416
Salo, Harri	143
Salonen, Tuomas	78, 143
Samanipour, Saer	52, 53
Sanchez, Jorge	345
Sanga, Malin	402, 407, 410
Santonocito, Raffaella	372
Saraiva, André	285
Saric, Nikola	270
Sas, Vasile-Dan	285
Sauca, Ana	286
Saugy, Jonas	346
Saugy, Martial	346
Saunders, Matthew	343, 383
Schaufelbühl, Stefan	196
Schepers, Colin	129, 132
Schillaci, Saverio	458
Schneider, Peter M.	46
Schnürer, Frank	239
Schoenberger, Torsten	58
Schotsmans, Eline	263
Schunk, Lisa	446
Schyma, Christian	394

AUTHOR (PRESENTING = BOLD)	PAGE	AUTHOR	PAGE
Schäper, Jan	474	Ström, Simon	172
Schönberger, Torsten	474	Stuart, Barbara	254, 255
Scoundrianos, Aurèle	130	Sturup, Joakim	244
Scudder, Nathan	320	Su, Steven	465
Sears, Alison	320 , 158	Subramanian, Vasanth	217
Seckiner, Dilan	122 , 121	Susik, Mateusz	149
Sekula, Andrzej	415	Suzanne, Mathieu	126
Sekula, Karolina	415	Svensson, Ulf	385
Sell, Christian	422	Swiers, Leandra	116
Sergidou, Eleni	340	Swofford, Henry	215
Serier, Maurice	154	Szkuta, Bianca	142, 146, 401
Servida, Francesco	128, 249	Söderberg, Anna-Karin	235
Setia, Puneet	167 , 414	Söderström, Kristina	445
Seto, Yasuo	386	Söderström, Martin	78
Sheridan, Kelly	204	Talka, Teppo	152
Reymond, Oleksandr	242	Talukder, Rashel	284
Shu, Chang	423	Tatarnikova, Tetiana	479
Shwaafeh, Jamil	428	Taylor, Melissa	326
Sidstedt, Maja	402, 420	Teglind, Rebecka	180
Sieberth, Till	121 , 122, 177	Tensorer, Lauriane	367
Siketić, Zdravko	443	Tesio, Pascaline	156
Silva, Maya	221	Tetty, Justice	47
Simoens, Bart	80	Thakral, Sahil	167, 414
Sinha, Arvind	414	Thevis, Mario	70
Sippola, Erkki	280	Thibert, Valerie	439
Sirgmet, Andra	292	Thompson, Robert	269
Sisco, Edward	63 , 94	Thomsen, Benny	278 , 459
Siti, Chiara	412	Thong-on, Atcharawadi	378
Sjerps, Marjan	338	Thurn, Bridget	263 , 465
Sjoukema, Pieterjan	159	Tillmar, Andreas	151 , 162, 163, 164
Škruba, Eva	296	Trejos, Tatiana	89 , 485
Slagter, Martin	154	Trojanowski, Piotr	238
Sluis, Iris	179 , 430	Truzzo Sfrazzetto, Giuseppe	372
Smeets, Math	437	Tsai, Chao-Cheng	71
Smigiel-Kaminska, Daria	384	Tuccitto, Nunzio	372
Smith, Paul	223	Tuinman, Sietse	154
Smyth, Alexander	269	Tully, Gillian	42 , 315
Solanke, Abiodun Abdullahi	114	Tuvskog, Johanna	193
Souvignat, Thomas	128, 134, 249	Udrisard, Robin	173
Spek, Aart	139	Ueland, Maiken	254, 255, 263, 465
Spichiger, Hannes	131	Ugen, Mattijs	129, 132
Spiers, Cai	221	Uhlig, Steffen	92
Spindler, Xanthe	105, 343, 383	Ulander, Jens	198
Sprong, Annette	361	Umlauf, Gunther	83
Staadig, Adam	164	Wagner, Isolde	475
Stamouli, Amalia	92 , 91	Vakkilainen, Tanja	329
Steadman, Dawnie	253	Walczewska-Szewc, Katarzyna	376
Stigter, Erik	183	Waldebring, Robert	365 , 369
Stigter, Hendrik	436	Wallberg, Maria	360
Stock, Rosemary	237	Wallén, Helena	360
Stoel, Reinoud	195, 208	Wallenberg, Marcus	362
Strandqvist, Carl	365, 369	Wallgren, Jakob	369
Strano Rossi, Sabina	170	Wallin, Jaana	277, 473
Strindlund, Olle	362	Wallman, James	263
Strong, Graham	248	Wallmark, Nanny	399 , 408

AUTHOR (PRESENTING = BOLD)

PAGE

Valsecchi, Andrea	252, 466
Walsh, Simon	314
Walstad, Tore	238
van Asten, Arian C.	82, 52, 53, 54, 64, 72, 81
van Beurden, Anouk S.A.	81
van Bilsen, Amy	276
Van Bochove, Marc A.	99
van Dam, Annemieke	88, 240
Van Damme, Irene	371
van de Crommert, Peter	284
van de Wetering, Judith	91
van den Berge, Margreet	413
van den Bossche, Piet	437
Van Den Doel, Karien	316
van den Elzen, Richard	240
van den Hurk, Rick S.	81
Van den Pol, Carlijn	103
van der Heijden, Antoine	82
van der Horst, Anouk	437
van der Linden, Jennifer	154
van der Meer, Klaas	298
Van der Weerd, Jaap	103, 100
van der Vloed, David	230
van der Zwan, Anne-Wil	154
van Mook, Walther	437
Van Natta, Kristine	439
van Oorschot, Roland A.H.	142, 146, 413
Van Zandwijk, Jan Peter	133, 266
Vander Pyl, Courtney	89
Vandersteen, Katrijn	298
Wang, Bruce	486
Wang, Xiao	486
Wang, Yuanfeng	273
Varenne, Anne	97
Warren, Emily	204
Was-Gubala, Jolanta	381, 384
Was-Gubala, Jolanta	387
Watanabe, Shimpei	386
Watcharayotinkul, Wanna	378
Webb, Gregory	299
Weber, Matthias	200, 446
Weber, Philip	231
Weimar, Bert	200, 446
Velay, Jean-Luc	190
Wende, Marc	83
Ventsel, Kaja	238
Vergeer, Peter	338, 95
Vermeij, Erwin	202
Wermelinger, Marc	68
Werner, Denis	96, 196, 273
Wescott, Daniel J.	262
Vestergren, Tommy	304
Westphal, Folker	55, 474
Wettborg, Eva	304, 307, 303

AUTHOR

PAGE

Weyermann, Céline	308, 310, 331, 76, 77, 87, 90, 102, 377
Wheeler, John	56
Wiberg, Daniel	410
Widin Klasén, Lena	306
Vidoli, Giovanna	253
Vieira, Andreia	472
Wilk, Leah	182
Villamon, Maria Jesus	444
Willis, Sheila	305, 309, 315, 308, 310
Wilson, Amy	337
Vincenti, Marco	234, 335
Wingren, Carl Johan	429
Wing-Yee, Tang Vicky	343
Witteman, Cilia	195, 208
Voisard, Romain	331
Vollebregt, Ellen	154
Wood, Charmaine	169
Worasuwannarak, Wisarn	406
Worring, Marcel	340
Woźniowski, Krzysztof	376
Wróbel, Maria	415
Wu, Xiongyu	73
Yang, Wenrong	142
Yeh, Chia-Yu	71
Yeh, Ya-Ling	71
Yousakun, Nithiporn	378
Ypma, Rolf	350, 91, 154, 340
Yu, Ming-Tsang	71
Yu, Yingchao	273
Yu, Zailiang	423
Zadora, Grzegorz	234, 468, 484
Zagermann, Johannes	474
Zalewski, Wojciech	376
Zampa, Francesco	224, 226, 227, 288, 216
Zaugg, Kim	249
Zavattato, Davide	372
Zhang, Wentian	465
Zhang, Yueke	423
Zhu, Huiyu	221
Zilg, Brita	172
Zuidberg, Matthijs	413
Zuri, Valentina	293
Önnerud, Hans	79;

ABSTRACT NBR	PAGE	ABSTRACT NBR	PAGE	ABSTRACT NBR	PAGE	ABSTRACT NBR	PAGE	ABSTRACT NBR	PAGE
PS001	40	OP010	59	OP059	117	OP109	169	OP158	219
PS002	41	OP011	52	OP060	118	OP110	170	OP159	229
PS003	42	OP012	76	OP061	119	OP111	181	OP160	230
PS004	43	OP013	53	OP062	120	OP112	176	OP161	231
PS005	44	OP014	71	OP063	121	OP113	171	OP162	238
PS006	45	OP015	60	OP064	122	OP114	172	OP163	234
PS007	46	OP016	54	OP066	123	OP115	182	OP165	235
PS008	47	OP017	72	OP067	124	OP116	173	OP166	236
PS009	48	OP018	61	OP068	125	OP118	177	OP167	237
KN001	50	OP019	73	OP069	126	OP119	183	OP168	239
KN002	51	OP020	62	OP070	129	OP120	178	OP169	240
KN003	79	OP021	55	OP071	132	OP121	186	OP170	243
KN004	85	OP022	56	OP072	137	OP122	187	OP171	244
KN005	89	OP023	77	OP073	130	OP124	188	OP172	245
KN006	75	OP024	63	OP074	133	OP125	189	OP173	246
KN007	108	OP025	74	OP075	134	OP126	190	OP174	247
KN008	127	OP026	80	OP076	135	OP127	191	OP175	248
KN009	128	OP027	81	OP077	138	OP128	192	OP177	249
KN010	145	OP028	82	OP078	136	OP129	193	OP179	253
KN011	144	OP029	83	OP079	131	OP130	200	OP180	254
KN012	151	OP031	84	OP080	139	OP131	195	OP181	255
KN013	166	OP032	86	OP081	142	OP132	196	OP182	256
KN014	194	OP033	87	OP082	143	OP133	205	OP183	257
KN015	209	OP034	88	OP083	148	OP134	197	OP184	258
KN016	215	OP035	90	OP084	146	OP135	198	OP185	259
KN017	228	OP036	91	OP085	149	OP136	206	OP186	260
KN018	241	OP037	92	OP086	150	OP137	207	OP187	261
KN019	264	OP038	93	OP087	147	OP138	201	OP188	262
KN020	280	OP039	102	OP089	152	OP139	202	OP189	263
KN021	281	OP040	94	OP090	159	OP140	203	OP190	251
KN022	334	OP041	78	OP091	160	OP141	208	OP191	265
KN025	109	OP042	95	OP092	153	OP142	204	OP192	266
KN026	268	OP043	96	OP093	154	OP143	199	OP193	101
KN027	250	OP044	97	OP094	155	OP144	210	OP194	267
KN028	314	OP045	98	OP095	161	OP145	211	OP195	269
KN029	326	OP046	103	OP096	162	OP146	212	OP196	270
KN030	302	OP048	99	OP097	163	OP147	224	OP197	271
KN031	282	OP049	100	OP098	156	OP148	225	OP198	272
OP001	64	OP050	104	OP099	157	OP149	220	OP199	273
OP002	65	OP051	105	OP100	164	OP150	221	OP200	274
OP003	66	OP052	110	OP101	158	OP151	222	OP201	278
OP004	67	OP053	113	OP102	179	OP152	216	OP202	275
OP005	57	OP054	114	OP103	174	OP153	223	OP203	276
OP006	68	OP055	115	OP104	180	OP154	217	OP204	277
OP007	69	OP056	111	OP105	167	OP155	218	OP205	283
OP008	70	OP057	112	OP106	175	OP156	226	OP206	284
OP009	58	OP058	116	OP108	168	OP157	227	OP207	285

ABSTRACT NBR	PAGE	ABSTRACT NBR	PAGE	ABSTRACT NBR	PAGE	ABSTRACT NBR	PAGE	ABSTRACT NBR	PAGE
OP208	286	OP258	351	PP036	390	PP086	444	WS003	523
OP209	287	OP259	352	PP037	391	PP087	445	WS004	508
OP210	288	OP260	353	PP038	392	PP088	446	WS005	515
OP211	289	OP263	347	PP039	393	PP090	447	WS006	493
OP212	290	OP264	354	PP040	394	PP091	448	WS007	494
OP213	291	OP265	213	PP041	395	PP092	450	WS008	512
OP214	292	OP266	214	PP043	396	PP093	451	WS009	513
OP215	306	OP267	252	PP044	398	PP094	452	WS010	497
OP216	307	OP268	293	PP045	399	PP095	453	WS011	516
OP217	303	OP269	294	PP046	400	PP096	454	WS012	524
OP218	304	OP270	295	PP047	401	PP098	456	WS013	525
OP219	308	OP271	296	PP048	402	PP099	457	WS014	534
OP220	309	OP272	297	PP049	403	PP100	458	WS015	530
OP221	312	OP273	298	PP050	404	PP101	459	WS016	526
OP222	313	OP274	337	PP051	405	PP102	460	WS017	517
OP223	310	OP275	344	PP052	406	PP104	461	WS018	531
OP224	311	OP276	242	PP053	408	PP105	462	WS019	498
OP225	305	OP277	299	PP054	409	PP106	463	WS020	499
OP226	318	OP278	300	PP055	407	PP107	464	WS021	500
OP227	325	PP002	358	PP056	410	PP108	465	WS022	495
OP228	319	PP003	359	PP057	411	PP109	467	WS023	505
OP229	320	PP004	360	PP058	412	PP110	468	WS024	518
OP230	315	PP005	361	PP059	413	PP111	469	WS025	527
OP231	316	PP006	362	PP060	414	PP112	470	WS026	528
OP232	321	PP007	363	PP061	415	PP113	472	WS027	532
OP233	322	PP008	364	PP062	416	PP115	473	WS028	496
OP234	323	PP009	365	PP063	417	PP116	474	WS029	509
OP235	317	PP011	366	PP064	418	PP117	475	WS030	534
OP236	324	PP012	367	PP065	419	PP118	478	WS031	533
OP237	327	PP013	368	PP066	420	PP119	479	WS032	510
OP238	328	PP014	369	PP067	421	PP120	480	WS033	506
OP239	329	PP016	370	PP069	422	PP121	481	WS034	501
OP240	330	PP017	371	PP070	426	PP122	484	WS035	502
OP241	331	PP018	372	PP071	427	PP123	485	WS036	511
OP242	332	PP019	373	PP072	428	PP124	486	WS037	514
OP243	335	PP021	374	PP073	429	PP125	487	WS038	519
OP244	338	PP022	377	PP074	430	PP126	489	WS039	529
OP245	345	PP023	378	PP075	431	PP5001	375	WS040	503
OP246	346	PP024	379	PP076	432	PP5002	423	WS041	507
OP247	339	PP026	380	PP077	433	PP5003	439	WS042	520
OP249	340	PP027	382	PP078	434	PP5004	440	WS043	504
OP250	341	PP028	383	PP079	435	PP5005	449	WS044	521
OP251	342	PP030	384	PP080	436	PP5006	466		
OP254	343	PP031	381	PP082	437	PP5007	482		
OP255	336	PP032	385	PP083	438	PP5008	376		
OP256	349	PP034	386	PP084	442	WS001	492		
OP257	350	PP035	387	PP085	443	WS002	522		

NOTES



A series of 20 horizontal dotted lines spanning the width of the page, providing a guide for writing notes.

