THE FORENSIC EXHIBIT.

Volume 4
Issue 4

Dec 2021

Shining a spotlight on the work of the Australia New Zealand forensic science community

A message from the NIFS Team

The ever changing COVID landscape continued to present challenges for the NIFS Team in 2021 as well as for the forensic and broader communities.

Virtual meetings are now the norm. Along with our stakeholders, we have adapted well to the online collaborative environment to ensure that we continue to deliver projects of value to the Australia New Zealand forensic community.

Our Focus

We are focussed on progressing our work program activities as outlined in the ANZPAA NIFS Business Plan 2021-22. Key work items underway include the Forensic Fundamentals project that identifies the underpinning science and validation requirements for the different areas of forensic science; the Forensic Capability Mapping project that aims to identify current and emerging capability risks for our ANZFEC stakeholders; and the Standardised Consumables project, currently exploring the feasibility of a standardised pricing arrangement for high throughput analytical chemistry consumables. We have also recently completed the procurement of over 400 proficiency tests from national and international suppliers on behalf of our stakeholders.

Looking toward 2022, we are developing a series of virtual events and activities for our Engender Change program that aim to promote diversity and inclusion in forensic science and transform culture through leadership.

Welcomes and Farewells

There were significant changes to our governance group, ANZFEC, in the last quarter of 2021: we farewelled John Doherty, Anthony Lee, Grant Twining and Jill Vintiner, and we welcomed Lara Keller, Matthew McCreadie, and Stuart Mearns.

Tracey Green also joined us as ANZPAA CEO. Tracey has over 35 years of national and international experience in operational and corporate policing, with experience in criminal investigation. Tracey is a strong advocate of policing as a profession, with a proven commitment to international collaboration with police and law enforcement agencies, ensuring education and research are operationally relevant and aligned to policing needs. The NIFS Team are looking forward to working with Tracey and the broader ANZPAA Team to deliver our shared work program activities in 2022.

At ANZPAA NIFS, we said goodbye to Tracie Gould, who joined Victoria Police Forensic Service Department as Group Manager Fingerprint Sciences Group on a 12 month secondment. We welcomed Ellen Konza on a 12 month secondment from New South Wales Police Force who will be leading the activities associated with delivering the Australasian Forensic Science Assessment Body (AFSAB) program. More on Ellen can be found later in this edition.

Finally, it is with great sadness we advise that Vanessa Goodall has stepped down from her role as Director ANZPAA NIFS. Vanessa joined NIFS in May 2021 and was pivotal in commencing Service Level Agreement discussions with our stakeholders and developing a vision for our Strategic Plan 2022-25. Although her time with NIFS was short, Vanessa has made a significant contribution to our work program, and she will be greatly missed. The NIFS Team wish Vanessa and her family all the very best for the future.

We wish you all a wonderful festive season and the NIFS Team looks forward to working with all our stakeholders in 2022.

In this issue:

ANZPAA
Australia New Zealand Policing Advisory Agency

NIFS
National Institute of Forensic Science Australia New Zealand

Engender Change

ENGENDER CHANGE

Transforming Culture Through Leadership

Exciting activities are coming in 2022 for Engender Change Advocates

Sign up now

Learn more
https://www.anzpaa.org.au/forensic-science/engender-change

Welcome
Ellen Konza

Please join us in welcoming the newest member of the ANZPAA NIFS Team – Ellen Konza.

Ellen has joined ANZPAA NIFS as Senior Forensic Project Officer until September 2022.

Ellen has 20 years of experience in forensic science, working with New South Wales Police Force (NSWPF). As a Senior Crime Scene Officer, Ellen has examined numerous major crime scenes.

Bloodstain Pattern Analysis (BPA) is her speciality, having undertaken the Chair's role on the ANZPAA NIFS BPA Technical Advisory Group. Ellen also recently managed a NSWPF project to transition BPA training to an online platform.

Ellen will be managing the Australasian Forensic Science Assessment Body (AFSAB) program and assisting with other aspects of the ANZPAA NIFS works program.

2021 Best Paper Award Winners

ANZPAA NIFS would like to congratulate the following recipients of the 2021 ANZPAA NIFS Best Paper Awards:

Best Paper – Forensic Fundamentals

Winner

Alexandra Bettison, Matt N. Krosch, Janet Chaseling and Kirsty Wright.

Bloodstain Pattern Analysis: Does experience equate to expertise?

Highly Commended

Nicola Beckett, Rebecca Tidy, Bianca Douglas and Colin Priddis.

Detection of intact insulin analogues in post-mortem vitreous humour - Application to forensic toxicology casework.

Best Paper – Capability Enhancement and Innovation

Winner

Duncan Taylor, Jo-Anne Bright, Lenara Scandrett, Damien Abarno, Shan-I Lee, Richard Wivell, Hannah Kelly and John Buckleton.

Validation of a top-down DNA profile analysis for database searching using a fully continuous probabilistic genotyping model.

Highly Commended

Meng-Han Lin, Shan-I Lee, Xinlong Zhang, Laura Russell, Hannah Kelly, Kevin Cheng, Stuart Cooper, Richard Wivell, Zane Kerr, Judi Morawitz and Jo-Anne Bright.

Developmental validation of FaSTR™ DNA: Software for the analysis of forensic DNA profiles.

Best Technical Article or Note

Winner

Russell Cook, Natasha Mitchell and Julianne Henry.

Assessment of Diamond™ Nucleic Acid Dye for the identification and targeted sampling of latent DNA in operational casework.

Highly Commended

Jo-Anne Bright, John Buckleton and Duncan Taylor.

Probabilistic interpretation of the Amelogenin locus.

Highly Commended

Selina Leow and Denice Higgins.

Can dental charting from a post-mortem computed tomographical scan produce a confident forensic identification without traditional physical and radiographic examination?

Best Case Study

Winner

Andrew Camilleri, Sam Alfred, Cobus Gerber, Stephen Lymb, Ben Painter, Anne Rathjen and Peter Stockham.

Delivering harm reduction to the community and frontline medical practitioners through the South Australian Drug Early Warning System (SADEWS).

Highly Commended

Rees Powell, Peter Collins, Graham Horsley, John Coumbaros and Wilhelm van Bronswijk.

Enhancing the evidential value of textile fibres Part 2: Application of a database-driven fibre comparison strategy to a cold-case investigation.

Best Literature Review

Winner

Jack Garland, Benjamin Ondruschka, Ugo Da Broi, Cristian Palmiere and Rexson Tse.

Post mortem tryptase: A review of literature on its use, sampling and interpretation in the investigation of fatal anaphylaxis.

Highly Commended

Meghan Mckinnon, Maciej Henneberg and Denice Higgins.

A review of the current understanding of burned bone as a source of DNA for human identification.

Best New Publisher in a Refereed Journal

Winner

Owyn Butters, Matt N. Krosch, Michell Roberts and Donna MacGregor.

Application of forward-looking infrared (FLIR) imaging from an unmanned aerial platform in the search for decomposing remains.

Highly Commended

Lauren Atwood, Jennifer Raymond, Alison Sears, Michael Bell and Runa Daniel.

From identification to intelligence: An assessment of the suitability of forensic DNA phenotyping service providers for use in Australian law enforcement casework.

Research and Innovation Roadmap

The purpose of the ANZPAA NIFS Research and Innovation Roadmap 2020-2025 is to promote the investment of funding and resources in research that is operationally relevant and of vital importance to forensic science service provision in Australia and New Zealand. ANZPAA NIFS developed the Roadmap through extensive engagement with the forensic community. It defines research areas that are important to strengthening current forensic science processes and building future capability. The figure below summarises the Roadmap research areas aligned to the ANZPAA Strategic Priorities.

Promoting Research in Forensic Science

ANZPAA Strategic Priority	Research Area	
Address Risk →	Forensic Fundamentals	Strengthening underpinning science
	Human Factors	Improving objectivity & practice
Enhancing Practice →	Data Sets	Developing activity level reporting
	New Tools	Automating processes & creating new capabilities
Shaping Stronger Connections →	Forensic Intelligence	Using forensic data for broader purposes

You can find more information on the Roadmap via the following link: https://www.anzpaa.org.au/forensic-science/our-work/projects/research-and-innovation-project.

Forensic Fundamentals - Phase 2 Update

Overview

The aim of the Forensic Fundamentals project is to identify the underpinning science and validation requirements for forensic science disciplines. This project involves conducting a gap analysis for multiple forensic science disciplines. These gap analyses will inform priority research areas promoted by ANZPAA NIFS.

Claim Assessment & Gap Analysis

Working groups map the claims made within their discipline, including claims surrounding underpinning principles and expert knowledge and interpretative ability. Scientific literature is then assessed for each claim to determine the level of empirical support that exists (assessed in accordance with the Empirical Study Guideline available on the NIFS website **http://www.anzpaa.org.au/forensic-science/our-work/products/publications**) and identify where further empirical study would provide greatest value.

2020-21

During 2020-21 the Forensic Fundamentals included the following disciplines: Toxicology, Audio Video, Drug, Anthropology, Textile Damage and Clandestine Laboratory. The reports for these disciplines were presented at ANZFEC 19 (July 2021) and ANZFEC 20 (October 2021) and are available to ANZFEC agencies upon request.

2021-22

In 2021-22 the project will include the following disciplines: Biological Screening, DNA, Chemical Trace – Paint, Fibres, Lubricant and Glass, Odontology, Documents, Shoeprints and Tyremarks, Fire Investigation and Computers.

The Effect of Decomposition Processes on Fired Bullet Striae and Postmortem Interval Estimates

Matthew Bolton
University of Technology, Sydney

Toolmark identification is a branch of forensic science, where the underlying principle involves a 'harder' object, described as the tool, coming in contact with a 'softer' work piece. This contact imparts random, microscopic irregularities from the tool onto the work piece. The features transferred from the firearm to the cartridge case and bullet when a firearm is discharged are analysed during microscopic examinations. Specifically, the comparison of these irregularities or striations contained within a Land Engraved Area (LEA) allows for a barrel to be individually identified as having produced the marks on a fired bullet.

Fired bullets associated with homicides are often retained within the body and exposed to decomposition processes, especially if the body is not recovered within a relatively short timeframe. Shortly after death, the body begins to decompose primarily via two processes: autolysis and putrefaction, leading to a host of chemicals being present in the cadaver that may be responsible for damaging embedded bullets.

There have been relatively few studies investigating the effect of decomposition processes on fired bullet striae and the work completed thus far has been confined to the Northern Hemisphere. The development of the Australian Facility for Taphonomic Experimental Research (AFTER), within the Centre of Forensic Science at the University of Technology, Sydney, provides a valuable research facility within an Australian environment in which a study of this type can be conducted.

The aim of this research is to investigate the impact of decomposition on the degradation of fired bullet striations and to determine potential time-of-death estimates. The stages of decomposition are relatively well known, however the effects of decomposition on fired bullet striations have had limited research.

Specifically, the project aims to identify a time period when fired bullets may no longer be identifiable, after targeting specific tissue types and regions within decomposing human donors and pig carcasses. This will be through the development of a corrosion scale, microscopic examinations utilising qualified firearms examiners and computer-based correlations of the sample bullets.

To date, fired bullets have been exposed to a human donor in winter, one pig carcass in autumn and two further pig carcasses in late spring. These bullets have undergone manual microscopic examinations by examiners across Australia. Early results have indicated that the bullets corrode quickly in hot, humid environments ('faster' decomposition) and that at a certain level of corrosion, the ability for examiners to identify fired bullets decreases. However, as these are early results, more analysis is required to confirm the preliminary observations.

Supervisors:
Dr Maiken Ueland, Centre for Forensic Science, UTS, and Deputy Director of The Australian Facility for Taphonomic Experimental Research (AFTER).

Dr Scott Chadwick, Centre for Forensic Science, UTS, and Director of Undergraduate Programs for the Faculty of Science.

▲ *9mm Parabellum calibre copper jacketed bullets displaying corrosion after exposure to a decomposing pig analogue for approximately 2 weeks.*

Evaluation of DNA Recovery Methods from Fired Cartridge Cases and Their Effects on Ballistic Toolmarks Over Time.

Colby Hymus (PathWest), Scott Egan (PathWest), James Inskip (Western Australian Police Force) and Jasmine Tay (PathWest)

DNA recovery and generation of useful DNA profiles from fired cartridge cases has traditionally been highly challenging and often unsuccessful. The poor DNA yield may be due to a combination of factors such as heat generated in the firing process, the limited surface area of the cartridge casing to deposit cellular material upon, the chemicals used in the manufacture of the cartridges or maintenance of the firearm. This is an active area of research and recent articles have been published investigating methods to maximise the recovery of DNA from cartridges. This led to discussions between members of the Ballistics team at the Western Australian Police Force (WAPF) and PathWest Forensic Biology (PWFB) about a collaborative project to look at any potential for improving DNA recovery from cartridges.

Cartridge cases are typically made of brass, which is an alloy of zinc and copper. Copper has been documented to contribute to DNA degradation from oxidative stress (Bonsur *et al* 2020)[1]. A recent study by Bille *et al* (2020), showed that the protein Bovine Serum Albumin (BSA), which contains a copper binding peptide sequence, Glycine-Glycine-Histidine (GGH) has the ability to bind to the copper molecules and sequester them away from DNA molecules, therefore reducing copper-mediated DNA degradation[2]. Bille *et al* (2020) prepared a solution of BSA and a GGH tri-peptide (BTmix) and added it to their DNA extraction method. The results demonstrated that the combination of rinsing the cartridge casing with cell lysis buffer containing the BTmix and swabbing the cartridge case improved success rate of obtaining DNA profiles.

▲ *Fired 22 Long Rifle calibre cartridge cases exposed to PrepFiler (Left) & QIAGEN ATL (Right) extraction buffers.*

Phase one of the experiment investigated the effects of different extraction buffers and methods on the recovery of DNA, including looking at the differences between nickel and brass cartridges. 22 Long Rifle calibre rimfire ammunition were selected for initial experiments as they represented the most common type encountered in casework. Experiments clearly demonstrated that the swabbing of cartridges resulted in lower DNA recovery than direct immersion in extraction buffers.

Assessing the extraction buffers, it appeared the addition of BTmix only slightly improved DNA recovery for the brass cartridges, but had lower average recovery for nickel cartridges. Overall, extraction by immersing the cartridge in the PrepFiler BTA method returned the highest DNA yield for both brass and nickel cartridges. It was of interest that recovery was not significantly reduced when comparing fired and unfired cartridges, indicating that degradation may be more attributable to the interaction between the DNA and copper substrate rather than the firing process.

Having identified the optimal method of extraction, the next phase will be to investigate the effects of this process on toolmarks. Cartridges will be fired, and a subset will undergo DNA profiling, with toolmarks from these cartridges compared to the non-processed cartridges at set time points by a ballistics expert.

Overall, the ability to investigate and refine our method for obtaining the greatest amount of probative information (both DNA and toolmarks) from fired cartridges has significant benefits for ongoing and future investigations. This project is also a strong example of collaboration between WAPF and PWFB and how information exchange between the two agencies has led to a more robust experiment being conducted. We are excited to see the results from Phase Two of the experiment and share these with the Australian New Zealand forensic community.

1 Bonsur, D. O. M., Higgins, D., Austin, J. J. (2020) Forensic touch DNA recovery from metal surfaces - A review. *Sci Justice*. 60(3):206-215.

2 Bille et al. (2020). An improved process for the collection and DNA analysis of fired cartridge cases. *Forensic Science International: Genetics.* 46.

Serial Number Restoration

Joel R. Waszczuk, Forensic Firearm Examiner
New South Wales Police Force

A serial number on a firearm is an identifiable code used for the purposes of tracking and registration. This unique marking also provides an avenue for investigators to trace the firearm's history and identify previous owners. This information is commonly known by criminals and thus illicit firearms are often seized with a defaced serial number. This is generally accomplished by grinding, filing, or milling the area containing the marking.

The efficient recovery and accurate interpretation of a defaced serial number is an important task for forensic investigators, such as firearm examiners. Chemical etching is a practice commonly used to identify these defaced markings, however there are a significant number of factors which influence the success and clarity of the restored markings.

Chemical etchants 'restore' serial numbers by highlighting the compressed (strained) material that remains as a result of the original serial number stamping process, allowing for a visual representation of the material deformation.

A common problem with the recovery of a serial number is that the restored characters often dissipate after time, and photography may not always be capable of capturing a clear detailed image equal to that perceived by the observer during the etching process. Thus, there is a heavy reliance on the examiner accurately interpreting and documenting the recovered information.

The 2009 National Academy of Sciences (NAS) and 2016 President's Council of Advisors on Science and Technology (PCAST) reports highlighted the need for further research and validation in forensic science, particularly in pattern matching fields such as forensic ballistics.

▲ *Chemically Restored Serial Number HIY932*

As serial number restorations are regularly undertaken by forensic ballistics examiners, the area has been identified as an area potentially lacking scientific validity. The ANZPAA NIFS 2019 Forensic Fundamentals Gap Analysis project recognised the benefit of further empirical research in forensic ballistics including the analysis and interpretation of restored serial numbers. The project also promotes the publication of forensic expertise testing for forensic disciplines.

In response to the abovementioned works, an expert/novice comparison study was devised. The study involves the chemical restoration and interpretation of over 100 serial number samples each consisting of six alphanumeric characters (to best replicate a common firearm serial number format).

After restoration, the restored markings will be independently interpreted by a number of trained forensic firearm examiners and novices over multiple time intervals. A collaboration of the interpretation results will be used to assess the accuracy levels of both experts and novices; identify characters that are more likely to be misidentified and determine a minimum the length of time between the initial restoration and observer's interpretation.

The study commenced in mid-2020 and has since involved participants from multiple jurisdictions including New South Wales, the Australian Capital Territory and Tasmania; and endeavours to be further expanded to Queensland and Victoria. It is hoped that the results of the study will be used to provide validation to a regularly used laboratory practice, enabling forensic firearm examiners to confidently address court enquiries in relation to the accuracy of their interpretations.

Robotics Replacement Project

NSW Health Pathology Forensic & Analytical Science Service

The DNA Laboratory at the NSW Health Pathology Forensic & Analytical Science Service (FASS) has commenced the procurement process for a multi-million-dollar Robotics Replacement Project.

For more than a decade FASS Forensic DNA has been experiencing the benefits of robotics along with subsampling initiatives and submission of robot ready tubes by NSW Police.

The new robotics project marks a transformational turning point for FASS which is set to become one of the most highly automated forensic biology laboratories in the world. The new system will enable high volume throughput and FASS will have the capacity to process in excess of 100,000 DNA samples per year with optimised turnaround times.

Improvement to turn-around times will be achieved by automating the remaining manual processes, including differential extraction. Importantly, the new system will allow for priority and business-as-usual sample processing to occur concurrently. Improvements to ergonomics, utilisation, safety, cleaning and maintenance will be highly welcomed by staff.

Given the size and scope of the new project, the discovery phase before going to tender was thorough and extensive including comprehensive scoping of the global market for available or imminent technology. NSW Police played an important role by providing predictions of future criminal activity and policing focus to determine types and volume of samples.

FASS DNA laboratory staff were regularly engaged with to ascertain what works well, what doesn't and what future enhancements and capabilities they would like to see. The impact on core business of increasing submissions of high priority samples was identified as a challenge to maintaining short turnaround times and the configuration of platforms to minimise this impact will be a key feature of the final integrated solution. Additionally, the new system will increase FASS staff expertise in automated applications which could then be implemented elsewhere in the service.

A significant amount of work has also been done to ensure a sustainable, future proofed service. This includes the consideration of adopting a new generation DNA typing kit; exploring ways to adapt to international product supplier changes including a possible adjustment to plastic requirements in the EU which may affect current chemistry; and allowing for additional MPS automation in the future.

To support the project, the refurbishment of a testing validation laboratory will allow new instruments to be validated without impacting current casework. On completion of the robotics validation phase, this testing space will become available for experimental research work across FASS and provide additional resources in the event of a Disaster Victim Identification incident.

A newly refurbished purpose-built Evidence Recovery Unit co-located adjacent to the DNA laboratory will streamline interaction and cross training of staff.

▲ *DNA Scientist Allan Murray operating a robotic liquid handling platform*

DNA Testing of Human Remains

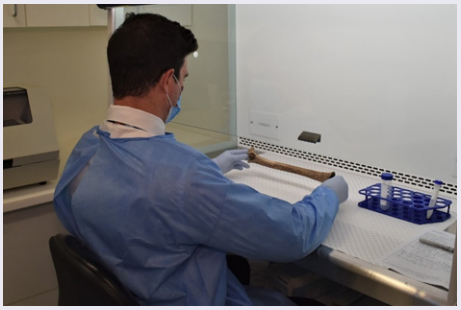
NSW Health Pathology Forensic & Analytical Science Service

NSW Health Pathology's Forensic & Analytical Science Service (FASS) is proud to be part of ground-breaking research which supports NSW Police and the wider community.

Recently Senior Forensic Biologist Jeremy Watherston identified methods to achieve faster identification of disaster victims. Timely, accurate identification of victims gives much-needed answers to family members and streamlines the investigation by providing preliminary leads during the crucial early stages. While DNA profiling is the gold standard for disaster victim identification (DVI) in mass disaster events, advances in forensic biology have increased the options for the collection, sampling, preservation and processing of samples for DNA profiling.

Traditionally biological samples such as bones and teeth have been targeted for DNA which involve laborious and time-consuming surgical collection procedures followed by extensive preparation, cleaning and DNA processing steps. Jeremy's research focused on minimally-invasive samples such as nails, tissue biopsy, and small bones which were amenable to in-field collection and could be combined with efficient typing protocols requiring minimal sample preparation and pre-treatment steps. While these samples are easy to collect, they also offer humanitarian advantages and facilitate better engagement with other practitioners.

Working with supervisors from the University of Technology Sydney (UTS) and FASS, Jeremy's research has been conducted at the nexus of research and professional practice. Collaboration with the Australian Facility for Taphonomic



▲ *Senior Forensic Biologist Jeremy Watherston.*

▲ *© ABC News https://www.abc.net.au/radio/programs/am/human-bodies-used-in-mass-casualty-training-exercise/12015650*

Experimental Research (AFTER) provided an opportunity to test authentic postmortem (PM) and compromised samples while testing the practicality and application of the approaches in the field. Working concurrently as a senior forensic biologist and reporting extensively on the identification of human remains allowed Jeremy to draw on his experience to help shape the approaches; fully aware of the reporting implications for the coronial and/or criminal process.

In 2020 Jeremy participated in a national DVI exercise coordinated by ANZPAA's DVI Committee and hosted by AFTER. Jeremy trialled the application of in-field DNA testing on two different rapid DNA platforms, capable of generating DNA profiles within 90 minutes. His goal was to achieve rapid identifications and re-association of body parts, and to assess how the technology could be integrated into PM phase operations. This work has been accepted for publication in the *International Journal of Legal Medicine.*

After identification of limitations with existing rapid DNA platforms, Jeremy developed an efficient DNA profiling protocol for DVI and other degraded, skeletonised human remains. This protocol targets simple to collect sample types, requires minimal pre-treatment and is compatible with the high-throughput, automated backend DNA testing currently in use at FASS. This means that bone examination and extraction times were reduced from 1.5 days to approximately two hours. This work was recently published in MDPI *Forensic Sciences*: https://www.mdpi.com/2673-6756/1/3/14.

These DNA approaches should not be pursued for every sample. For example, more compromised samples are best submitted to the laboratory for more effective extraction and genotyping. However, Jeremy's research will help develop and optimise rapid protocols for future in-field identification of deceased people in mass casualty, counterterrorism and humanitarian forensic operations.

Jeremy's research enhances NSW's commitment to resolving missing person cases, and FASS's goal of remaining a leader in DNA-led identification for compromised human remains.

Jeremy Watherston, Senior Forensic Biologist, FASS and PhD Candidate, University of Technology Sydney (UTS)

Supervisors:
Professor Dennis McNevin (UTS)
Associate Professor Jodie Ward (UTS)
Associate Professor David Bruce (FASS)

Using Artificial Neural Networks to Streamline DNA Profile Reading

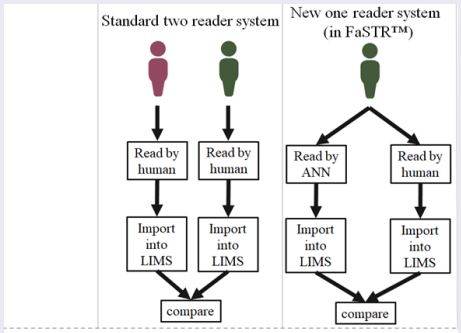
Luke Volgin, Senior Forensic Scientist – Biology
Forensic Science SA

Reading DNA profiles is a common part of the workload for any forensic biology laboratory and a task often performed by two independent scientists who compare their results and resolve differences. On 1st November 2021, Forensic Science SA (FSSA) became the first laboratory in the world to officially switch on the FaSTR™ DNA run reading software using a trained neural network, alongside a scientist, to analyse results from a DNA profiling batch of reference samples.

Recent developments in machine learning tools such as Artificial Neural Networks (ANNs) have been successful in performing pattern recognition tasks, often at a standard equal to or exceeding those of humans. Over the past six years this methodology has been developed for the task of 'reading' DNA profiles, where the detected peaks of an electropherogram (EPG) are automatically classified into categories based on their intrinsic properties. Progress has been made by integrating ANN profile reading within the FaSTR™ DNA software, developed by the Institute of Environmental Science and Research Ltd (ESR) in collaboration with FSSA.

The practical capabilities and operational benefits of using FaSTR™ DNA software were investigated at FSSA for the automated reading of GlobalFiler™ reference DNA profiles. The workflow that was ultimately implemented involved a 'single-reader system' for reference sample analysis, whereby a human reads the results using a series of rules-based filters and thresholds (the standard approach) side-by-side with an ANN as the second reader (the automated approach). A visual representation of the workflow is shown in Figure 1.

What can be seen from Figure 1 is the drastic reduction of manual artefact removal in FaSTR™ DNA when



Peaks manually removed	867	11
Readers required	2	1
Number of differences	N/A	2

▲ ***Figure 1*** *Schematic of the previous workflow and the FaSTR™ workflow (values given are based on the comparison of 331 profile reads). Note: Samples selected were previously read by two readers and the data for the number of differences were not available.*

comparing the two workflows. There are two main reasons for this: the performance of the ANN in the automated approach, and the auto-removal of peaks with advanced filter settings for pull-up, stutter, peak morphology and elevated baseline in the standard approach.

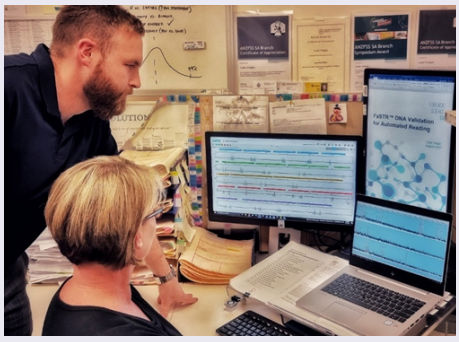
Figure 1 also demonstrates the benefits of implementing FaSTR™ DNA include:

1. The number of readers required is reduced by 50% with the use of ANN
2. Additional filter settings for artefact removal improved the manual reading experience
3. Improved stutter filtering using allele-specific stutter thresholds based on regressions
4. The combination of points 2 and 3 above leading to fewer sample re-works.

The accuracy to detect and label allelic peaks and remove artefact peaks for reference DNA profiles was 99.7% using the FaSTR™ DNA ANN module, which was deemed fit for purpose for casework implementation. The FaSTR™ workflow at FSSA is currently demonstrating the efficiency gains that can be realised with a single-reader system, with a saving of approximately one day of human reading time per week.

The future direction at FSSA will involve a validation of the system for reading evidence samples (mixed DNA profiles). This will focus on additional features of the software such as a decision tree model for estimating the number of contributors along with STRmix™ integration for automatic sample deconvolution. There will also be further consideration into the development of the ANN to read DNA profiles produced with different amplification systems, such as YFiler™ Plus, or to improve the functioning of the ANN to the point that it could be used as the sole reading system, without a human component.

In terms of the broader landscape in this space, there remains further scope in software development to refine and improve the methodology. One such way would be a function whereby a human can override incorrect decisions made by the ANN so that it could learn from incorrect decisions and strengthen the underlying algorithm over time. Also, since the ANN considers every scan point of an EPG, there is the possibility to remove analytical thresholds altogether, in order to maximise the amount of information obtained from a DNA profile.



▲ *Luke Volgin with Denise Ward who was the first person to read DNA profiles in casework with a machine learning algorithm*

Lumi Drug Scan Service - Lighting the Way

Institute of Environmental Science and Research Limited

Proudly developed by the Institute of Environmental Science and Research Limited (ESR) and New Zealand Police, Lumi Drug Scan is a revolutionary mobile drug detection service that harnesses the latest technology to detect if a suspected sample is methamphetamine, cocaine, or MDMA.

▲ *A sample being screened with Lumi Drug Scan*

▲ *The Lumi Drug Scan mobile app screens*

What makes the Lumi integrated solution so different is the fact it was developed from the ground up by ESR's forensic science experts working alongside frontline police. The officer on the beat has always been at the centre of our thinking and guiding development. The result of this is that any officer can gain access to real-time screening of suspected drug samples to support their decision making through Lumi.

Lumi brings together accessibility, speed and accuracy. Just place a bagged sample on the device and Lumi can determine if the sample is methamphetamine, cocaine, or MDMA – providing the result on your mobile phone within a few seconds.

The Lumi service combines an easy-to-use mobile app, sophisticated machine learning algorithms, a secure cloud service, and a robust and lightweight handheld near-infrared (NIR) device from Spectral Engines that's as dependable in the cold of New Zealand's high country as it would be on the Nullarbor in summer. The only thing you need is an internet connection, whether delivered by mobile or even satellite. The ability to scan through plastic packaging supports officer safety while maintaining sample integrity. In addition to the benefits it brings frontline users, the Lumi ecosphere supports digital case management while the Lumi analytics dashboard provides rich trends and analysis to law enforcement agencies allowing them to see what is being intercepted, when and where.

The Lumi drug detection machine learning algorithms are developed from ESR's extensive library of drug reference samples as well as street intercepted samples. This not only ensures results that are highly reliable but also highly relevant, as the detection is tuned to recognise the specific types of illicit drugs circulating within the community. Having been developed by a forensic science organisation, Lumi users can be sure reliability and quality are built in to Lumi's DNA and that it's fit for frontline use. A forensic validation undertaken on the accuracy of Lumi screening workflow demonstrated an overall accuracy of 96.7% for the detection of methamphetamine and cocaine. The accuracy of the detection of MDMA was 97.7%.

New Zealand Police has completed a rigorous evaluation of Lumi focussed on product testing, fitness for purpose, and user experience. During this 6 month pilot frontline officers across 5 of the 12 New Zealand Police districts were able to put Lumi through its paces in a broad range of real-world conditions, screening almost 900 suspected drug samples. New Zealand Police is working through internal governance committee approval to support the rollout of the service across New Zealand.

Feedback from New Zealand Police indicates the difference Lumi can make: *"Lumi has proven very popular with Police staff. It allows officers to test drugs through plastic, eliminating the need to open packets with suspected drugs inside. It allows officers to consider the best way to resolve the incident and ensure the person in possession of the drug is considered for a health-based resolution."* – Assistant Commissioner Bruce O'Brien

"We will always have to go to ESR for court and evidential purposes, but Lumi as a drug screening tool - it's fantastic." – frontline Lumi pilot user

https://www.facebook.com/NZPolice/videos/314239293283529/

▲ *The Lumi workflow: The mobile app connects the device to the cloud-hosted machine learning models, allowing the spectra from a sample to be analysed and a result provided to the officer in real-time*

Arctic Forensics – 'Digital Data Analysis Made Simple'

Bruce Markey
Queensland Police Service

Digital forensics is a field that will continue to grow in complexity, demand, and cost. Traditionally, hardware write-blockers have been used to extract data from mass storage devices in a forensically sound manner. These tools are not only expensive but must be constantly updated as new technologies appear (mSATA, M.2, eMMC, NVMe, etc.). Many current and evolving mass storage interface technologies do not have external hardware solutions (for example, eMMC is often non-removable).

To overcome these physical constraints and the ever-higher prices demanded by corporate products, Arctic Forensics was born. The original goal was to build a free software solution for forensic imaging of storage devices. Inspired by *FIREBrick*, a project the University College Dublin, a forensic operating system (*arcticLinux*) built on the Linux kernel was created. The modified kernel prevents all unintentional writes to internal and attached drives. As a minimalist build, the Intel x86 based operating system loads quickly from an external medium (USB, optical disc) into memory (less than 512MB required), launching the text-based application, *arcticBear*. The operating system will boot on both legacy (BIOS) and UEFI firmware, bypassing Secure Boot using a shim.

arcticBear - copying and triaging

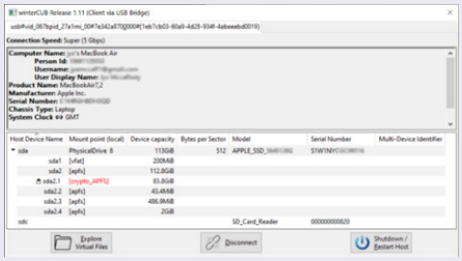
The *arcticBear* application can be used to create forensic copies (raw, EWF, etc.) of internal/attached media to an external drive, but its primary method of data acquisition is via a USB Host-to-Host Bridge* (transfer cable) using existing forensic software. This methodology enables the analyst to use their preferred forensic applications to copy and/or triage the target computer safely. *arcticLinux* supports file systems including; Linux's Ext, Apple's HFS/APFS, Microsoft's ex/FAT and NTFS, and Btrsf. With the appropriate passcode, *arcticBear* can decrypt (on-the-fly) encrypted volumes such as LUKS, TrueCrypt and Bitlocker. Once a particular encrypted volume is 'unlocked', the decrypted volume is mapped over the original. This negates the need to decrypt locked volumes after the parent drive is imaged. The *arcticBear* application also supports iSCSI and wired/Wifi network destination stores along with virtual file (disc image) mounting. This enables usage in enterprise network infrastructure.

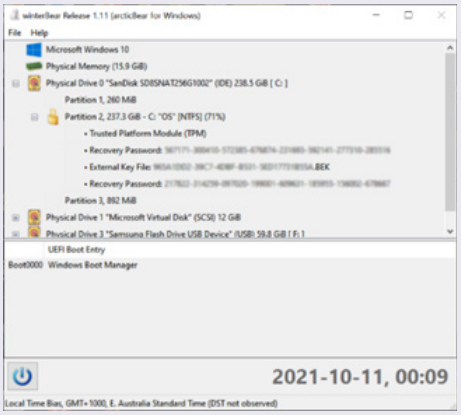
nanoq – hands-free copying/triaging

A simplified, smaller application, *nanoq* requires no user interaction, shares much of the same functionality (excluding network capability) by placing the computer in 'target-mode' with no disk-write ability. The target drive is then safely accessible via USB cable connected to the analyst's computer.

winterCUB – safe forensic access

The *winterCUB* application, running on the analysts' Windows computer, guarantees full, read-only access to storage media accessible to the target machine. Support for software RAIDs (such as Intel's Rapid Storage Technology) and Microsoft Dynamic drives is included. Data transfer via USB cable is handled asynchronously allowing multiple drives to be imaged/accessed simultaneously. The *arcticBear*/*nanoq* solutions negate the need for expensive hardware to access storage devices. Since the hardware interface for devices are provided by the computer in which they reside, the software is fully extensible.





The *winterBear* application is an alternative to *arcticBear*/*nanoq* for data extraction of 'live' Windows based computers. All mounted volumes are made available read-only, including Microsoft Dynamic drives (RAID) and open, encrypted stores. In the case of BitLocked drives, the active protectors are exposed, including recovery keys. The *winterBear* application exposes open BitLocked drives as unencrypted data. When the parent drive is imaged, for example, unencrypted data from the BitLocked volume will be captured. Physical memory is also accessible.

Forensic Tool Suit

The Arctic Forensics project includes several Windows forensic tools to perform dedicated tasks. Instead of monolithic, expensive software solutions, Arctic Forensics tools are targeted. For example, the *snowyOwl* application parses the Windows Jump List (calculating AppId's instead of relying on AppId lists). The narwhal tool extracts useful information from the Windows Registry (including user password hashes), and *snowGoose* natively exposes audio/video media from Hikvision and RayShark (Swann) digital video recorders. The *arcticFox* tool is a highly effective software write-blocker.

FREE

All software provided by Arctic Forensics is free, based solely on OpenSource code, and published under the GNU General Public License. Software and basic instructions are provided via http://arcticforensics.mybluemix.net/. The Arctic Forensics project aims to benefit forensic analysts, not corporations.

* Transfer cables using the Prolific PL25A1 (USB 2) and PL27A1 (USB 3.0) chipsets are the only ssupported USB Host-to-Host Bridges.

ANZFSS Brisbane 2022

Donna MacGregor
Griffith University/Queensland Police Service, Chair of Organising Committee for ANZFSS 2022

Greetings from Queensland and the 2022 ANZFSS Organising Committee!

As we near the end of 2021 and reflect back on the year, we acknowledge that it has been another year of uncertainties on both local and national levels thanks to the ongoing effects of the pandemic. No one knows what new challenges 2022 will bring, but we on the organising committee are optimistic that with vaccination rates across the country increasing and state borders slowly opening up, that 2022 will be a better year for all.

Regardless of whatever next year throws at us, the one thing we are all confident about is that the 25th International ANZFSS symposium will be going ahead at the Hilton Hotel, Brisbane City between the 11 and 15th of September, 2022.

Planning for the symposium is progressing well and gaining momentum. Our plenary speakers are locked in. The call for abstracts has gone out and the portal is now open for submissions. The call for workshops opened in November. Super early bird registrations will open in February. We are excited that we can offer the first 200 registrations at the 2018 rate of $1300. The registration fee includes four days of scientific program with morning tea, lunch and afternoon tea provided; the welcome drinks function; a catered theme night and the symposium dinner. The venue for the symposium dinner will be the main auditorium at Brisbane City Hall. And for the 2022 symposium, we will be offering for the first-time, a wellness program in conjunction with Goodlife gyms, also included in your registration.

For all symposium updates please see our official webpage at www.anzfss2022.com

www.facebook.com/ANZFSS2022/

@anzfss2022

@anzfss_2022

For all enquires including sponsorship or exhibitor packages, please contact the organising committee at anzfss2022@encanta.com.au

IAFS 2023 – A Pathway towards a Memorable Meeting!

Distinguished Professor Claude Roux
President, International Association of Forensic Sciences, University of Technology Sydney

Key Dates

- **Call for Abstracts Open:** Wednesday 12 October 2022
- **Call for Abstracts Deadline:** Wednesday 8 February 2023
- **Super Early Bird Registration Open:** Monday 14 November 2022
- **Super Early Bird Registration Deadline:** Tuesday 13 December 2022
- **Early Bird Registration Deadline:** Wednesday 21 June 2023
- **Author Registration Deadline:** Wednesday 21 June 2023
- **Meeting Dates:** 20 – 24 November 2023

For any queries, please contact the IAFS 2023 Meeting Managers via iafs2023@arinex.com.au or visit www.iafs2023.com.au

Stay up-to-date with all the latest information by joining the IAFS mailing list.

Join the conversations:

www.facebook.com/IAFS2023/

@iafs2023

The Forensic Exhibit.
Events Calendar

2022

FEBRUARY

74th The American Academy of Forensic Sciences (AAFS) Annual Scientific Conference

21-25 February 2022

Seattle, Washington

https://aafs.org

MAY

9th European Academy of Forensic Science Conference (EAFS)

30 May – 3 June 2022

Stockholm, Sweden

https://www.eafs2022.eu/

JUNE

New South Wales Fingerprint Experts Conference

8 – 9 June 2022

Sydney, Australia

AUGUST

29th Congress of the International Society for Forensic Genetics (ISFG)

29 August – 2 September 2022

Washington, DC

http://www.isfg2021.org

SEPTEMBER

25th International Symposium of the Australian and New Zealand Forensic Science Society (ANZFSS)

11 – 15 September 2022

Brisbane, Australia

http://www.anzfss2022.com/

2023

NOVEMBER

23nd Triennial Meeting of the International Association of Forensic Sciences (IAFS) in conjunction with the 26th Symposium of the Australian and New Zealand Forensic Science Society (ANZFSS)

20 – 24 November 2023

Sydney, Australia

https://iafs2023.com.au/

#IAFS2023

The Forensic Exhibit.
More information

Acknowledgement of Country

ANZPAA NIFS acknowledges Aboriginal and Torres Strait Islanders are Australia's first peoples and the traditional owners and custodians of the land on which we work. ANZPAA NIFS is committed to fulfilling the principles of New Zealand's founding document The Treaty of Waitangi (Te Tiriti o Waitangi). Central to the principles is a common understanding that all parties will relate and participate with each other in good faith with mutual respect, co-operation and trust.

The Forensic Exhibit is committed to fulfilling the intent of international treaties and human rights legislation applicable to the various jurisdictions in which we operate, our obligations to Aboriginal and Torres Strait Islander peoples, and the principles of the New Zealand (Aotearoa) Treaty of Waitangi (Te Tiriti o Waitangi).

Newsletter contributions

If you would like any further information on ANZPAA NIFS or would like to contribute to the next edition of *The Forensic Exhibit* please contact ANZPAA NIFS Secretariat: secretariat.nifs@anzpaa.org.au

Contact us

ANZPAA NIFS
Victoria Police Centre
GPO Box 913
MELBOURNE VIC 3001
secretariat.nifs@anzpaa.org.au
www.nifs.org.au

Follow us on Twitter:
@NIFS_ANZ

ANZPAA
Australia New Zealand Policing Advisory Agency

NIFS
National Institute of Forensic Science Australia New Zealand