Forensic Science Honours Projects: Autumn 2020

AS OF 29 SEPTEMBER
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General information

The project proposals listed in this booklet are available to students enrolling in the Bachelor of Forensic Science (Honours) (C09100) and Master of Science (Honours) (C04267) / Master of Philosophy in Forensic Science (C04393) courses. All of the listed projects are designed to run for a standard 37 week academic calendar year. Autumn intake projects commence on Monday 24 February 2019.

In Honours, students will gain direct training in the skills required for undertaking research in forensic science as well as further developing their investigative and communication skills. Honours degrees offer the opportunity for students to undertake a research project within one of the research groups at UTS or collaboratively with an external organisation. The aim of the Honours program is to produce professional forensic scientists with highly adaptable and practical scientific skills.

Application & Admission

There are two application processes for Honours courses in the Faculty of Science and these are course specific. For further information and to download the forms, visit https://www.uts.edu.au/future-students/science/science-courses/honours-courses.

Bachelor of Forensic Science (Honours) applicants will need to apply to the course by submitting a UTS Direct Application Form. Direct application forms are due by 28 November 2019.

Master of Science (Honours) / Master of Philosophy in Forensic Science applicants will need to lodge an internal course transfer request with the Student Centre to transfer from their Master of Science / Master of Forensic Science coursework degree. Internal course transfer requests for Autumn commencement must be made by 15 November 2019.

Applicants to both courses will also need to submit the supplementary Faculty of Science Honours application form with their top three (3) project preferences listed in order. You only need to complete sections 1-5. Prospective students are encouraged to speak to potential UTS supervisors before selecting their projects (contact details are listed on each project proposal). Faculty of Science supplementary application forms must be submitted to science.maps@uts.edu.au (cc to the Program Director, xanthe.spindler@uts.edu.au) by the dates listed above.

Successful applicants to both Honours degrees must have completed a UTS-recognised bachelor’s degree in forensic science at an appropriate level. Applicants to the Bachelor of Forensic Science (Honours) course must have attained at least a credit average (≥ 65) over the final two-thirds of their undergraduate program. Successful applicants to the Master of Philosophy course should demonstrate exceptional academic achievement and research potential to be considered for enrolment. Applicants typically complete 48 cp of coursework (1 year full time equivalent) prior to commencing their research project.

More detailed information on the course structure and international admission requirements can be found in the UTS Handbook.
Bachelor of Forensic Science (Honours)

The course comprises 48 credit points of study, consisting of two academic stages. The major component of the course (75%, 36 cp) is a research project that extends over the full duration of the course and normally takes the form of an experimental investigation. The project is undertaken within one of the research groups at UTS in the area of forensic science. Projects may also be undertaken in collaboration with an external partner. Projects are chosen by the student, although first preferences cannot always be accommodated. As part of the project, students undertake a critical review of the existing literature in their research area and develop a research plan for the year.

The results of the project are presented in an oral seminar and in a written thesis, both of which are formally assessed. The remaining 12 credit points of study are coursework: Expert Evidence Presentation in Autumn semester and Criminology and Policing in Spring semester. Students may enrol in the course for Autumn or Spring intake.

Students who have completed the Bachelor of Forensic Biology (Biomedical Science) will receive credit recognition for 65863 provided they have successfully completed 79028 Complex Forensic Cases (Law for Biology) or previously completed 65863 in place of 79028. Students must apply for credit recognition upon enrolment with Student Centre.

Master of Science (Honours) / Master of Philosophy in Forensic Science

The Master of Philosophy provides students with a unique opportunity to undertake original research and gain in-depth knowledge in their chosen discipline of forensic science. The project is undertaken within one of the research groups at UTS in the area of forensic science. Projects may also be undertaken in collaboration with an external partner. This course is designed to provide a scholarship pathway to the PhD program.

The course requires 96 credit points of study, comprising 24 credit points of professional stream subjects, a 24 cp major and a 48 cp intensive research component. The Honours research project extends over the final year and normally takes the form of an experimental, analytical or theoretical investigation. As part of the project, students undertake a critical review of the existing literature in their research area and develop a research plan for the year. The results of the project are presented in an oral seminar and in a written thesis, both of which are formally assessed.

Please note that project availability is subject to change after the publication of this booklet. It is worth speaking to prospective supervisors as new projects may become available. A second edition of this book containing new projects will be published in mid-October. You are advised to wait until this second edition is released before finalising your application.
Commencing your Honours project

The Honours project accounts for most or all of your study load for academic year and will involve active experimental work, data analysis, reading literature, and writing. UTS safe work practices and the Faculty of Science after hours work procedures encourage you to complete your laboratory work during core office hours (weekdays 9 am – 5pm) whenever possible. If you do need to perform experimental work out-of-hours you should discuss any arrangements with your supervisor.

There is no set number of hours you need to be on campus or weekly timetable for research (except for timetabled coursework), although we tend to advise 36cp students to be research-active the equivalent of 4 working days per week and 48cp students to be research-active 5 working days per week. What you gain from your Honours year is proportional to the effort you are willing to make. Most research groups have regular progress meetings that involve project updates and paper reviews or presentations. The Centre for Forensic Science also holds regular research seminars and meetings that are compulsory for research students.

You are expected to work with your supervisor to prepare a project plan in the initial weeks of semester. Laboratory inductions and the risk management plan should be completed during the first two weeks of your project as these processes are essential for gaining security access. Your supervisor can provide you further guidance on how to schedule and complete your induction and risk management plan.

Each Honours research thesis subject will have an UTSOnline (Canvas for Master of Philosophy) page that will be updated with the subject outline and research support materials. It will also be the primary route of contact for the Honours program director to update you on upcoming seminars, events, and assessments.

Please note that the supervisory panels listed for each project are indicative only. Your supervisory panel may change closer to the commencement of your project.
Title | Development of an automatic firearms recognition system to identify firearms in CCTV and still images.

Description of problem work is intended to address | Forensic Ballistics Investigation Section (FBIS) examiners are required to view still images and CCTV footage to provide advice to investigators as to the type of firearm, often by make and model, that a person is holding in the footage.

Whilst identification back to an individual firearm is often not possible, the examiner may be in a position to provide advice to investigators as to the possible type of firearm present in the images.

Members of FBIS attended a workshop on Photometry at the 2019 Association of Firearm and Toolmark Examiners (AFTE) conference in Nashville Tennessee. From this workshop, the idea for this project was formulated for possible development in the future.

Outline of goals/objectives | The scope of this project would be extremely large and possibly very complex; however, as a proof-of-concept, the student would be required to 3D scan a small sub-set of firearms, develop some form of software that can compare the scanned 3D images to a number of ‘staged’ images of a person carrying a firearm created by the student.

If this concept proved viable, further large scale projects could possibly be undertaken in conjunction with UTS, the Forensic Imaging Section and FBIS.

Special requirements | 3D scanner,
Supervised access to the FBIS Firearms Reference Library,
Computer and software equipment.

Industry/external partner | NSWPF FBIS

UTS supervisor | TBC. Please contact the Honours coordinator (Xanthe.Spindler@uts.edu.au) for further information

External supervisor | S/O Matthew Bolton

This project is suitable for graduates of the following discipline areas:

- [ ] Biology
- [ ] Chemistry
- [x] Crime Scene
- [x] Digital
Criminalistics
**Bachelor of Forensic Science (Honours) and Master of Philosophy (Forensic Science)**

Project keywords: Image analysis, physical characteristics (biometrics), Foetal alcohol spectrum disorders

<table>
<thead>
<tr>
<th>Title</th>
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<tr>
<td>Impact of pre-natal alcohol consumption on historical criminal activity: faces of foetal alcohol spectrum disorder in archival ‘mugshots’</td>
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</table>

This project will investigate the impact that pre-natal alcohol consumption played in early twentieth-century criminal offending by examining digital images of individuals incarcerated in New South Wales for facial markers of foetal alcohol spectrum disorders (FASD). This will be a world-first study of the extent to which the contemporary relationship observed between FASD and criminal offending was present historically, one uniquely enabled by the high-quality mugshots preserved by the Sydney Police & Justice museum and the NSW State Record Office. This will be part of a larger project investigating the impact of alcohol on criminal behaviour, with the historical nature of the records involved providing unprecedented opportunities to study this issue from an intergenerational and life-course perspective.

<table>
<thead>
<tr>
<th>Nature of problem work is intended to address</th>
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<tr>
<td>The project aims to increase public awareness of FASD through community-facing outcomes such as a curated exhibit at the Police &amp; Justice Museum, media pieces etc. In particular it will offer a means to draw attention to the many individuals who remain undiagnosed due to their subtle physical indicators and lack of screening by diagnostic services for the criminal justice system. It is also hoped that documenting a methodology for FASD analysis of records not specifically created for diagnostic purposes will have flow-on benefits for refining this diagnostic process. This work will provide guidelines to assist in establishing consistency for the visual characteristics that are pathognomic of adult FASD by helping to standardize and refine these criteria.</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Industry/external partner</th>
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<tbody>
<tr>
<td>Sydney Police and Justice Museum; NSW State Records.</td>
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<table>
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<tr>
<th>Special requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. Alana Piper (public history, FASS)</td>
</tr>
<tr>
<td>Dr. Tamara Sztynda (Life Sciences) (<a href="mailto:Tamara.Sztynda@uts.edu.au">Tamara.Sztynda@uts.edu.au</a>)</td>
</tr>
</tbody>
</table>

<table>
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<tr>
<th>UTS supervisors</th>
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</thead>
<tbody>
<tr>
<td>Dr. Alana Piper (public history, FASS)</td>
</tr>
<tr>
<td>Dr. Tamara Sztynda (Life Sciences) (<a href="mailto:Tamara.Sztynda@uts.edu.au">Tamara.Sztynda@uts.edu.au</a>)</td>
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<table>
<thead>
<tr>
<th>External supervisor</th>
</tr>
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<tbody>
<tr>
<td>This project is suitable for graduates of the following discipline areas:</td>
</tr>
<tr>
<td>☒ Biology</td>
</tr>
</tbody>
</table>
Bachelor of Forensic Science (Honours)

Project keywords: dating, weathering, interpretation, fibres

<table>
<thead>
<tr>
<th>Title</th>
<th>The degradation of rayon in multi-purpose cloths in different soil types within the Sydney region</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nature of problem work is intended to address</td>
<td>The Chemical Criminalistics Unit of the NSW Forensic &amp; Analytical Science Service was recently asked to examine a multi-purpose cloth found at the scene of a deceased person. It is believed that the death occurred some years before. The cloth was compared to two packets of the same type of cloth (unused), both of which contained rayon; however, the evidential cloth was found not to contain this fibre type. The scientist was asked if the rayon could have degraded such that it was no longer observed during examination. It would be expected that a student undertaking this case would need minimal assistance in term of laboratory resources, UTS having the necessary resources available (a range of multi purpose cloths (e.g. Chux style) would need to be purchased and evaluated, soil samples would be required); minimal commitment by the external supervisors would be required (~1 hr a week, mostly concentrated in the initial and final stages)</td>
</tr>
<tr>
<td>Outline of goals/objectives</td>
<td>To study the degradation of rayon in rayon containing multi-purpose cloths in different soil types.</td>
</tr>
<tr>
<td>Industry/external partner</td>
<td>NSW Forensic &amp; Analytical Science Service, Chemical Criminalistics Unit</td>
</tr>
<tr>
<td>Special requirements</td>
<td>N/A</td>
</tr>
</tbody>
</table>
| UTS supervisors | A/Prof Barbara Stuart (Barbara.Stuart@uts.edu.au)  
Dr Maiken Ueland  
Prof Claude Roux  
Dr Simone Gittelson |
| External supervisor | Connie Aldaba |

This project is suitable for graduates of the following discipline areas:

- [ ] Biology  
- [x] Chemistry  
- [ ] Crime Scene  
- [ ] Digital
# A Survey of the Background Presence of GSR on ‘Random’ Man

## Nature of problem work is intended to address
The FASS Chemical Criminalistics Units analyses a large number of cases involving gunshot residue. The analysis is often requested to assist in determining whether or not someone has had a firearms association. There are no current surveys that can assist in determining the background GSR population on the clothing and hands of people in both country and metropolitan NSW. Knowing this would assist in the interpretation of GSR casework and enable the decision makers, i.e. the courts, to understand the relevance of the GSR evidence in a given set of circumstances.

## Outline of goals/objectives
To determine the background level of GSR present on the clothing and hands of ‘random’ man from country and metropolitan NSW.

## Industry/external partner
NSW Forensic & Analytical Science Service, Chemical Criminalistics Unit

## Special requirements
Access to an SEM at UTS would be required.

## UTS supervisors
TBC. Please contact the Honours coordinator (Xanthe.Spindler@uts.edu.au) for further information.

## External supervisor
Nadine Krayem

This project is suitable for graduates of the following discipline areas:

- [ ] Biology  
- [x] Chemistry  
- [ ] Crime Scene  
- [ ] Digital
Project keywords: Cleaning products; Protocol; Database; GCMS; IC

<table>
<thead>
<tr>
<th>Title</th>
<th>Identification of cleaning product residues on clothing</th>
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<tbody>
<tr>
<td>Nature of problem work is intended to address</td>
<td>The FASS Chemical Criminalistics Unit is often asked to identify whether or not cleaning products e.g. bleach, household sprays, laundry powders, have been used to clean clothing and other textiles. Currently GCMS and IC are the primary techniques used to look for such residues. A protocol for the identification of the presence of cleaning products would assist in casework. In addition, a preliminary database of the most commonly occurring components found in cleaning products would further assist with the interpretation of findings in such casework.</td>
</tr>
<tr>
<td>Outline of goals/objectives</td>
<td>(i) To produce a protocol for the identification of cleaning products residues on clothing and textiles (ii) To produce a preliminary database of the commonly occurring components found in readily available cleaning products.</td>
</tr>
<tr>
<td>Industry/external partner</td>
<td>NSW Forensic &amp; Analytical Science Service, Chemical Criminalistics Unit</td>
</tr>
<tr>
<td>Special requirements</td>
<td></td>
</tr>
<tr>
<td>UTS supervisors</td>
<td>Dr Scott Chadwick (<a href="mailto:Scott.Chadwick@uts.edu.au">Scott.Chadwick@uts.edu.au</a>)</td>
</tr>
<tr>
<td>External supervisor</td>
<td>Dr Jo Bunford / Peter Ballard</td>
</tr>
</tbody>
</table>

This project is suitable for graduates of the following discipline areas:

- [ ] Biology
- [x] Chemistry
- [ ] Crime Scene
- [ ] Digital
Bachelor of Forensic Science (Honours) and Master of Philosophy (Forensic Science)

Project keywords: GCMS; Body products; Analysis; Solvent extraction; Optimisation

<table>
<thead>
<tr>
<th>Title</th>
<th>A protocol for locating, extracting, analysis and identifying traces of personal care products on clothing.</th>
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**Nature of problem work is intended to address**

The Chemical Criminalistics Unit of the NSW Forensic & Analytical Science Service has recently had a number of requests in which the analysis of clothing for body oils, lotions or cosmetics was requested. Currently solvent extraction followed by gas chromatography-mass spectrometry is most commonly used for such testing. This project would assist us in optimising the sensitivity of our testing regime in case involving these products and potentially determine additional testing or equipment that could be used.

It is envisaged that the work would be publishable, assisting the wider forensic community to produce protocols of their own for examination of such cases.

It would be expected that a student undertaking this case would need minimal assistance in term of laboratory resources: the laboratories at UTS have the necessary analytical equipment available; minimal and inexpensive materials (a variety of lotion, oil and cosmetic samples, and different fabric types) would be needed to prepare samples for testing and analysis; minimal commitment by the external supervisors would be required (~ 1 hr a week, mostly concentrated in the initial and final stages).

**Outline of goals/objectives**

To determine the best available technique(s) for determining the presences of traces of body lotion/oils and cosmetics etc on clothing, and their subsequent extraction, analysis and identification within the CCU.

**Industry/external partner**

NSW Forensic & Analytical Science Service, Chemical Criminalistics Unit

**Special requirements**

UTS supervisors: Dr Scott Chadwick (Scott.Chadwick@uts.edu.au)

External supervisor: Dr Jo Bunford

This project is suitable for graduates of the following discipline areas:

- ☐ Biology
- ☒ Chemistry
- ☐ Crime Scene
- ☐ Digital
<table>
<thead>
<tr>
<th>Title</th>
<th>Development of a Class Characteristic database for saws and other cutting implements in bone.</th>
</tr>
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<tbody>
<tr>
<td><strong>Description of problem work is intended to address</strong></td>
<td>Forensic Ballistics Investigation Section (FBIS) examiners periodically undertake toolmark case work to examine bone(s) from homicide victims. The examination involves making test cuts of exhibit tools and comparing these to the marks on the bone. Whilst identification back to an individual tool is often not possible, the examiner may be in a position to provide advice to investigators as to the possible class of tool used. Members of FBIS attended a workshop on Toolmarks in Bone and Cartilage at the 2019 Association of Firearm and Toolmark Examiners (AFTE) conference in Nashville Tennessee. From this workshop, the idea for this project was formulated for possible development in the future.</td>
</tr>
<tr>
<td><strong>Outline of goals/objectives</strong></td>
<td>The student would be required to cut ‘dry’ and ‘wet’ bone using a number of different hand and electric saws and take Isomark (or another suitable casting medium) of the cut region in order to develop a physical database that can be used at FBIS to provide advice on the class of tool used. It may also provide some indication of the different cutting actions involving ‘wet’ and ‘dry’ bone and if the state of the bone affects the class characteristics. The second objective would be to compare Isomark, Microsil and any other casting mediums to determine which produces the best results for comparison examinations.</td>
</tr>
<tr>
<td><strong>Special requirements</strong></td>
<td>The student will need a number of bones (cow, sheep etc.) that would sufficiently replicate human bone (i.e. femur, humerus) and a number of hand and electric saws to cut the bone. The student will need Isomark, Microsil and other suitable casting medium for the second phase of this project.</td>
</tr>
<tr>
<td>Industry/external partner</td>
<td>NSWPF FBIS</td>
</tr>
<tr>
<td>UTS supervisor</td>
<td>TBC. Please contact the Honours coordinator (<a href="mailto:Xanthe.Spindler@uts.edu.au">Xanthe.Spindler@uts.edu.au</a>) for further information</td>
</tr>
<tr>
<td>External supervisor</td>
<td>S/O Tim Berry and S/O Matthew Bolton</td>
</tr>
</tbody>
</table>

This project is suitable for graduates of the following discipline areas:

- Physics
- Chemistry
- Digital
Digital & Document Examination
Camera Fingerprinting in the Age of AI-Assisted Photographing

In recent years, smartphone cameras are going through a major development phase. “Who can produce the best camera” has been an arms race between major smartphone manufacturers. Multi-camera smartphones, AI-assisted photography, etc. are now commonly available features. Although such hardware and software enhancement can produce really cool images and videos, the impact of such positive change on camera forensics is not yet clear.

This project aims to study the effectiveness of a popular camera forensics technique, the PRNU-based camera fingerprinting, for such a high-end recently available camera. The PRNU-based method is a very effective method to compute the camera fingerprint from a handful of images (or video frames) without even physically accessing the camera. This method is very useful to verify or identify the source camera of a crime image.

<table>
<thead>
<tr>
<th>Outline of goals/objectives</th>
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<tbody>
<tr>
<td>• Study the effectiveness of the PRNU-based method for a multi-camera smartphone</td>
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<tr>
<td>• Study the effectiveness of the PRNU-based method for AI-assisted photography</td>
</tr>
<tr>
<td>• Study the effectiveness of the PRNU-based method for highly edited images and videos (e.g., TikTok videos)</td>
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<tr>
<td>• Create a dataset of images (can be edited) taken under various camera settings.</td>
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</table>

This project is suitable for graduates of the following discipline areas:

- [ ] Biology  
- [ ] Chemistry  
- [x] Digital  
- [ ] Crime Scene

**Special requirements**

**UTS supervisor** Manoranjan Mohanty (Manoranjan.Mohanty@uts.edu.au)

**External supervisor**

**Primary contact** Manoranjan Mohanty
<table>
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<th>Title</th>
<th>Fake Label Detection</th>
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<tr>
<td>Description of problem work is intended to address</td>
<td>In today’s world market, fake product circulation is one of the major issues. One of the popular ways of releasing a fake product into the market is by faking the label (putting a misleading label on a low-quality product for distributing it as a high branded product). For example, as per a media report, almost a third of food products are labeled incorrectly. Recently, a watermarking-based method has been proposed to detect fake labels. In this scheme, a watermarking can be inserted to a genuine label by the producer of the product. The buyer of the product can then establish the genuineness of the product by finding out if the genuine watermark is present on the picture (taken in a specific viewpoint) of the label. This watermark detection is done using biosequence analysis, which can find (i) if the watermark is from the original label, (ii) if the watermark is from a copy of the label, or (iii) there is no watermark on the label. This project aims to study the effectiveness of this biosequence-based method in a more real-world-like setup, e.g., when the label is pictured from different camera angles and under different lighting conditions.</td>
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</tbody>
</table>
| Outline of goals/objectives | • Study the effectiveness of the biosequence-based method from different camera angles  
• Study the effectiveness of the biosequence-based method under different lighting conditions  
• Create a dataset of watermarked-labels (both genuine and fake) photographed from different camera angles and under lighting conditions. |
| Special requirements | |
| Industry/external partner | Manoranjan Mohanty (Manoranjan.Mohanty@uts.edu.au)  
Dennis McNevin |

This project is suitable for graduates of the following discipline areas:

- [ ] Biology
- [ ] Chemistry
- [ ] Crime Scene
- [☒] Digital
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<thead>
<tr>
<th>Title</th>
<th>Error rate determination of pen lift, speed and direction in document examination experts.</th>
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<td>With attention in recent years being drawn to the validity and robustness of the scientific methodologies in forensic disciplines, the requirement to produce scientifically sound and determined rates of error is an increasing requirement for presentation of evidence in court.</td>
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<td>Although some small studies of the accuracy of overall forensic document examination have been published, little information exists into the error rates or accuracy determined by each individual inferred dynamic feature.</td>
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<tr>
<td></td>
<td>This project aims to ascertain how well forensic document examiners can determine pen lift, pen speed and pen direction, with a determination of overall accuracy and error rate for each inferred dynamic feature.</td>
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<td>• Capture ground truth data from handwriting samples from a variety of individuals in regard to pen lift, speed and direction</td>
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<td></td>
<td>• Provide these samples to forensic document examiners for forensic analysis</td>
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<tr>
<td></td>
<td>• Compare results from forensic document examiners back to the ground truth data</td>
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<tr>
<td></td>
<td>• Determine error rate and accuracy</td>
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<td></td>
<td>• Analyse data to identify sources of error if possible</td>
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<thead>
<tr>
<th>Industry/external partner</th>
<th>NSW Police Force</th>
</tr>
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<tbody>
<tr>
<td>Special requirements</td>
<td>Software capable of capturing handwriting ‘ground truth’ data, e.g. MovAlyzeR. <a href="https://neuroscript.net/movalyzer.php">https://neuroscript.net/movalyzer.php</a></td>
</tr>
<tr>
<td>UTS supervisors</td>
<td>TBC. Please contact the Honours coordinator (<a href="mailto:Xanthe.Spindler@uts.edu.au">Xanthe.Spindler@uts.edu.au</a>) for further information.</td>
</tr>
<tr>
<td>External supervisor</td>
<td>Sgt. Dean Swift (Document Examination Unit, NSW Police Force)</td>
</tr>
</tbody>
</table>

This project is suitable for graduates of the following discipline areas:

- [ ] Biology
- [x] Chemistry
- [x] Crime Scene
- [ ] Digital
Fingerprint Detection
Exploring the relationship between substrate chemistry and fingermark detection

We still have a very limited understanding of how fingermarks interact with the underlying substrate. This is especially problematic for fingermarks on paper and some plastics, as the composition of the substrate has a substantial impact on successful fingermark detection. In order to improve processes such as physical developer, we need to identify the major chemical and physico-chemical influences on development quality (e.g. background staining).

There are a variety of analytical techniques available for studying and imaging the inorganic and organic composition of substrates and/or fingermarks: microscopy, UV-visible spectrophotometry, FTIR microspectroscopy, Raman microspectroscopy, laser ablation ICP-MS, SEM energy dispersive X-ray spectroscopy, and thermogravimetry-GC-MS. These results can then be correlated to the quality of the detected fingermarks to determine the factors that have the greatest impact on enhancing latent fingermarks.

This project is part of a larger study on the effects of the substrate on fingermark deposition and development. The specific objectives of this project are to:

1. Characterise a variety of common paper products;
2. Develop and assess fingermarks on these products using standard chemical and metal deposition techniques; and
3. Identify potential elements or components that have the largest impact on fingermark deposition and detection.

Successful completion of this project will lead to publication and presentation of results at international conferences.

**Industry/external partner**

N/A

**Special requirements**

Students will need to select 1-2 analytical techniques to focus on in consultation with the supervisory panel.

**UTS supervisors**

Xanthe Spindler (Xanthe.Spindler@uts.edu.au)

Other supervisors TBC depending on chosen techniques

**External supervisor**

This project is suitable for graduates of the following discipline areas:

- ☑ Biology
- ☑ Chemistry
- ☐ Crime Scene
- ☐ Digital
### Title
Impact of De-sticking Agents on Latent Fingermark Development and Adhesive Analysis.

### Description of problem work is intended to address
In certain cases involving adhesive tapes, the adhesive may need to be removed from a surface using different types of de-sticking agents. A number of studies have found that these de-sticking agents have no negative impact on fingermark enhancement, however most of these studies have been conducted in the US and Australian Adhesive tapes have shown to have different compositions to US tapes. Similarly these studies have also focussed on the fingermark development, not the subsequent analysis and classification of the tape.

Previous research conducted at UTS and FASS has explored the impact that different fingermark chemicals have on the subsequent tape analysis. This work found that cyanoacrylate had a negative impact on rubber adhesive tape analysis by FTIR, whereas WetWop had no negative impact on any type of tape. With the addition of the de-sticking agents, this may further alter the results.

### Outline of goals/objectives
The aim of this work is to:
- Test a range of different de-sticking agents on their ability to remove adhesives from a range of surfaces
- Determine the impact (if any) these de-sticking agents have on subsequent tape or fingermark analysis

### Special requirements
Student should have experience in using FTIR and understand a range of different fingermark development techniques.

### Industry/external partner
Dr Joanna Bunford (NSW Health Forensic and Analytical Science Services)

### UTS supervisor
Dr Scott Chadwick (scott.chadwick@uts.edu.au)

### External supervisor
Dr Joanna Bunford

This project is suitable for graduates of the following discipline areas:
- [ ] Biology
- [x] Chemistry
- [x] Crime Scene
- [ ] Digital
# Title

**Biodegradable plastics and the impact on fingermark development**

As single-use plastics are being phased out, there is a rise in the number of recycled, biodegradable and reusable plastic bags present on the market. Previous studies that have looked into developing fingermarks on plastic bags, have shown that the chemical composition of the plastic has a significant impact on the quality of fingermarks developed as well as the preferred technique.

Since these new plastics are untested for fingermark development, there is a need for studies to look into how these new plastics may affect the quality of fingermarks detected as well as the preferred techniques.

## Outline of goals/objectives

The aim of this work is to:

- Test a range of different recycled, biodegradable and reusable plastics bags to determine the best fingermark development procedure for each category.

- Student should have experience in using FTIR and understand a range of different fingermark development techniques.

## Special requirements

Student should have experience in using FTIR and understand a range of different fingermark development techniques.

## Industry/external partner

**UTS supervisor**

Dr Scott Chadwick ([scott.chadwick@uts.edu.au](mailto:scott.chadwick@uts.edu.au))

Dr Sebastien Moret ([Sebastien.Moret@uts.edu.au](mailto:Sebastien.Moret@uts.edu.au))

**External supervisor**

N/A

This project is suitable for graduates of the following discipline areas:

- ☐ Biology
- ☑ Chemistry
- ☑ Crime Scene
- ☐ Digital
**Title**
Encapsulation of various luminescent dyes into SiO$_2$ nanoparticle for fingermark detection

**Description of problem work is intended to address**
Interference from substrate chemistries and background luminescence is a major drawback of current fingermark detection methods. This project will address this issue through the development and validation of SiO$_2$-based nanoparticles that have versatile optical properties that can be tuned to meet optical requirements by introducing a luminescent dye in their inner structure and studying their interaction.

**Outline of goals/objectives**
The aim of this project is to:
- Synthesis SiO$_2$ nanoparticles with different dyes
- Study the encapsulation of the dye molecules within the SiO$_2$ matrix
- Compare various dyes and find the ideal one for fingermark detection

Successful completion of this project will lead to publication and presentation of results at international conferences.

**Special requirements**
N/A

**Industry/external partner**
N/A

**UTS supervisor**
Dr Fehmida Kanodarwala (Fehmida.Kanodarwala@uts.edu.au)
Dr Sebastien Moret

**External supervisor**
N/A

This project is suitable for graduates of the following discipline areas:

- [ ] Biology
- ☒ Chemistry
- [ ] Crime Scene
- [ ] Digital
# Assessment of chromium-doped zinc gallogermanate as a IR fluorescent finger-mark powder suspension

Powder suspensions consist of a fine powder dispersed through a concentrated detergent and wetting agent solution. Initially used for treating adhesive surfaces, powder suspensions are also effective at developing finger-marks on general non-porous and semi-porous substrates. The use of these such powders has grown in popularity over recent years, as more substrates that are rendered unsuitable for processing with regular fingerprint powder, produce suitable developed latent finger-marks with powder suspensions.

Iron Oxide and Carbon-base powder suspensions will produce a black finger mark and titanium dioxide-based powder suspension will produce white marks. Development of only white or black finger-marks on substrates limits the applications of these powder suspensions. Investigation and development of a fluorescent powder suspension is required to widen the variety of substrates upon which powder suspensions can be applied, especially in response to patterned or textured substrates. Chromium-doped zinc gallogermanate is one such substance that appears to be promising as an in-field fluorescent powder suspension formulation, given its low IR excitation requirements.

Pfund  
King & Skros (2017)  
Sunlight-activated near-infrared phosphorescence as a viable means of latent fingermark visualisation.pdf

## Outline of goals/objectives

- To investigate chromium-doped zinc gallogermanate as a suitable compound for use within a powder suspension formulation.
- To research and compare against other fluorescent compounds suitable for powder suspensions
- Record and assess latent finger-mark development
- Comment on environmental and cost applications for consideration by law enforcement
- Realistic application of ‘in field’ techniques to be observed
- Application testing on known difficult substrates – DVD’s/CD’s (with/without impact on data recovery), dashboards, carbon fibre vinyl car wrap.

<table>
<thead>
<tr>
<th>Industry/external partner</th>
<th>NSW Police Force</th>
</tr>
</thead>
<tbody>
<tr>
<td>Special requirements</td>
<td>Appropriate equipment to synthesise the chromium-doped zinc gallogermanate powder</td>
</tr>
<tr>
<td>UTS supervisors</td>
<td>TBC. Please contact the Honours coordinator (<a href="mailto:Xanthe.Spindler@uts.edu.au">Xanthe.Spindler@uts.edu.au</a>) for further information.</td>
</tr>
<tr>
<td>External supervisor</td>
<td>Nicholas Harvey Walker (Crime Scene Services Branch), Lauren Atwood (Science and Research Unit)</td>
</tr>
</tbody>
</table>

This project is suitable for graduates of the following discipline areas:

- [ ] Biology
- [x] Chemistry
- [x] Crime Scene
- [ ] Digital
Forensic Interpretation
Bachelor of Forensic Science (Honours) and Master of Philosophy (Forensic Science)

Title: Phalange Ridge Flow Trends

Nature of problem work is intended to address:

Unlike finger tips, the friction ridge patterns or characteristics on the phalanges has been little studied. Although the friction ridge flow on the phalanges is reported to have some common universal trends, the evidence for this is largely anecdotal. A comprehensive study investigating phalange ridge flow would answer this question and provide valuable information for searching and matching friction ridge detail when impressions recovered from crime scenes capture ridge detail from the phalanges.

Outline of goals/objectives:

Determine whether consistent universal trends exist in the ridge flow found on the phalanges of the fingers.

Industry/external partner:

NSWPF Fingerprint Operations Branch

Special requirements:

At this stage it is envisaged that the student will be required to collect inked impressions from a large number of donor sources that specifically capture phalange data (as record Ten-Print forms, although potentially useful, are generally limited in the amount of captured phalange friction ridge skin).

UTS supervisor:

TBC. Please contact the Honours coordinator (Xanthe.Spindler@uts.edu.au) for further information.

External supervisor:

CSO Andrew Chapman

This project is suitable for graduates of the following discipline areas:

☑ Biology  ☑ Chemistry  ☑ Crime Scene  ☑ Digital
<table>
<thead>
<tr>
<th>Title</th>
<th>Bayesian networks for assessing the relative probabilities of propositions for court room evidence</th>
</tr>
</thead>
</table>
| Description of problem work is intended to address | A likelihood ratio (LR) can be produced for a single item of evidence. However, this is rarely the case. A typical criminal trial involves multiple evidence items (exhibits) and other relevant information, none of them independent in that they must be combined (by the court) to assess guilt or innocence. How can the LRs for multiple evidence items and other information be combined? A technique gaining currency is the use of Bayesian networks where the output from one or more Bayesian nodes forms the input for one or more other nodes. This allows an overall LR to be calculated for an event. For example, consider the following propositions:  
• H1: The defendant (A) handled the weapon  
• H2: The defendant (A) shook hands with another person (B) who handled the weapon  
The LR for these propositions is a combination of other pairs of propositions:  
• H3: The DNA profile (evidence) recovered from the weapon is derived from the defendant (A)  
• H4: The DNA profile (evidence) recovered from the weapon is derived from a random member of the population  
Also:  
• H5: The DNA recovered from the weapon (evidence) was a result of direct handling of the weapon by the defendant (A)  
• H6: The DNA recovered from the weapon (evidence) was a result of secondary transfer from the defendant A to person B and then from person B to the weapon  
Propositions H1 to H6 can be assembled into a Bayesian network in order to estimate an LR for H1 and H2. However, the precision of the LR depends on the data used to populate the network which may or may not be available and which may have uncertainty associated with it. Similar propositions can be considered with other traces and situations, for example gunshot residues, fibres and other microtraces, even fingermarks. Activity level evaluation has become a challenge in forensic science. |
| Outline of goals/objectives | This project will involve a theoretical exploration of Bayesian networks for forensic applications with a focus on sensitivity analysis to assess the applicability of Bayesian networks to common forensic scenarios. There is potential to team up with one of the existing PhD students in the trace evidence area.  
This project requires mathematical aptitude. |
| Special requirements |  |
| Industry/external partner |  |
| UTS supervisor | Professor Claude Roux (Claude.Roux@uts.edu.au)  
Professor Dennis McNevin (Dennis.McNevin@uts.edu.au) |
This project is suitable for graduates of the following discipline areas:

- Biology
- Chemistry
- Crime Scene
- Digital
<table>
<thead>
<tr>
<th>Title</th>
<th>The use of receiver operator characteristic (ROC) curves for analysing discrimination between probability densities as applied to Bayesian interpretation of court room evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description of problem work is intended to address</td>
<td>Receiver operator characteristic (ROC) curves are used to determine the discrimination potential of a binary classification where the classification is based on a threshold. They can be used to investigate the behaviour of the likelihood ratio (LR) applied to a particular forensic test where the LR is used as a discriminator of true support for the prosecution proposition (true positive rate) and false support for the prosecution proposition (false positive rate). The area under the ROC curve (AUC) is an indicator of the performance of the LR under various scenarios. In forensic science, this approach has been used to assess the performance of algorithms for the prediction of pigmentation traits like eye colour from genotype (<a href="https://www.sciencedirect.com/science/article/pii/S187249731100144X">https://www.sciencedirect.com/science/article/pii/S187249731100144X</a>), algorithms to predict ancestry from genotype (<a href="https://link.springer.com/article/10.1007/s00414-016-1504-3">https://link.springer.com/article/10.1007/s00414-016-1504-3</a>) and has been recommended as an approach to assess probabilistic genotyping algorithms (<a href="https://vb6ykw2twb15uf9341ls5n11-wpengine.netdna-ssl.com/wp-content/uploads/2018/07/5.-John-Butler-ISHI-29-Presentation.pdf">https://vb6ykw2twb15uf9341ls5n11-wpengine.netdna-ssl.com/wp-content/uploads/2018/07/5.-John-Butler-ISHI-29-Presentation.pdf</a>). However, it could be applied to any forensic discipline where an LR is involved and for which experimental “ground truth” data exists, thus providing experimental probability densities for true and false support for a prosecution hypothesis.</td>
</tr>
<tr>
<td>Outline of goals/objectives</td>
<td>This project will involve the development of a mathematical formalism for the use of ROC curves to assess the performance of any forensic test producing a LR for weight of evidence.</td>
</tr>
<tr>
<td>Special requirements</td>
<td>This project requires mathematical aptitude.</td>
</tr>
<tr>
<td>Industry/external partner</td>
<td></td>
</tr>
<tr>
<td>UTS supervisor</td>
<td>Professor Dennis McNevin (<a href="mailto:Dennis.McNevin@uts.edu.au">Dennis.McNevin@uts.edu.au</a>)</td>
</tr>
<tr>
<td>External supervisor</td>
<td></td>
</tr>
</tbody>
</table>

This project is suitable for graduates of the following discipline areas:

- Biology
- Chemistry
- Crime Scene
- Digital
Title | How many DNA donors contributed to this DNA profile?
---|---
Description of problem work intended to address | DNA mixtures are commonly encountered at crime scenes. Any single individual contributes one or two alleles (DNA segments) at any genetic locus to a DNA profile (as an electropherogram). These alleles may be shared (or not) with the alleles from other contributors. There are typically 20 genetic loci included in a modern genetic profile. When presented with a DNA mixture, the forensic investigator wants to know how many DNA donors contributed to the mixture. The problem can be generalised as follows: what is the probability of \( N \) contributors to a DNA profile when there are \( n \) loci each with \( m \) alleles \( (a_1, a_2, a_3, \ldots, a_i, \ldots, a_m) \) where the relative frequency (probability of contribution) of each allele is \( p_1, p_2, p_3, \ldots, p_i, \ldots, p_m \).

Outline of goals/objectives | This project will involve the development of a mathematical formalism for the determination of the probability distribution for the number of contributors to a DNA profile. While an analytical solution is preferred, the project may also benefit from computational simulations.

Special requirements | This project requires mathematical aptitude.

Industry/external partner

UTS supervisor | Professor Dennis McNevin (Dennis.McNevin@uts.edu.au)
Dr Stephen Woodcock

External supervisor

This project is suitable for graduates of the following discipline areas:

- [x] Biology
- [ ] Chemistry
- [ ] Crime Scene
- [x] Digital
### Title

Bayesian networks for the evaluation of simple paint cases.

The Chemical Criminalistics Unit of the NSW Forensic & Analytical Science Service examines cases involving paint including vehicle collisions, break and enter, vandalism, hit and run. The laboratory uses the Bayesian approach to interpret the evidence and provide a strength of evidence to assist the courts. Bayesian networks can assist in exploring the value of evidence and provide a transparent and logical evaluation of the findings in a case.

It would be expected that a student undertaking this case would need minimal assistance in term of laboratory resources, UTS having the necessary skills available (access to Hugin to would be needed); minimal commitment by the external supervisors would be required (~ 1 hr a week, mostly concentrated in the initial and final stages).

### Outline of goals/objectives

To develop Bayesian Networks for the evaluation of the findings relating to simple paint cases e.g. two vehicle collision, paint on a tool, sprayed paint on clothing etc.

### Industry/external partner

NSW Forensic & Analytical Science Service, Chemical Criminalistics Unit

### Special requirements

**UTS supervisors**

TBC. Please contact the Honours coordinator (Xanthe.Spindler@uts.edu.au) for further information.

**External supervisor**

Dr Jo Bunford

This project is suitable for graduates of the following discipline areas:

- ☐ Biology
- ☒ Chemistry
- ☐ Crime Scene
- ☐ Digital
Forensic Biology & Genetics (inc. wildlife)
Forensic Biology & Genetics (inc. wildlife)

Bachelor of Forensic Science (Honours) and Master of Philosophy (Forensic Science)

<table>
<thead>
<tr>
<th>Title</th>
<th>Species specificity of forensic human identity DNA assays</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description of problem work is intended to address</td>
<td>Forensic DNA profiling is a mainstay of law enforcement and forensic evidence. Modern short tandem repeat (STR) assays have extremely high differentiation potential. While they are marketed as being specific to humans, they are reported to amplify homologous DNA loci in close primate relatives. Although not intended for this purpose, it is possible that STR profiling assays may also be used to differentiate between chimpanzees. Taronga zoo requires the scats of chimpanzees to be linked to their owners for a parasitology project. Chimpanzee tracheal washes and/or blood samples will be used as references.</td>
</tr>
</tbody>
</table>
| Outline of goals/objectives | The aims of this project are to:  
1. Extract DNA from chimpanzee scats  
2. Determine the utility of human forensic DNA profiling assays for differentiating between chimpanzees |

<table>
<thead>
<tr>
<th>Special requirements</th>
<th></th>
</tr>
</thead>
</table>
| Industry/external partner | Taronga Zoo  
Laboratory of Veterinary Parasitology, Sydney School of Veterinary Science (SSVS), University of Sydney |
| UTS supervisor | Professor Dennis McNevin (Dennis.McNevin@uts.edu.au) |
| External supervisor | Professor Jan Slapeta |

This project is suitable for graduates of the following discipline areas:

- [X] Biology
- [ ] Chemistry
- [ ] Crime Scene
- [ ] Digital
**Title**
Validation of the Ion Chef and Ion GeneStudio S5 massively parallel sequencer for whole human mitochondrial genome sequencing

**Description of problem work is intended to address**
The NSW Forensic & Analytical Science Service has acquired an Ion Chef and Ion GeneStudio S5 (Thermo Fisher Scientific) massively parallel sequencer. Initially, it will be employed for whole human mitochondrial genome (mtDNA) sequencing using the Precision ID mtDNA Whole Genome Panel (Thermo Fisher Scientific). The sequencing pipeline must be validated according to standard guidelines (eg. SWGDAM Interpretation Guidelines for Mitochondrial DNA Analysis by Forensic DNA Testing Laboratories).

**Outline of goals/objectives**
The aim of this project is to contribute to the validation of the Ion Chef and Ion GeneStudio S5 massively parallel sequencer for whole human mitochondrial genome sequencing.

This project offers a unique experience to work in the FASS laboratory to help validate the Ion Chef and Ion S5 instruments. As such, the project will be offered to an exceptional student with a record of accomplishment in forensic genetics.

**Special requirements**
This project offers a unique experience to work in the FASS laboratory to help validate the Ion Chef and Ion S5 instruments. As such, the project will be offered to an exceptional student with a record of accomplishment in forensic genetics.

**Industry/external partner**
NSW Forensic & Analytical Science Service

**UTS supervisor**
Professor Dennis McNevin

**External supervisor**
Dr Catherine Hitchcock

This project is suitable for graduates of the following discipline areas:

- [x] Biology
- [ ] Chemistry
- [ ] Crime Scene
- [ ] Digital
<table>
<thead>
<tr>
<th>Title</th>
<th>Biological Fluid Detection using Nanoparticle – Aptamer Conjugates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description of problem work is intended to address</td>
<td>Current methods of confirmatory analysis of body fluids are time-consuming, expensive and there is loss of valuable sample. This current project will address this issue through the development of aptamer fluorophore nanoparticle conjugates that could be used for both presumptive and confirmatory tests at crime scene</td>
</tr>
</tbody>
</table>
| Outline of goals/objectives | The aim of this project is to:  
- Synthesis upconverting nanoparticles  
- Screen an aptamer library for ability to specifically bind to proteins in blood, saliva and semen  
- Attach screened aptamers to upconverting nanoparticles  
- Utilise these aptamer fluorophore nanoparticle conjugates for both presumptive and confirmatory tests of various biologic samples (blood, saliva, semen, etc) |
| Special requirements | N/A |
| Industry/external partner | N/A |
| UTS supervisor | Dr Fehmida Kanodarwala (Fehmida.Kanodarwala@uts.edu.au)  
Prof Dennis McNevin  
Prof Claude Roux |
| External supervisor | N/A |

This project is suitable for graduates of the following discipline areas:  
☑ Biology  
☑ Chemistry  
☐ Crime Scene  
☐ Digital
### Title

**Isolation of DNA using Magnetic Nanoparticles**

### Description of problem work is intended to address

Current methods of separation of DNA from biological samples are time-consuming and labor-intensive. This current project will address this issue through the development of magnetic nanoparticles and attach them to DNA strands that are complementary to forensic STR motifs.

### Outline of goals/objectives

The aim of this project is to:

- Synthesis magnetic nanoparticles and attach DNA strands with:
  - a sequence of nucleotides complementary to a forensic STR repeat motif
  - An oligonucleotide, sample-specific barcode
  - Sequencing adapters
- Attach these DNA strands to magnetic nanoparticles to produce batches of nanoparticles with single, clonal strands
- Utilise the combined batches of nanoparticles to enrich STR targets in fragmented DNA

### Special requirements

N/A

### Industry/external partner

N/A

### UTS supervisor

Dr Fehmida Kanodarwala ([Fehmida.Kanodarwala@uts.edu.au](mailto:Fehmida.Kanodarwala@uts.edu.au))

Prof Dennis McNevin

Prof Claude Roux

### External supervisor

N/A

This project is suitable for graduates of the following discipline areas:

- ☒ Biology
- ☒ Chemistry
- ☐ Crime Scene
- ☐ Digital
<table>
<thead>
<tr>
<th>Title</th>
<th>Species identification of non-human evidence using massively parallel sequencing</th>
</tr>
</thead>
</table>
| Description of problem work is intended to address | The species identification of non-human evidence has many forensic casework applications including:  
- Determining if biological samples found at crime scenes are human or non-human in origin (e.g. bones, hairs)  
- Identifying the species of origin of unknown seized animal and plant material (e.g. preserved tissues, souvenirs)  
- Identifying the individual ingredients of mixed biological samples to determine if any components are derived from endangered or toxic species (e.g. Chinese Medicines)  
- Identifying the individual species present in environmental samples to aid provenance determination (e.g. soils)  
Forensic species identification is currently performed by Sanger sequencing of specific target regions of DNA (e.g. 12S rRNA) in specialist DNA laboratories. Thermo Fisher Scientific™ have developed a food authenticity testing workflow to detect animal and plant species in a range of food samples using massively parallel sequencing. This project seeks to assess if this workflow could be applied to a range of forensically relevant animal and plant samples to determine species of origin for forensic casework applications using the latest sequencing technology. |
| Outline of goals/objectives | The overall objective of this project is to assess the Thermo Fisher Scientific™ end-to-end Food Authenticity Workflow for the forensic species identification of non-human evidence.  
The specific aims are:  
- To sequence a range of forensically relevant animal and plant species using the SGS™ All Species ID Meat and Plant DNA Analyzer Kits on the Ion Chef™ and Ion GeneStudio™ S5 according to the manufacturer recommended workflow  
- To determine if the SGS™ All Species ID Software can accurately detect and identify species of origin of a range of native and domestic animal and plant species  
- To determine if the SGS™ All Species ID Software can accurately detect and identify species of origin of individual components of mixed biological samples  
- To optimise the workflow for forensic (old, degraded, heat/chemical treated, mixed) samples (if optimisation is required)  
- To optimise the workflow for the simultaneous analysis of animal and plant products in a single sequencing run (if optimisation is required) |
This project will involve the DNA extraction, quantification, amplification, sequencing and analysis of forensically relevant animal and plant species. The student may be required to complete some laboratory work at external DNA laboratories where specific approvals may need to be sought to access these facilities.

**Industry/external partner**

Australian Museum (TBC)

**UTS supervisor**

A/Prof Jodie Ward (Jodie.Ward@uts.edu.au)

Prof Dennis McNevin

**External supervisor**

Prof Rebecca Johnson (TBC)

This project is suitable for graduates of the following discipline areas:

- ✔ Biology
- ☐ Chemistry
- ☐ Crime Scene
- ☐ Digital
<table>
<thead>
<tr>
<th>Title</th>
<th>Optimal DNA recovery from decomposed and skeletonised human femur shafts and feet</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description of problem work is intended to address</strong></td>
<td>Despite a substantial body of work that exists regarding the DNA-based identification of skeletal elements, inter- and intra-bone variation in DNA content is yet to be fully examined for humans, particularly under controlled conditions. Most of the current and previous literature surrounding DNA-based identifications from skeletal elements stems from experiences from casework of actual DVI and mass human identification efforts. The most robust and comprehensive study by Antinick et al. (2018) was carried out on cow (Bos taurus) and domestic pig (Sus scrofa domesticus) samples. This project seeks to replicate the study on human skeletal remains; namely femur and foot bones. By sampling donors at the Australian Facility for Taphonomic Experimental Research (AFTER) over various timeframes, and exposed to different environmental insults, the study will investigate: whether femur bones or smaller cancellous bones of the foot produce higher DNA yields; the optimal target area for femurs or optimal foot bone selection for downstream nuclear and mitochondrial DNA testing; whether differences in DNA yield exist for different environmental insults such as surface and burial environments, and seasonal differences; and finally, whether DNA recovery can be improved by using different DNA extraction protocols depending on the downstream DNA testing workflow.</td>
</tr>
</tbody>
</table>
| **Outline of goals/objectives** | - To assess inter- and intra-bone variation in nuclear and mitochondrial DNA quantity and quality in human femur shafts and foot bones in decomposed, skeletonised and buried individuals  
- To determine an optimal area of sampling femur shafts and feet for the purposes of genetic identification in compromised human remains cases; particularly mass disaster, missing person and homicide cases  
- To assess the effect of environmental conditions on DNA recovery from selected bones  
- To determine an optimal DNA extraction protocol for bones undergoing either nuclear or mitochondrial DNA testing |
| **Special requirements** | This Honours project will contribute findings for the development of a rapid DNA protocol for the identification of compromised human remains for a doctoral project currently being carried out.  
Bone samples will be collected from human donors at AFTER.  
Ethics approval has already been granted for this body of work.  
This project may require the student to obtain site access to the DNA laboratory at the Forensic & Analytical Science Service, including evidence of current vaccination status.  
This project will involve the sample preparation of human bones and performing DNA extractions, DNA quantification, nuclear/mitochondrial DNA testing and analysis of DNA data. |
<table>
<thead>
<tr>
<th>Industry/external partner</th>
<th>NSW Health Pathology, Forensic &amp; Analytical Science Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>UTS supervisor</td>
<td>A/Prof Jodie Ward (<a href="mailto:Jodie.Ward@uts.edu.au">Jodie.Ward@uts.edu.au</a>)</td>
</tr>
<tr>
<td></td>
<td>Prof Dennis McNevin</td>
</tr>
<tr>
<td>External supervisor</td>
<td>Jeremy Watherston</td>
</tr>
</tbody>
</table>

This project is suitable for graduates of the following discipline areas:

- [x] Biology
- [ ] Chemistry
- [ ] Crime Scene
- [ ] Digital
Forensic Toxicology & Drug Detection
### Title
Quantification of menthol in equine urine by GC-MS

Menthol is considered a potential doping substance by racing authorities but little is understood about its prevalence in the equine population. This project aims to develop and validate an analytical method for the quantification of menthol in equine urine by Gas Chromatography-Mass Spectrometry (GC-MS). The validated method will be used to assess the prevalence of menthol in equine urine for the proposal of a threshold to mitigate misuse. Comparison of these results to administration study data will aim to distinguish pharmacological manipulation from physiological variation.

1. Training in laboratory procedures for the preparation and analysis of equine urine samples by GC-MS.
2. Apply principles of analytical method validation for the quantification of menthol in equine urine samples.
3. Establish a reference population of menthol levels in routine equine urine samples.
4. Investigate the sensitivity and specificity of the validated method to identify doping cases using administration studies.

### Outline of goals/objectives

<table>
<thead>
<tr>
<th>Special requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Working in a routine forensic laboratory analysing biological samples</td>
</tr>
<tr>
<td>• Adherence to Racing NSW policies and procedures (e.g. WH&amp;S, Security)</td>
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<tr>
<td>• Follow quantitative method validation procedures</td>
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<tr>
<td>• Perform Gas Chromatography-Mass Spectrometry (GC-MS) analysis</td>
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<tr>
<td>• Perform statistical analysis of results</td>
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### Industry/external partner
Australian Racing Forensic Laboratory, Racing NSW

### UTS supervisor
Professor Shanlin Fu (Shanlin.Fu@uts.edu.au)

### External supervisor
Dr Adam Cawley (Australian Racing Forensic Laboratory, Racing NSW)

This project is suitable for graduates of the following discipline areas:

- [ ] Biology
- [x] Chemistry
- [ ] Crime Scene
- [ ] Digital
Title

GC-MS profiling of equine urine samples for longitudinal assessments

Description of problem work is intended to address

Racing NSW has established the Equine Biological Passport (EBP) to perform longitudinal profiling of biomarkers in racehorses. A global or “top-down” statistical interpretation is required for data obtained from routine Gas Chromatography-Mass Spectrometry (GC-MS) analysis of equine urine samples to identify outliers resulting from pharmacological manipulation as distinct from physiological variation.

Outline of goals/objectives

1. Training in laboratory procedures for the preparation and analysis of equine urine samples by GC-MS.
2. Integrate metabolomic analysis principles into experimental design to assess analytical precision and physiological variance.
3. Establish a reference dataset from Total Ion Chromatograms of routine equine urine samples.
4. Apply the developed method to longitudinal assessment of EBP samples.
5. Investigate the sensitivity and specificity of the developed method to identify doping cases using administration studies.

Special requirements

• Working in a routine forensic laboratory analysing biological samples
• Adherence to Racing NSW policies and procedures (e.g. WH&S, Security)
• Perform Gas Chromatography-Mass Spectrometry (GC-MS) analysis
• Use open source software to perform statistical interpretation of data

Industry/external partner

Australian Racing Forensic Laboratory, Racing NSW
Shimadzu Scientific Instruments (Oceania) Pty.Ltd

UTS supervisor

Professor Shanlin Fu (Shanlin.Fu@uts.edu.au)

External supervisor

Dr Adam Cawley (Australian Racing Forensic Laboratory, Racing NSW)
Dr Chris Bowen (Shimadzu Scientific Instruments (Oceania) Pty.Ltd)

This project is suitable for graduates of the following discipline areas:

☐ Biology  ☒ Chemistry  ☐ Crime Scene  ☐ Digital
Title

Toxicological and pharmacological study of Synthetic Cannabinoids 5-fluoro CUMYL-P7AICA

Synthetic Cannabinoids (SCs) is a group of substances that are chemically synthesized and act on brain cells similar to the primary psychoactive constituent of cannabis (marijuana), delta-9-tetrahydrocannabinol. SCs are perorally consumed as a replacement for cannabis to get “high”. Prior to 2008, there was little or no observation of SCs in the recreational drug market, but currently, SCs have become the mostly widely used class of recreational psychoactive compounds. Approximate one thousand types of SCs have been identified and appeared in the illicit market. Most of the details pharmacological and toxicological effects of SCs is unknown, which making their easy access and uncontrolled dissemination a serious threat to public health and safety.

Recently, a few new SCs have been appeared in NSW illicit market, these are 5-fluoro CUMYL-P7AICA, NM2201, XLR11 and FUBAMB. There are very few studies have been conducted on the drugs’ effects to humans, and there is no study has been carried out on 5-fluoro CUMYL-P7AICA, which has been found to be a popular and widely abused in the Hunter areas.

In vitro human toxicology/pharmacological study of 5-fluoro CUMYL-P7AICA is urgently needed.

Outline of goals/objectives

To obtain toxicological / pharmacological data of 5-fluoro CUMYL-P7AICA effects in humans.

Industry/external partner

NSW Police Force – Pharmacology Services Unit

Special requirements

Human Cells and chemical 5-fluoro CUMYL-P7AICA, which are commercially available.

UTS supervisors

TBC. Please contact the Honours coordinator (Xanthe.Spindler@uts.edu.au) for further information.

External supervisor

Dr Shuang Fu, Dr. Jennifer Raymond

This project is suitable for graduates of the following discipline areas:

☑ Biology  ☑ Chemistry  ☐ Crime Scene  ☐ Digital
Why Forensic Science at UTS?
Because UTS is reshaping forensic science

The UTS Centre for Forensic Science is a world-leading hub backed by renowned experts and world-class facilities.

Our forensic and analytical facilities are purpose-built, unique and fitted with state-of-the-art equipment. Combine this with the ‘cream’ of forensic experts in the Southern Hemisphere, you’ll be working with the best!

Our forensic scientists engage in a wide range of innovative and practical research activities, training and consultation that impact on national security, public safety and justice.

UTS Science also offers a suite of hands-on holistic forensic science degree with majors in crime scene investigation, forensic chemistry, forensic biology and digital forensic science.

The Australian Facility for Taphonomic Experimental Research (AFTER) is a unique body donation facility dedicated to the study of forensic taphonomy in Australia. It is the only such facility in the world outside of the United States of America.

www.forensics.uts.edu.au

World-leading forensic science

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Prof Claude Roux
Director, UTS Centre for Forensic Science
President, International Association of Forensic Sciences 2017-2020