Science Honours Information Booklet

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The Honours year is one of the most rewarding of any scientific degree. This is the time in which all your knowledge comes together, usually as part of a team, to work on a problem of fundamental or practical importance. You work alongside your supervisors, postdocs, PhD students and collaborators to make a difference. You learn the art of scientific communication, critical thinking and defense of a position.

We hope this booklet provides you with some inspiration to the types of research being undertaken within the School of Mathematical and Physical Sciences. We hope you find it interesting enough to want to know more.

A/Prof Irina Kabakova
Associate Head of School, Education and Students
Chair, Honours Committee

ral Information

This section describes the following awards:

C09168 Bachelor of Science (Honours) (BSc(Hons))

Bachelor of Science (Honours) in Chemistry (BSc(Hons))

Bachelor of Science (Honours) in Physics (BSc(Hons))

C09100 Bachelor of Forensic Science (Honours)

The Bachelor of Science (Honours) and Bachelor of Forensic Science (Honours) offer training in research, enable students to conduct independent research and deepen their knowledge. Honours is available for high performing undergraduate science students in a range of fields in chemistry, environmental sciences, forensic science and physics.

Honours programs provide students with a unique opportunity to undertake original research and gain in-depth knowledge in a particular field of science complementary to their bachelor study. Honours students have access to staff that are leading researchers and experts in their field. The program adds a new dimension to the skills students acquired during their undergraduate years and enhances their immediate employment prospects and future career potential. Honours also provides a pathway for students interested in pursuing postgraduate studies at masters and PhD level and enhances graduate's career and study options.

Why UTS Science??

UTS Science, one of Australia's leading university science faculties, is committed to scientific advancement that creates a more sustainable world. When students study with UTS, they join a university that delivers global impact in STEM education and research and a faculty that produces scientists with the power to transform the profession.

More information on the course can be found in UTS Handbook.

Admission requirements

Applicants must have completed a UTS recognized bachelor's degree in a relevant discipline at an appropriate level. Our Honours program is normally open to students who have attained at least a credit average over the final two-thirds of the undergraduate program.

The English proficiency requirement for international students or local applicants with international qualifications is: Academic IELTS: 6.5 overall with a writing score of 6.0; or TOEFL: paper based: 550-583 overall with TWE of 4.5, internet based: 79-93 overall with a writing score of 21; or AE5: Pass; or PTE: 58-64 with a writing score of 50; or C1A/C2P: 176-184 with a writing score of 169.

Eligibility for admission does not guarantee offer of a place.

For further inquiries please email to the program directors within your specific discipline:

- Physics - Prof Milos Toth (Milos.Toth@uts.edu.au)
- Chemistry - Prof Andrew McDonagh (Andrew.McDonagh@uts.edu.au
- Forensic Science – A/Prof Xanthe Spindler (Xanthe.Spindler@uts.edu.au)

Bachelor of Science (Honours) including Chemistry and Physics and Bachelor of Forensic Science (Honours) program structure

The course comprises 48 credit points of study across two academic stages. The major component of the course is a research project that extends over the full duration of the 9-month course and normally takes the form of an experimental or theoretical/computational investigation. The project is undertaken within one of our science-based research-active groups at UTS. Projects may also be undertaken in collaboration with an external partner, and this is subject to approval. Projects are chosen by the student, using this booklet as a guide, although first preferences cannot always be accommodated due to restrictions to ensure a fantastic student experience with supervision. 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. Students may enroll in the course for Autumn or Spring intake. Other professional development activities and seminars are scheduled throughout the year and will be advertised via the Canvas subject sites.

Commencing your project

Your project accounts for most, or all, of your study load for the academic year and will involve active experimental/theoretical work, data analysis, reading literature, and writing and other forms of communication. 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 8 am – 6 pm) whenever possible. If you do need to perform experimental work out-of-hours, you should discuss any arrangements with your supervisor to make appropriate arrangements and ensure our policies for OHS are in place.

There is no set number of hours you need to be on campus or weekly timetable for research. A standard 24cp session is approximately 420 hours of study (including self-directed work). We recommend 48cp students be research-active 5 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. Honours in physics includes a journal club that is assessable and compulsory for all students.

You are expected to work with your supervisor to prepare a project plan in the initial weeks

of semester [illegible] inductions and the risk management pla[illegible]e completed during the firs[illegible]eks of your project as these processes are ess[illegible]ntial f[illegible]g security access. Your supervisor can provide you further guidance [illegible]w t[illegible]plete your induction and risk management plan. Each research thesis su[illegible]nvas subject site that will be updated with the subject outline and research s[illegible]s. It will also be the primary route of contact for the Honours director to update y[illegible] 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.

FAQs

Is there any coursework in Honours?

Some disciplines have a component that addresses important, relevant topics such as a journal club, presentation skills, and writing skills. Others will require additional techniques and skills to be learnt to get the most from your project. Any informal professional development, research skill, and seminars will be advertised to your cohort.

Do all of my undergraduate subjects have to be above a credit/distinction?

No. We assess your eligibility based on your weighted average mark, so a challenging subject or difficult semester may not affect your eligibility.

What documents do I need for the application?

You will need to attach the following documents to your application form:

- Confirmation of supervisor (usually a PDF of an email)
- Project proposal
- EHS certification by external supervisor (if relevant/already available)
- Human or animal ethics approval (if relevant/already granted)

There are several other compulsory fields that need to be filled out before submitting your application. Your supervisor will inform you about any funding or other approvals that are required for your project. Please select “pending” for any specific approvals that are needed but not yet available (e.g. EHS risk assessment, biosafety, ethics).

What happens after I submit my application?

Honours offers are a multi-step process. SAU send your application to the faculty for assessment:

1. The application is assessed by the Head of School or delegate.
2. Approved applications are then forwarded to the Program Director.
3. Program Directors assess your eligibility for your chosen program.

4. This decision is passed back to SAU, who either offer you a place or decline your application.
5. You accept your offer and enroll for the next intake (Autumn or Spring).

This process usually takes several weeks because the applications have to be assessed by multiple people across the university.

How are projects allocated?

We encourage prospective Honours students to meet with as many academic supervisors to talk about available projects that interest them. Supervisors may discuss a project with more than one student to find the person who best fits the research area. Supervisors will contact the successful student and provide a 'confirmation of supervision' email for you to attach to your application form.

What happens if I can't find a project?

This is rare but it does sometimes happen. Sometimes we don't have enough projects or supervisors available to accommodate everyone wishing to enroll in Honours. Program Directors will do their best to accommodate your interests.

I'm having issues with the online application form.

Please get in touch with the relevant Program Director. We can help with limited troubleshooting and report any issues to SAU. If it's not something we can help with then Student Centre is your best option for advice.

Are there fees or scholarships for Honours students?

Domestic Honours: The Honours program is a Commonwealth Supported Place degree and eligible for HECS-HELP.

International Honours: The subject fees are the same as a standard undergraduate course and change yearly.

There are no scholarships available from the school or the faculty. Some supervisors offer Honours scholarships from their research funds. Students should enquire with potential supervisors about these. In all cases, the Faculty provides a research budget for project consumables for each Honours project.

For more information, head to https://cis.uts.edu.au/fees/course-fees.cfm.

I have a job outside of uni. What do you mean by "research active 5 days a week"? Does that mean I'm in the lab all week?

Honours research is a full-time commitment. "Research active" means working on any aspect of your project: literature searching and reading, assignments, lab work, data

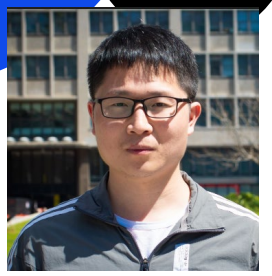
analysis and interpretation, and group meetings. You'll find that [illegible] spent on-campus will [illegible] month-to-month depending on your experiments [illegible] ks are required. Most students find that the middle of their projec[illegible] e m[illegible] od (May – September). How much time you spend really depends on [illegible] ent skills and project type.

Can I work as a tutor while doing my Honours year?

Indeed, Honours students are eligible and encouraged to teach as a tutor/lab demonstrator for one activity within the 1st year undergraduate subject relevant to their qualification. The tutors need to receive written approval from their Honours supervisor and be paired for teaching with more experienced casual academic staff member. Other conditions may apply and be advised by your supervisor. This is a great professional development activity that also pays well. We encourage all our Honours students to undertake some form of casual employment in our labs, tutes or workshops depending on the discipline.

Chemistry Supervisors

(alphabetical order)



Dr Guochen Bao

Chancellor's Research Fellow
Chemistry
guochen.bao@uts.edu.au

Dr Guochen Bao is an Emerging Leadership 1 Fellow of the Australia National Health and Medical Research Council (NHMRC EL1), a Chancellor's Research Fellow (CRF) at University of Technology Sydney (UTS), with expertise in organic synthesis, analytical chemistry, spectroscopy, hybrid nanomaterials, nanophotonics characterisations, and biomedical engineering. He received his Dual PhD degrees in 2020 at Hong Kong Baptist University (in Chemistry) and in 2021 at UTS (in Nanomaterials and Nanophotonics), respectively. Before his current position, he worked as a postdoctoral researcher at the School of Civil and Environmental Engineering and the Institute for Biomedical Materials and Devices at UTS, respectively. Currently, Dr Bao leads the research focusing on developing hybrid materials, with desired functions, and optical and nanophotonic properties, and integrating these new functionalities into molecular/nano-probes and functional devices for ultrasensitive bioassay, biomedical imaging, and precise therapy.

Guochen's research excellence is evidenced by a growing number of publications in highly regarded journals. His work has been mostly published in top and prestigious journals, including *Nature Reviews Materials* (accepted), *Light: Science & Applications* (Nature Publishing Group), *Nature Photonics*, *Nano Letters*, *ACS Nano*, *Coordination Chemistry Reviews*, *Analytical Chemistry*, *Advanced Science*, and *Angewandte Chemie*. This has resulted in a high average impact factor (>20) in his leading papers. His equal first-author paper on responsive microrobots featured on the cover page of the high-quality journal *ACS Nano*. Dr Bao's knowledge and views on hybrid lanthanide nanoparticles and their potential applications resulted in invited first/corresponding authored review papers in the respected journal *Coordination Chemistry Reviews* (2021 & 2022). He also shared scholarly opinions as the first author of a "News & Views" article in *Nature Photonics*.

Keywords: lanthanide probes; upconversion materials; biological imaging; near-infrared probes; therapy
Honours programs: Bachelor of Science (Honours).

I supervise Honours projects on:

- Molecular probes for cancer therapy.
- Hybrid photon upconversion materials for biomedical applications
- Novel molecular NIR responsive probes.

What methods or research skills will you learn?

- Organic synthesis and characterisation
- Synthesis of upconversion nanoparticles
- Spectroscopy (UV-vis, fluorescence)
- Analytical chemistry
- Cell imaging

For more information about Guochen please see:

https://profiles.uts.edu.au/Guochen.Bao/

A/Prof David Bishop

Associate Professor
Analytical Chemistry
David.bishop@uts.edu.au

The focus of my research is on using technology for difficult analytical challenges in a diverse range of disciplines, particularly in the biological and environmental sciences. I am a principal researcher in the application of laser ablation-ICP-MS for imaging biological samples in the field of metallomics, and developing hyphenated technologies for environmental and biological applications. For example, in collaboration with researchers at UCLA I developed surrogate biomarkers for the terminal childhood illness Duchenne muscular dystrophy, and a method I validated for the analysis of organotin compounds in environmental samples is currently being used by a large multinational environmental contracting laboratory.

Keywords: analytical chemistry, laser ablation imaging, environmental contaminants analysis

Honours programs: Bachelor of Science (Honours) in Chemistry

I supervise Honours projects on:

- Development of novel tags for conjugation to antibodies that allows the spatial quantification of biomolecules.
- Laser ablation imaging of heavy and essential metals in various biological tissues.
- Investigating the presence of neurotoxins implicated in MND in Australian waterways and blue-green algal species.
- Analysis of environmental contaminants such as heavy metals (Hg, Ag, Pb, etc) and persistent organic pollutants (PFAS, PCBs, etc) in biological matrices.

What methods or research skills will you learn?

- LA-ICP-MS, LC-MS/MS, GC-MS
- Sample preparation
- Method development and validation
- Data analysis

Our team:

- Dr Thomas Lockwood, Monique Mello, Siobhan Peters, Rosemary Bergin

I collaborate with:

- Professor Andrew McDonagh
- Professor Jiajia Zhou
- Dr Dayanne Bordin
- Professor Ken Rodgers (SoLS)
- Professor Simon Mitrovic (SoLS)
- Associate Professor Jon Wanagat (University of California Los Angeles)
- Associate Professor Roger Pamphlett (University of Sydney)
- Professor Richard Banati (ANSTO/University of Sydney)

Dr Dayanne Bordin

Lecturer
Analytical Chemistry
Dayanne.Bordin@uts.edu.au

I am an analytical chemist and a member of the Atomic Medicine Initiative. My research focuses on developing innovative mass spectrometry-based techniques for characterizing small biomolecules, trace elements, proteomic bioindicators, and emerging nanomaterials in a forensic, biological, and clinical context.
My primary interest lies in advancing the detection and diagnosis of cancer and metabolic diseases associated with chronic inflammation by implementing innovative techniques and technologies to provide patients with earlier and more accurate diagnoses, ultimately leading to improved health outcomes.

Keywords: Analytical Chemistry, sample preparation, biomarkers, mass spectrometry.

Honours programs: Bachelor of Science (Honours) in Chemistry

We supervise Honours projects on:

- Aiming to improve disease screening, diagnosis, prognosis, and response to therapy through the use of the BioPhase 8800 system. This system utilizes fast separations, automated identification, and high-sensitivity UV and laser-induced fluorescence detectors.

- Developing sensitive and selective methodologies for early detection of malignancies and pathogeneses using advanced analytical equipment and mass spectrometry techniques. These methodologies involve identifying key biomarkers, analysing trace elements, and utilizing advanced bio-imaging techniques.

What methods or research skills will you learn?

- Sample preparation techniques (LLE, SPE, SPME);
- Chromatographic and separation techniques (GC, LC, IC and CE);
- Spectroscopic analysis techniques (MS, MS/MS, high-resolution MS, UV, DAD and fluorescence);
- Microfluidics and lab-on-a-chip;
- Hyphenation techniques (LA-ICP-MS, CE-ICP-MS, GC-ICP-MS);
- Analytical method development and validation.

Our team:

Distinguished Professor Philip Doble, Dr Janice McCauley, Dylan Johnson

I collaborate with:

- Dr Maiken Ueland (MAPS)
- Dr Helen Xu (FEIT)
- Dr Sarah Meyer (Sciex)
- A/Prof Matthew Padula (SOLS)

Prof Phil Gale

Deputy Dean, Faculty of Science
Organic and Biomolecular Chemistry
philip.gale@uts.edu.au

Phil's research interests are in the design and synthesis of receptors for molecular guests and in particular, anions. These compounds have applications as future treatments for cancer and diseases like cystic fibrosis. Phil's group makes new drug-like receptors and then measures their binding and anion transport properties in lipid bilayer membranes. For example, cystic fibrosis is caused by faulty chloride transporters in lung epithelial cells. We are developing compounds that could replace the function of the faulty channels and help tackle the symptoms of the disease. Alternatively, our compounds can disrupt the pH gradients across cell membranes, and we have explored their ability to cause apoptosis in cancer cells.

For more information about Phil please see:

https://profiles.uts.edu.au/Philip.Gale
https://galeresearchgroup.com
https://en.wikipedia.org/wiki/Philip_A._Gale

Keywords: supramolecular chemistry; organic synthesis; medicinal chemistry; molecular recognition; cell membranes.

Honours programs: Bachelor of Science (Honours).

I supervise Honours projects on:

- Development of new anion receptors using hydrogen bonding and other non-covalent interactions. We're developing new macrocycles for selective anion binding.
- Switchable anion transporters. We're developing new anion transporters that can be switched on by an external stimulus. For example, the transporter could be designed to switch on in the conditions found in a tumour and so selectively disrupt cancer cells.
- Targetable anion transporters. We are making fluorescent anion transporters that target specific sub-cellular components, such as the mitochondria or the nucleus, to discover how influencing these systems will affect cells.

What methods or research skills will you learn?

- Organic synthesis – You will be trained in a broad range of synthetic skills while making your own novel receptors and transporters.
- Measuring binding – you'll use various spectroscopic techniques (NMR, UV/vis and fluorescence) to find out how well your receptors bind to guests.
- Lipid bilayer transport – you'll use vesicle systems which imitate a cell membrane to measure transport across lipid bilayer membranes.

Our Team:

- Dr Dan McNaughton, Billy Ryder, Alex Gilchrist, Patrick Wang, Raed Mostafa.

I collaborate with:

- Tristan Rawling, Charles Cranfield

IBMD

Postdoctoral Researchers
Institute for Biomedical Materials & Devices (IBMD)
Jawairia.khan@uts.edu.au

Dr Jawairia (Jia) Khan is a material scientist whose research focuses on developing low-cost fiber-based microfluidics for point-of-care analysis including electrophoretic separations and *in-situ* on-fiber analyte detection. The ultimate goal is to integrate the system into wearable sensors. Her research expertise spans materials and devices, fabrication techniques, nanotechnology, analytical chemistry and characterisation.

Keywords: lanthanide and near-infrared probes, upconversion, biological imaging, Lab-on-a-Chip, biosensing, wearable devices, microfluidics

Honours programs: Bachelor of Science (Honours) in Applied Chemistry, Bachelor of Science (Honours) in Physics, Bachelor of Science (Honours) in Biomedical Science

We supervise Honours projects on:

- Novel molecule-based sensing probes
- Novel probes for photodynamic therapy
- Novel hybrids for photon upconversion
- Mechanisms of energy transfer at the organic-inorganic interface
- Novel fiber-based microfluidics for electrophoretic separation and biosensing
- Novel biosensors for the detection of emerging biomarkers (miRNA, EVs, ctDNA)
- Design, fabrication and characterization of textile based microfluidic devices

What methods or research skills could you learn?

- Organic synthesis and characterization (NMR, MS)
- Synthesis of upconversion nanoparticles (TEM, XRD)
- Spectroscopy (UV-vis, fluorescence, FT-IR, DLS, nanodrop)
- Analytical chemistry (HPLC, LC-MS)
- Cell imaging, cell culture, bioconjugation
- Micro- and nanofabrication techniques

We collaborate with:

- Distinguished Prof. Dayong Jin
- Prof. Yuen Yee Cheng
- Dr Gungun Lin
- Shihui Wen
- Jiajia Zhou

Prof Steven Langford

Head, School of Mathematical and Physical Sciences
Organic Chemistry, Clean Energy
Steven.langford@uts.edu.au

Steve has a strong international reputation as an organic chemist, using concepts from Nature to build functional materials for diverse use including in materials science, optoelectronics and sensors. He is a recognised leader in naphthalene diimide (NDI) chemistry and its applications to semiconductor and energy transduction/storage solutions by exploring architecture, morphology and electronics. His current interests are in the sensing of ammonia and water as important sources for the hydrogen economy, investigating organic materials in flow batteries and finding sustainable solutions for waste cellulose.

Keywords: Naphthalene diimide, sensor, semiconductor, energy, carboxymethylcellulose

Honours programs: Bachelor of Science (Honours)

I supervise Honours projects on:

- The development of chemistry of NDIs, core-substituted NDIs and hetero-NDIs (multiple projects):

  The agility and structural diversity within our synthetic processes indicate an innate ability to design and tune, provide structural control, better energy matching and processability. Enhancing this chemistry toward optical and electronic tunability and information processing is paramount for application.

- The development of organic flow batteries:

  Organic flow batteries based on NDIs and hetero-NDIs will be developed and evaluated for the first time. Demonstrating simple yet effective organic FB's is a major goal. They will be fabricated and the device parameters, such as power density, energy efficiency and charge-carrying capacity will be optimized through electrode and electrolyte modification, charging and overcharging protocols.

- Novel conducting sheets based on NDIs:

  The *nucleophilic* chemistry of NDIs will be adopted to investigate new *π*-conjugated, *n*-channel 2D polymers as 'graphene alternatives' using solid-state polymerisation techniques. Quantum confinement in single or few-layer thick 2D organic sheets is expected to lead to emergent phenomena, in addition to applications in flexible optoelectronics, including thin-film chemiresistive devices.

What methods or research skills will you learn?

- How to make stuff: Using methodology developed within the group
- How to measure stuff: Use of NMR, UV-Vis, fluorescence to time-resolved techniques. Imaging using SEM, TEM, XRD.

Our team:

- Dinushi Munasingha Mudiyanselage, PhD Student
- Oliver Royle, Hons Student
- Fred Marlton, Chancellors Research Fellow
- Asif Mahmood, Chancellors Research Fellow
- Sujeewa De Silva, Lecturer Materials Science

Dr Hao Liu

Associate Professor, ARC Future Fellow
Electrochemistry, Clean Energy
Hao.Liu@uts.edu.au

Dr Hao Liu joined UTS in 2012 as a Chancellor's Postdoctoral Fellow. He is current an ARC Future Fellow and Associate Professor in Chemistry discipline at UTS. Dr Liu interests in the synthesis of nanostructured materials and their applications in the fields of lithium-ion batteries, sodium-ion batteries, lithium–sulfur batteries, lithium-oxygen batteries, supercapacitors and electrocatalysts. He has developed the synthesis and applications for one-dimensional, mesoporous, core-shell structured and composite materials for energy storage and conversion. His innovative work has been cited more than 12000 times, with an h-index of 57 (ISI Web of Science). He has attracted more than $6.4 million funding as a CI. He is one of "2018 Highly Cited Researchers" selected by Clarivate Analytics

Keywords: lithium-ion batteries, sodium-ion batteries, lithium–sulfur batteries, lithium-oxygen batteries, supercapacitors, electrocatalysts.

Honours programs: Bachelor of Chemistry (Honours), Master of Research (Chemistry)

I supervise Honours projects on:

- Cathode Precursor Production Pilot Plant
  The aim of this project is to develop a series of novel cathode materials with high operation voltage, high specific capacity, high energy/power density and excellent retention for practical lithium ion batteries.

What methods or research skills could you learn?

- Synthesize cathode materials with with optimised chemical compositions and crystal structures via doping, coating and phase regulation strategies.
- Investigation of the electrochemical performance of novel cathode material for lithium ion batteries by electrochemical measurements.
- Physical, chemical and structural characterizations of cathode materials through microscopies.
- Fabricating prototype pouch cells of lithium-ion batteries.
- Battery theories and technologies.

Our team:

- Hao Tian, Research associate
- Yuhan Xie, PhD student
- Tao Huang, PhD student
- Xu Yang, PhD student

I co-supervise projects with:

- Guoxiu Wang
- Steven Langford
- Michael Cortie
- Zhenguo Huang
- Future Battery Industry CRC

Dr Asif Mahmood

Chancellor's Research Fellow
Materials Chemistry, Clean Energy
Asif.Mahmood@uts.edu.au

Asif Mahmood received his MS degree in Materials and Surface Engineering from the National University of Science and Technology, Islamabad, Pakistan, in 2011 and a PhD degree in Materials Science and Engineering from Peking University, Beijing, in 2016. Currently, he is working as a Chancellor's Research Fellow at UTS. Before joining UTS, he worked at Southern University of Science and Technology for 2 years and at the School of Chemical and Biomolecular Engineering, the University of Sydney, for three years. His research interests include nanomaterials for electrochemical processes and rechargeable batteries. He has published over 70 research articles in high-quality peer-reviewed journals including Energy Environ. Sci., (Impact Factor#33), Adv. Mater., (Impact Factor#27.398), Angew. Chem. Int. Ed., (Impact Factor#12) and Adv. Energy Mater. (Impact Factor#24.8) etc. His research has attracted a large number of citations (Times cited ~7000, H-index 39). He has won several awards including an Exceptional Award for Academic Innovation, Peking University International Students Academic Award and Excellent Foreign Student Scholarship. Lately, he was recognised as the Higher Education Rising Stars 2020 by The Educator in Australia.

Asif's research program focuses on development of nanoporous materials for energy conversion and storage applications. The porous material includes metal-organic frameworks (MOFs), carbonaceous nanomaterials, metal-carbon hybrids etc. while the applications include rechargeable batteries (Li-ion, Na-ion), supercapacitors, hydrogen production etc. The development of nanoporous materials improves the electrochemical contact area of the electrode/electrolyte, thereby enhancing the energy storage capability and stability.

Keywords: nanoporous materials, energy conversion and storage, environmental sustainability, rechargeable batteries, supercapacitors, hydrogen production

I supervise Honors projects on:

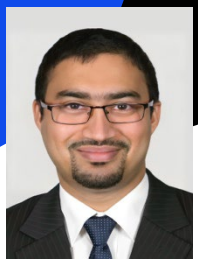
- Understanding of charge storage process on nanoporous materials
- Use structure-property relationship to harness enhanced electrochemical activities
- Designing nanoporous materials for energy storage devices with high energy density

What methods or research skills could you learn?

- Learn how to designing and tuning the porous structure
- Learn how to synthesise the highly porous nanostructures
- Learn about key characterisation tools: SEM, XRD, BET, TEM, Electrochemical workstation, charge-discharge units

Our team:

- Centre for Clean Energy Technology



Dr Parvez Mahmud

Senior Lecturer, Faculty of Science
Energy and Sustainability
Parvez.Mahmud@uts.edu.au

Dr Parvez Mahmud is an expert in life cycle assessment (LCA) and the sustainable design of energy systems. His research interests include clean energy generation, conversion and storage, sustainable and eco-design, material flow analysis (MFA), waste management, circular economy, and life cycle engineering. He has been actively collaborating with several national and international professional organizations and industries, and is sought worldwide to deliver keynote speeches and lectures at workshops and conferences.

Keywords: energy; sustainability; life cycle assessment; circular economy; waste management.

Honours programs: Bachelor of Chemistry (Honours), Master of Research (Chemistry).

I supervise Honours projects on:

- Sustainable energy systems: integrating life cycle assessment for design optimization.
- Life cycle assessment of battery materials for circular and sustainable energy systems.
- Accelerating the decarbonization of hydrogen production through sustainable innovation.
- Circular economy enhancement through material exchange collaboration.
- Environmental impact assessment and techno-economic analysis of a hybrid microgrid system.

What methods or research skills will you learn?

- You will be trained in a range of life cycle software and databases, including OpenLCA, SimaPro, GREET, Ecoinvent, and Nexus for sustainable design of energy systems.
- Circular Economy/Material Exchange Platform that enables brands and suppliers to collaborate on sustainable material sourcing and circular economy practices.
- Techno-Economic Analysis – you'll use HOMER Energy and RETScreen tools to handle a wide range of energy system configurations and objectives. This supports complex optimization algorithms and provides detailed insights into the techno-economic feasibility of renewable energy projects.

Our team:

- PhD Students: Muhammad Wajahat, Muhammad Adil, Md. Nouman, Saima Hasan, Sirjana Adhikari, Afsana Jerin

I collaborate with:

- Prof Guoxiu Wang
- Prof Damien Giurco
- Prof Jahangir Hossain
- Prof Zhong Lin Wang
- Prof Abbas Kouzani
- Prof Jun Chen
- Prof Amanda Ellis

Dr Fred Marlton

Chancellor's Postdoctoral Research Fellow
Chemistry
Frederick.marlton@uts.edu.au

Fred's research aims to understand the structure-property relationships of functional materials. He currently researches ferroelectric perovskites, which are used in a wide range of modern technologies, such as sonar devices or actuators in robotics. His particular focus is about determining how features on the atomic-scale affect their physical properties for applications in solid-state cooling. The atomic structure is determined by diffraction methods and requires the use of large-scale international facilities. This includes ANSTO's Australian Synchrotron and the Australian Centre for Neutron Scattering (ACNS).

Keywords: Ferroelectrics, functional materials, diffraction, atomic structure, nanotechnology

Honours programs: Bachelor of Science (Honours)

I supervise Honours projects on:

- Understanding structural disorder and phase transitions in perovskites for solid-state cooling.
- Investigating halide perovskites for semiconductor applications.
- Solid-state materials for battery applications (in collaboration with CCET).

What methods or research skills will you learn?

- Solid-state synthesis and ceramics processing.
- X-ray and Neutron diffraction. Students may have the opportunity to conduct experiments at the Australian Synchrotron in Melbourne and/or ACNS at Lucas Heights.
- Atomic structure modelling from diffraction data using the software Topas.
- Python coding for data analysis and visualization.
- Physical property measurements.
-

I collaborate with:

- Karunadasa Lab, Stanford University
- Prof Guoxiu Wang and the Centre for Clean Energy Technology (CCET)
- Prof Steven Langford
- The Australian Synchrotron and ACNS
- Oak Ridge National Laboratory USA
- Diamond Light Source, UK
- A/Prof John Daniels and A/Prof Neeraj Sharma at UNSW
- Prof Chris Ling and Prof Brendan Kennedy at USyd.

Dr Janice McCauley

Lecturer
Analytical Chemistry

Janice.McCauley@uts.edu.au

I am an Analytical Chemist and member of the Atomic Medicine Initiative. My research focuses on using cutting-edge analytical equipment to gain insight into disease risk factors and pathogenesis, with the goal of improving diagnostic, therapeutic, and preventive approaches. My primary interest lies in elucidating the underlying mechanisms of disease, which I accomplish by applying advanced analytical techniques to study samples from both cell models and clinical specimens.

Keywords: Analytical chemistry, tissue culture, cell biology, disease

Honours programs: Bachelor of Science (Honours) in Chemistry

I supervise Honours projects on:

- Investigate the selectivity of gas chromatography (GC) columns for use in capillary electrophoresis (CE), a high-resolution technique that enables the separation of complex biological and chemical mixtures. By developing better GC columns for use in CE, we aim to improve disease screening, diagnosis, prognosis, and response to therapy.

- Development of *in vitro* cell models for studying disease. Such models are commonly used to evaluate drug efficacy and toxicity, as well as to investigate biological processes. Coupling of these models with state-of-the-art analytical techniques allows for a deeper understanding of disease mechanisms.

What methods or research skills will you learn?

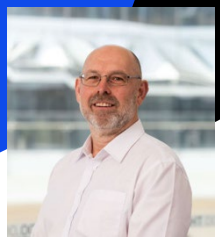
- Chromatographic and separation techniques (Gas Chromatography (GC), Liquid Chromatography (LC), Ion Chromatography (IC) and Capillary Electrophoresis (CE)
- Spectroscopic analysis techniques such as mass spectrometry (MS), tandem mass spectrometry (MS/MS), high-resolution MS, ultraviolet (UV), diode-array (DAD) and fluorescence
- Analytical method development and validation
- Tissue culture and cell biology

Our team

- Professor Philip Doble, Dr Dayanne Mozaner Bordin and Dylan Johnson

I collaborate with

- Professor Philip Doble
- Dr Dayanne Mozaner Bordin
- Dr Sarah Meyer (SCIEX)



Prof Andrew McDonagh

Professor
Synthetic Chemistry
Andrew.McDonagh@uts.edu.au

I completed my PhD at ANU on the synthesis of organometallic complexes for nonlinear optical properties. I spent 2 years as a postdoctoral researcher at the University of Bristol and then at UNSW working on the synthesis and optical properties of coordination complexes. At UTS I worked as an ARC post-doctoral fellow and then as an ARC research fellow.

More recently my research has focused on three main areas; (1) synthesis of inorganic complexes that have interesting properties (2) the synthesis and characterisation of gold nanoparticles that sinter to form gold films, and (3) impurity profiling of amphetamine-type substances.

Keywords: synthetic chemistry, inorganic chemistry, nanoparticles

Honours programs: Chemistry

I supervise Honours projects on:

- Photoswitchable inorganic complexes. These are complexes that bear ligands that change their shape when irradiated with light.
- Inorganic gold complexes that may take different isomeric forms.
- Gold nanoparticles that form gold films when heated.

What methods or research skills will you learn?

- Synthetic chemistry
- Chemical characterisation (^{1}H and ^{13}C NMR, mass spec)
- Other physical characterisation techniques as required.

Our team:

- Matthew Phillips, Paige Summers, Truong Nguyen, Anthony Thai, Alexandra Mercieca, Katharine Flower-Donaldson

We collaborate with:

- Dr Alexander Angeloski (UTS)
- Assoc Prof. Tristan Rawling
- Prof. Phillip Doble
- Many others

A/Prof Tristan Rawling

Associate Professor, Discipline Leader
Medicinal Chemistry
Tristan.rawling@uts.edu.au

Tristan completed his PhD at UTS on the synthesis of metal complexes for solar cells under the supervision of the world-renowned chemist, A/Prof. Andrew McDonagh. He then spent 4 years as a postdoctoral researcher at the University of Sydney where he worked on the development of anticancer fatty acids. He moved back to UTS where he continued his work on the development of fatty acid derived drugs as anticancer and analgesic agents. In recent years his research has focused on drugs that target membranes and mitochondria. Mitochondria are the powerhouse of the cell ;) and are structurally and functional different in cancer cells, making them potential targets for anticancer drugs and weight loss agents.

Keywords: medicinal chemistry, chemical biology, anticancer drugs, mitochondria, weight loss drug

Honours programs: Chemistry

I supervise Honours projects on:

- **Development of transmembrane proton transporters as potential weight loss drugs**
  2,4-Dinitrophenol (DNP) is a proton transporter (protonophore) that was used in the 1930s as an extremely effective weight loss drug. Patients could lose 1.5kg per week on an unrestricted diet, however there was a small problem- one of the side effects was death. Can we design, synthesise and test new protonophores that maintain the weight loss effects of DNP, but without the side effects?

- **Studying the anticancer and mitochondrial effects of ionic liquids**
  Ionic liquids (ILs) were supposed to be 'green solvents', a safe and environmentally friendly alternative to organic solvents, however it was discovered they kill cells by an unknown mechanism. Our group suspects ILs kill cells by disputing mitochondrial membranes. Can we use this insight to develop safe ILs, or potent cell killing ILs that can be used as anticancer agents?

What methods or research skills will you learn?

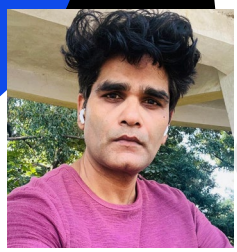
- Synthetic organic chemistry
- Compound characterisation (^{1}H and ^{13}C NMR, mass spec)
- Cell culture
- Cell-based assays (MTS cell viability, ATP etc)

Our team:

- Meryem-Nur Duman, Ritik Roy, Edward York, Ethan Pacchini, Freddy Ha

We collaborate with:

- A/Prof. Charles Cranfield (UTS)
- Prof. Philip Gale (USyd) and research team
- Prof. Megan O'Mara (UQ)



Dr Sandeep Kumar Singh

Senior Lecturer, School of Mathematical and Physical Sciences, Faculty of Science
sandeep.singh@uts.edu.au

Dr. Singh's research mainly focusses on nanoparticle-based drug delivery systems, which include a wide range of innovative approaches such lipid-based drug delivery systems, self-nanoemulsifying drug delivery systems, nano-emulsions, and nano-capsules. While designing carrier systems we use the Quality by Design approach to thoroughly examine and optimize influential formulation parameters that ensure efficacy and reliability of dosage forms. Furthermore, we explore Gastroplus® (predictive modelling software) to conduct *in silico* pharmacokinetic studies before delving into actual *in vivo* bioavailability studies. This approach saves time and cost in conducting clinical studies. Dr. Singh has guided 40 undergraduate students, 27 postgraduate students, and 9 PhD scholars for their research till date.

For more information about Singh please see:

www.linkedin.com/in/sandeep-kumar-singh-b5b78b225

Keywords: Lipid Nanoparticles; Novel Drug Delivery Systems; Pharmacokinetics; Quality by Design; *In Silico* Pharmacokinetics Simulation, Bioavailability Studies.
Honours programs: Bachelor of Advanced Science (Honours).

I supervise Honours projects on:

- Development and characterization of novel drug delivery system of drugs facing bioavailability issues.
- Conducting *In silico* pharmacokinetic (PK) studies to predict PK parameters.
- Exploring formulation by design approach to optimize robust formulation that meets the criteria of regulatory bodies.

What methods or research skills will you learn?

- Designing drug delivery systems using 'Design and Expert Analysis software'.
- Strategies to improve bioavailability issues of drugs belonging BCS II and IV.
- Methods to enhance the solubility and permeability of drugs.
- Characterization of nanoparticles using microscopy, particle size analyzer (DLS), DSC, FTIR, X-RD.
- Stability studies of prepared formulations
- *In silico* pharmacokinetics predictions.
- Dissolution and release studies along with mathematical modeling.
- Compartment, non-compartment and physiological based pharmacokinetics modelling.

I collaborate with:

- Dr. Tristan Rawling, Dr. Steven Langford, Dr. Irina Kabakova
- CDRI Lucknow India, RMRI Patna India, BIT Mesra, India, ICT Mumbai India,
- Pukyong National University, South Korea; University of Helsinki, Finland; King Saud University; University of Bradford, UK; The University of New Mexico.

A/Prof Dawei Su

Associate Professor
Inorganic Chemistry
Dawei.Su@uts.edu.au

Dr Dawei Su has a solid background in material science. His unique experience allows him to integrate materials science and physics with chemistry and nanotechnology. This synergy combines his expertise in experimental work (synthesis, characterisation, quantitative analysis) and atomic-scale and electronic-scale theoretical investigations (quantum chemistry, density functional theory and *Ab Initio* molecular dynamics). He is especially interested in the electronic structures of the anisotropy of crystal planes of the nanomaterials on their physical and chemical properties. He tries to obtain a realistic atomistic picture, which has significant implications for different applications of nanomaterials.

Keywords: Nanomaterials, crystallography, quantum chemistry calculations, density functional theory, *Ab initio* Molecular Dynamics.

Honours programs: Bachelor of Science (Honours)

I supervise Honours projects on:

- **Study of Metal-to-metal Charge-transfer Transitions in metal complexes**
  Ligand-to-metal charge transfer can bring about the separation of photogenerated charges. In this proposed project, the electronic structures of metal-organic frameworks will be studied. It aims to obtain a complete picture of the ligand-to-metal charge transfer. The interaction between the ligand and the transition metals of the metal complexes will be theoretically investigated combined with the experimental investigation.

What methods or research skills will you learn?

- Chemical synthesis
- Scanning electron microscopy
- X-ray diffraction and Raman spectroscopy
- FTIR, UV-VIS

Dr Maiken Ueland

Director AFTER
Analytical Chemistry, Forensic Science
Maiken.ueland@uts.edu.au

Maiken's main research areas are human decomposition chemistry with special focus on biomarkers in tissue and odour and their use in criminal investigations, including locating missing persons and estimating time since death. Her interest lies in using analytical chemistry to solve complex questions for legal investigations, climate change and health. Maiken also uses her knowledge in odour analysis in the investigation of wildlife crime and conservation.

For more information about Maiken's work please see:

https://profiles.uts.edu.au/Maiken.Ueland

https://twitter.com/MaikenLand

Keywords: Analytical chemistry, search and detection, forensic taphonomy, sensor technology

Honours programs: Bachelor of Applied Chemistry (Honours), Bachelor of Forensic Science (Honours), Master of Philosophy

I supervise Honours projects on:

- Improving the detection of victims in Mass disasters
- Developing and testing electronic nose technology
- Determining time since death using advanced analytical methods
- Developing methods to detect and prevent the illegal wildlife trade

What methods or research skills will you learn?

- GC-MS, GC×GC-TOFMS, GC-MS/MS, ATR-FTIR, electronic noses
- Sample preparation and analysis
- Advanced statistical analysis
- Field work

Our team:

- Sandali Alahakone, Bridget Thurn, Matthew Bolton, Emily Sunnucks, Kainat Fatima, Honours and interns

I co-supervise/collaborate with:

Barbara Stuart, Greta Frankham, Steven Su, David Suggett, Dennis McNevin, Matt Padula, Jen Matthews, Mackenzie de la Hunty, Scott Chadwick, the Australian Museum, law enforcement agencies, Australian Defence

Dist Prof Guoxiu Wang

Distinguished Professor, Director of the Centre for Clean Energy Technology,
Materials Chemistry, Electrochemistry, Battery Technology
Guoxiu.Wang@uts.edu.au

Professor Guoxiu Wang is the Director of the Centre for Clean Energy Technology and a Distinguished Professor in the School of Mathematical & Physical Sciences. Professor Wang is an expert in materials chemistry, electrochemistry, energy storage and conversion, and battery technologies. His research interests include lithium-ion batteries, lithium-air batteries, sodium-ion batteries, lithium-sulfur batteries, supercapacitors, electrochemical catalysis for green hydrogen production, graphene and MXenes. He has published over 650 refereed journal papers with over 60,000 citations and an H-index of 134 (Google Scholar). He has been recognised as a Highly Cited Researcher (Web of Science/Clarivate Analytics) in Materials Science in 2018 - 2021.

Keywords: Lithium-ion batteries; Sodium-ion batteries; Supercapacitors; Green hydrogen production; 2D materials.
Honours programs: Bachelor of Chemistry (Honours), Master of Research (Chemistry)

I supervise Honours project on:

- **Solid-state lithium batteries using phase-stabilised electrolytes.** The overall goal of the project is to develop advanced solid-state lithium batteries with high energy density for applications including portable electronic devices, electric vehicles, and electricity storage.

What methods or research skills could you learn?

- Synthesising solid-state electrolyte materials with optimised chemical compositions and crystal structures
- Physical, chemical and structural characterization of solid-state electrolyte materials by SEM, TEM and XRD.
- Electrochemical evaluating and testing the performances of solid-state electrolyte materials in lithium batteries.
- Investigating the formation and characteristics of interfaces between lithium metal anode and solid-state electrolyte, and cathode and solid-state electrolyte through in-situ instrumental analysis.
- Unravelling lithium ion conduction mechanisms in solid-state electrolytes and the interfaces between electrodes and solid-state electrolytes through the combination of theoretical and experimental research.
- Fabricating prototype solid-state lithium batteries using atomic-layer deposition (ALD) nanofabrication technique.
- Electrochemical testing and modelling of prototype solid-state lithium batteries.

I co-supervise projects with:

- A/Prof. Andrew McDonagh, Prof. Steven Langford, A/Prof. Hao Liu and Em Prof. Michael Cortie
- Assoc. Prof. Zhenguo Huang (FEIT)

Dr Jinqiang Zhang

Chancellor's Research Fellow, ARC DECRA Fellow
Chemistry, Material Science, Clean Energy Technology
Jinqiang.Zhang@uts.edu.au

Dr Jinqiang Zhang is an expert in materials design and mechanism research for clean energy technologies including energy storage and conversion systems. His research interests spread across a wide range of materials and applications, such as functional redox organic molecules, atomically dispersed catalysts, and hybrid branched materials for lithium-air batteries, lithium-ion batteries, lithium-sulfur batteries, zinc batteries, electrochemical water splitting, fuel cells, CO_2 capture and reduction. He has published over 80 articles in prestigious international journals including Nature Catalysis, Nature Nanotechnology, Nature Synthesis, Nature Communications, Science Advances etc., which have attracted over 8900 citations with an h-index of 47. His pioneering works underpin the Australian Government's net zero emission, contributing to not only the fundamental research in chemistry and engineering, but also the industrial development of energy storage and conversion technologies.

Keywords: Organic functional molecules; atomically dispersed catalysts; energy storage; energy conversion; batteries; electrocatalysis; CO_2 capture and reduction.

Honours programs: Bachelor of Science (Honours).

I supervise Honours projects on:

- Development of new functional organic materials with redox capability for lithium-air batteries with low over-potentials and high durability.
- Development of single atom catalysts and atomic clusters for hydrogen production and fuel cells.
- Development of functional Cu-based catalysts for CO_2 reactive capture.

What methods or research skills will you learn?

- Organic synthesis – functional organic molecule design and synthesis.
- Inorganic synthesis – atomically dispersed catalysts on various substrates.
- System design and modification – batteries, water splitting, CO_2 capture/reduction
- Advanced characterisations – SEM, XRD, BET, TEM, XAS, FTIR, Raman etc.

I collaborate with:

- Prof Guoxiu Wang and Prof Hao Liu from Centre for Clean Energy Technology
- Prof Steven Langford
- Prof Andrew McDonagh
- Prof Rose Amal (UNSW)
- Prof Edward Sargent (Northwestern University)
- Prof David Sinton (University of Toronto)

Dr Yufei Zhao

Lecturer, Faculty of Science
Electrochemistry, Clean Energy
yufei.zhao@uts.edu.au

Yufei's research interests are in the design and synthesis of highly efficient electrocatalysts, e.g., atomically dispersed catalysts, precious metal alloys, high entropy materials, perovskite oxides, etc., for energy conversion reactions, including water splitting, fuel cells, CO_2 reduction reactions. Yufei's group works on atomically dispersed catalysts, which possess the maximised atom efficiency and tunable electronic properties. Carefully designing and tailoring the coordination environment can maximise the efficiency of the atomically dispersed catalysts for boosted electrochemical performances in energy conversion reactions. For instance, in-situ exfoliated MXene coupled with Pt single atoms showed high hydrogen generation performance with a mass activity more than 40 times higher than the commercial Pt/C, while the epoxy-rich Fe single atoms boosted the oxygen reduction kinetics. For more information about Yufei please see:
https://profiles.uts.edu.au/Yufei.Zhao
https://scholar.google.com.au/citations?user=SJr3o7IAAAAJ&hl=en

Keywords: green hydrogen production; fuel cell; electrocatalysts; materials chemistry.
Honours programs: Bachelor of Science (Honours).

I supervise Honours projects on:

- Hydrogen evolution reaction. Design and development of low Pt electrocatalysts for hydrogen evolution reaction. We are developing Pt single atom catalysts and Pt atomic clusters with altered coordination environments for boosted catalytic performance.
- Acidic water oxidation. We are developing different strategies to engineer RuO_2 to enhance the corresponding stability in acidic and oxidation conditions.
- Alkaline seawater oxidation. We are working on layered double hydroxides (LDH), such as NiFe-LDH, CoFe-LDH, to resist serious corrosion and undesirable chloride oxidation during seawater oxidation process.

What methods or research skills will you learn?

- Nanomaterials synthesis – You will be trained in a broad range of synthetic skills while making your own novel electrocatalysts.
- Materials characterisation – you'll use various characterisation techniques (SEM, TEM, HAADF-STEM, XPS. Raman, etc.) to understand the atomic structure and surface chemical states of the synthesised electrocatalysts.
- Electrochemical performance test – you'll use three-electrode and two-electrode systems to evaluate the electrochemical performance of the electrocatalysts for the above-mentioned energy conversion reactions.

I collaborate with:

Professor Guoxiu Wang and the Centre for Clean Energy Technology (CCET), A/Professor Tristan Rawling (UTS), Professor Steven Langford (UTS), Professor Rose Amal (UNSW)

Forensic Sciences Supervisors

(alphabetical order)

A/Prof Scott Chadwick

Associate Professor, Associate Head of School Teaching and Learning, Forensic Science
Scott.Chadwick@uts.edu.au

Scott completed his PhD at UTS in 2013. His research focused on fingermark detection techniques in the near-infrared region, which involved developing new reagents for developing fingermarks on difficult surfaces, where conventional techniques are unsuccessful. Scott currently supervises students across a range of forensic disciplines including fingermark detection, chemical criminalistics, document examination, forensic intelligence and organic chemistry.

Keywords: Fingermark detection, chemical criminalistics, document examination, ballistics, intelligence

Honours programs: Bachelor of Forensic Science (Honours), Master of Philosophy (Forensic Science)

I supervise Honours projects on:

- Understanding the effect of substrate properties on fingermark detection success rates
- Improving existing fingermark detection processes for normal and difficult surfaces
- Sequencing of fingermark detection methods and chemical analysis
- Impurity profiling of illicit drug synthesis

What methods or research skills will you learn?

- Collection and visualisation of latent fingermarks
- ATR-FTIR, GC-MS, NMR
- Fingermark evaluation and quality assessment
- Synthetic chemistry skills

Our team:

- Matthew Bolton – MSc Student
- Analisa Chiaravalle – PhD Student
- Ciara Devlin – PhD Student
- Harrison Fursman – PhD Student
- Teneil Hanna – PhD Student
- Lumikki Ree – PhD Student
- Joel Waszczuk – PhD Student
- Harrison Woodward – PhD Student

I co-supervise projects with:

Morgan Alonzo, Mackenzie De la Hunty, Andrew McDonagh, Marie Morelato, Claude Roux, Xanthe Spindler, NSW Police Force, Australian Federal Police.

Dr Mackenzie de la Hunty

Lecturer, Forensic Science
Mackenzie.delaHunty@uts.edu.au

Mackenzie completed a PhD at UTS investigating ways to develop fingermarks on paper that has been wet or in high humidity, before taking up a role as a Scholarly Teaching Fellow at UTS. She then moved to Canberra to work at the Australian Federal Police (AFP) primarily in the Forensics Training Team as a member, and then Team Leader from 2019-2022. She is now back at UTS as a Lecturer and is excited to get back into the world of research. Her contacts and positive approach will see her develop industry-relevant projects for students who feel supported and excited to produce great research outputs.

Keywords: Fingermarks; Fire Investigation; Bomb Scene Examination; LiDaR; Microtraces;

Honours programs: Bachelor of Forensic Science (Honours), Master of Philosophy (Forensic Science)

I supervise Honours projects on:

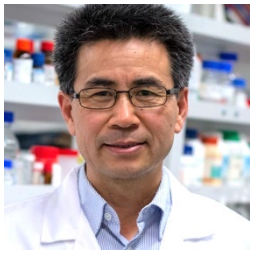
- Fingermarks
  - Development on porous substrates
  - Development on items from hazardous scenes (fire, bomb)
  - Residue composition, fundamentals and simulants
- Fire investigation: detection and analysis of ignitable liquid residues in scenes of arson
- Microtraces: Glass, Fibres, Paint collection and analysis
- Light Detection and Ranging (LiDaR) mapping for Crime Scenes

What methods or research skills will you learn?

- Analytical skills; GC-MS, FTIR
- Fingermark development techniques: Indanedione-Zinc, Ninhydrin, Powdering, Physical Developer
- Emulsion Chemistry: Fingermark residue simulant development
- Experimental design
- The use of LiDaR
- How to work effectively, and communicate with industry

I collaborate/co-supervise with:

- Australian Federal Police (AFP) Forensics
- NSW Fire & Rescue (NSWF&R)
- NSW Rural Fire Service (NSWRFS)
- ACT Fire & Rescue (ACTF&R)
- UTS Academics (Professor Claude Roux, Dr Scott Chadwick, Dr Maiken Ueland)



Prof Shanlin Fu

Professor
Forensic Science
shanlin.fu@uts.edu.au

I am heading the Drugs and Toxicology Group at the Centre for Forensic Science (CFS), running an active research program with the primary goal of developing sensitive methods for clinical diagnosis, therapeutic drug monitoring and drugs of abuse testing. Our research team aims to answer three main questions: i) what drugs of abuse are out there in the illicit drug market and how do we identify them? ii) how do we know if someone is using these drugs? iii) what happens once these drugs get into our body? You can find out more about our research activities and outputs from my UTS staff profile.

Keywords: forensic toxicology, forensic chemistry, poisons, drugs of abuse, new psychoactive substances
Honours programs: Bachelor of Forensic Science (Honours), Master of Philosophy (Forensic Science)

I supervise Honours projects on:

- Developing test methods for screening drugs of abuse including NPS in seized materials for in-field application by the law enforcement agencies
- Developing test methods for quantifying the levels of drugs of abuse including NPS in biological matrices such as urine, blood, oral fluid, and hair for clinical or medico-legal purposes
- Understanding the metabolism of NPS and identifying suitable markers for monitoring substance abuse
- Investigating the stability and degradation profile of drugs of abuse in various matrices including post-mortem specimens.

What methods or research skills will you learn?

- Drug analyte extraction techniques such as liquid-liquid extraction (LLE) and solid phase extraction (SPE)
- Chromatographic separation techniques such as gas chromatography (GC) and liquid chromatography (LC)
- Spectroscopic analysis techniques such as mass spectrometry (MS), tandem mass spectrometry (MSMS), high resolution MS, ultraviolet (UV), infrared (IR) and nuclear magnetic resonance (NMR) spectroscopy
- Analytical method development and validation
- Chemical reactions

I collaborate with:

- UTS researchers with expertise in forensic science and in analytical chemistry
- Law enforcement agencies such as Australian Federal Police
- Forensic science service providers such as NSW Forensic and Analytical Science Service; Australian Racing Forensic Laboratory, Racing NSW
- Education/Research organisations such as Shanxi Medical University, China; University of Sydney; University of Canberra

Prof Dennis McNevin

Professor
Forensic Science
dennis.mcnevin@uts.edu.au

Dennis began his career in forensic science in 2003 in the laboratories of the Australian Federal Police in Canberra where he recovered DNA from shed hairs. Since then, he has held academic positions at the Australian National University, the University of Canberra and now at UTS. His research focuses on forensic genetics, or the use of genetics in the service of the legal system. He has pioneered the use of new DNA sequencing technologies in Australia and infers the biogeographical ancestries and phenotypes of DNA donors for Australian police agencies. Dennis was recently seconded to the Australian Federal Police National DNA Program for Unidentified and Missing Persons as a genomics expert.

Keywords: DNA, genetics, genomics

Honours programs: Bachelor of Forensic Science (Honours), Master of Philosophy (Forensic Science)

I supervise Honours projects on:

- Population genetics
- Genetic kinship
- Recovery of trace DNA
- Extraction of DNA from environmentally challenged biological materials
- Preservation of DNA
- New DNA sequencing technologies
- Probabilistic genotyping
- Inference of biogeographical ancestry and phenotype from DNA
- Forensic proteomics

What methods or research skills will you learn?

- Analytical skills:
  - DNA profile interpretation
  - Population genetic analysis
  - Genetic kinship analysis
  - Probabilistic genotyping
  - Ancestry and EVC inference
- Laboratory skills:
  - Molecular biology
  - Working in a DNA-free environment
  - Quantitative polymerase chain reaction (qPCR)
  - DNA fragment analysis
  - Massively parallel sequencing

I collaborate with:

- Australian Federal Police Forensics
- NSW Police Force
- NSW Health Pathology Forensic & Analytical Science Service
- Victoria Police Forensic Services Department
- A/Prof Georgina Meakin, A/Prof Jodie Ward, A/Prof Matt Padula, Dr Dr Maiken Ueland

A/Prof Georgina Meakin

Associate Professor
Forensic Science
Georgina.Meakin@uts.edu.au

Georgina joined the UTS Centre for Forensic Science in October 2019, having spent six years teaching and researching at University College London's Centre for the Forensic Sciences. Building on her prior experience as a Forensic Scientist at The Forensic Institute in Glasgow (2010-2012), Georgina continues to provide advice and consultancy in casework in the UK, USA, and various other countries. This casework tends to underpin the research that Georgina and her students conduct, with research focusing on investigating the transfer, persistence, prevalence and recovery (TPPR) of DNA and other trace evidence. Georgina is particularly interested in research that directs the recovery and preservation of DNA at the crime scene and informs the interpretation and evaluation of trace DNA in casework.

Keywords: trace DNA, forensic interpretation, crime scene investigation, biological criminalistics
Honours programs: Bachelor of Forensic Science (Honours), Master of Philosophy (Forensic Science)

I supervise Honours projects on:

- DNA TPPR and interpretation/evaluation employing either laboratory or computer-based methods
- Transfer and persistence of DNA on touched/worn items within scenarios of relevance to various crime types
- Consideration of DNA recovery and preservation at the crime scene
- Detection and recovery of trace DNA and fingermarks and their relationship
- Investigation of trace DNA for intelligence purposes

What methods or research skills might you learn?

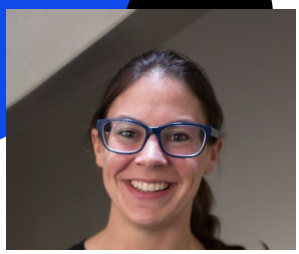
- DNA recovery using swabs, tapelifts and other methods
- DNA extraction using a commercial kit and the Automate Express
- DNA quantification using a commercial kit and RT-PCR instrument
- DNA profiling using a commercial kit and Genetic Analyzer
- Various software programs (e.g. GeneMapper, LRmix etc.)
- Systematic review and meta-analysis skills

Our team:

- PhD students: Rachael Hoffman and Helen Roebuck
- MSc student: Anshu Upadhayay

I co-supervise with:

- Claude Roux, Dennis McNevin, Xanthe Spindler, Marie Morelato & Scott Chadwick
- Alicia Haines (Western Sydney University); Bianca Szkuta (Deakin University)
- Ali Sears, Jen Raymond, Annemarie Nadort, James Daubney & Caitlin Almada (NSW Police Force); Matt Bolton & Caroline Driscoll (AFP); Roland van Oorschot (Victoria Police Forensic Services Department)



Dr Marie Morelato

Senior Lecturer
Program Director Bachelor of Forensic Science
Forensic Science
Marie.Morelato@uts.edu.au

Marie Morelato completed her Bachelor and Master degree in Forensic Science at the School of Criminal Justice of the University of Lausanne (Switzerland) in 2009. After completing her studies, she worked in the Wallis State Police (Switzerland) as a forensic scientist before moving to Australia to complete a one-year project on Gunshot residues at the UTS in collaboration with the Australian Federal Police (AFP).

In 2015, she completed her PhD on drug intelligence at UTS. The project was a collaboration between the AFP, the University of Lausanne and UTS. In 2016, she obtained the Chancellor's Postdoctoral Research Fellowship from UTS. Her research involves the use of illicit drug data in an intelligence perspective. She is now a senior lecturer in forensic science and the course director of the Bachelor of Forensic Science.

Keywords: forensic science, forensic intelligence, illicit drug, document fraud, utility

Honours programs: Bachelor of Forensic Science (Honours), Master of Philosophy (Forensic Science)

I supervise Honours projects on:

- Analysis of illicit drug specimens using portable near infrared technology
- Trafficking of illicit goods on cryptomarkets
- Utility of Trace DNA
- Analysis of used injecting paraphernalia
- Detection and monitoring of New Psychoactive Substances on online drug forums and google trends
- Forensic intelligence in handwriting
- Analysis of illicit drugs in wastewater

What methods or research skills will you learn?

- The use of forensic science beyond the Court
- How to understand criminal activities based on the study of different data sources
- Analysis of large datasets

Our team:

- Ciara Devlin, PhD student
- Harrison Fursman, PhD student
- Rachael Hoffmann, PhD student

I collaborate with:

- Claude Roux
- Scott Chadwick
- Georgina Meakin
- Anjali Gupta
- Australian Federal Police
- New South Wales Police Force
- Forensic and Analytical Science Service
- Medically supervised injecting centre

Dist Prof Claude Roux

Director UTS Centre for Forensic Science
Forensic Science
Claude.Roux@uts.edu.au

My research activities cover a broad spectrum of forensic science, including microtraces and chemical criminalistics, documents, fingerprints, forensic intelligence and the contribution of forensic science to policing and security. My professional motivation has been driven by my vision of forensic science as a distinctive academic and holistic research-based discipline. For this reason, I love working at the interface between several enabling science & technology disciplines or between STEM and humanities. Many of my former Honours students now work in forensic science practice, including the current AFP Chief Forensic Scientist. I work collaboratively with many of my colleagues and supervise an enthusiastic group of research students currently working on a multitude of forensic science problems that span from fingermark detection to drug and DNA intelligence, chemical criminalistics/microtraces, criminalistics and questioned document examination.

Keywords: microtraces, fingermark detection, forensic interpretation, forensic intelligence, chemical criminalistics, impact and effectiveness of forensic science.

Honours programs: Bachelor of Forensic Science (Honours), Master of Philosophy (Forensic Science)

I supervise Honours projects on:

- Improving the evaluation of forensic traces, including their transfer, persistence and prevalence
- Improving existing fingermark detection processes for normal and difficult surfaces
- Improving detection, recovery and characterization of many different traces including physical traces, microtraces, document materials (e.g. ink), illicit or sensitive materials (e.g. explosives, drugs)
- Improving the exploitation of traces to better feed intelligence, investigation and court processes

What methods or research skills could you learn?

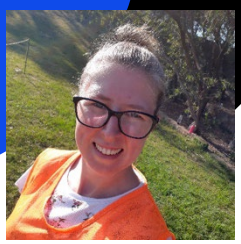
- Detection, collection and visualisation methods (vary depending on the trace)
- Instrumental techniques used in trace characterization, e.g. optical microscopy, ATR-FTIR, microspectrophotometry and other spectroscopic techniques, GC/MS
- How to design and undertake transfer and persistence experiments and population studies
- How to combine forensic results into an evaluative framework, prioritise trace types and examinations and better exploit casework data to be more effective

Our team:

- PhD Students: Victoria Lau, Matt Saunders, Lutfi Asad, Harrison Fursman, Rachael Hoffmann, Joel Waszczuk, Analisa Chiaravalle

I co-supervise projects with:

- Xanthe Spindler, Scott Chadwick, Marie Morelato and Georgina Meakin
- Australian Federal Police
- NSW Police Force
- NSW Forensic & Analytical Sciences Service
- Uniting Medically Supervised Injecting Centre



A/Prof Xanthe Spindler

Honours Program Director
Forensic Science
Xanthe.Spindler@uts.edu.au

Xanthe completed a PhD at the University of Canberra investigating ways to improve the detection of latent fingermarks before moving to UTS to continue her work as a postdoctoral fellow and later as a lecturer. My research program focuses on improving the recovery and value of forensic traces to enhance crime detection and resolution, with specific focus on fingermark detection and chemical criminalistics. Xanthe supervises a collaborative and enthusiastic group of research students working on a multitude of forensic science problems that span from fingermark detection and fingerprint identification to criminalistics and questioned document examination.

Keywords: fingermark detection, forensic interpretation, microtraces, fingerprint, chemical criminalistics

Honours programs: Bachelor of Forensic Science (Honours), Master of Philosophy (Forensic Science)

I supervise Honours projects on:

- Understanding the effect of substrate properties on fingermark detection success rates
- Improving existing fingermark detection processes for normal and difficult surfaces
- Developing fingerprint-based methods for wildlife detection and monitoring
- Detection and recovery of fingermarks and trace DNA
- Transfer and persistence of microtraces in different scenarios

What methods or research skills could you learn?

- Collection and visualisation of latent or blood fingermarks
- ATR-FTIR, microspectrophotometry, and other spectroscopic techniques
- Optical microscopy
- How to design transfer and persistence experiments
- DNA recovery and extraction

Our team:

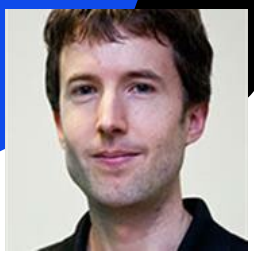
- Victoria Lau, PhD student
- Matt Saunders, PhD student
- Lutfi Asad, PhD student

I co-supervise projects with:

- Claude Roux
- Scott Chadwick
- Amber Brown
- Georgina Meakin
- Anjali Gupta
- NSW Police Force
- Australian Federal Police

Physics Supervisors

(alphabetical order)



A/Prof Matthew Arnold

Associate Professor
Physics
Matthew.Arnold-1@uts.edu.au

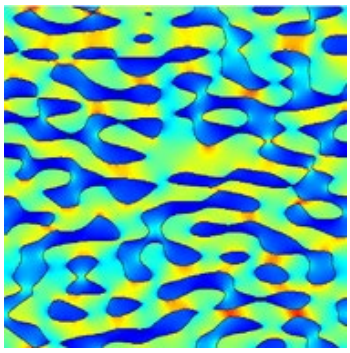
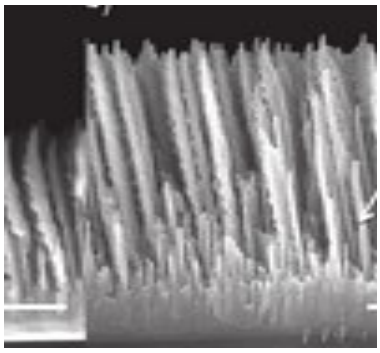
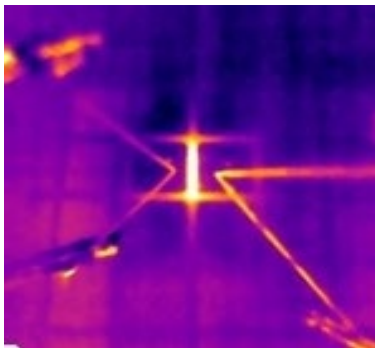
Matt is interested in complex physical systems and their electromagnetic capabilities, and enjoys all aspects of research including simulation, design, construction, and testing. He works in small teams on projects combining diverse areas of science and engineering, and has mentored research students who work in many different sectors and countries.

Keywords: electromagnetics, photonics, emergent phenomena, multiphysics

Honours programs: Physics

I supervise Honours projects on:

- Electromagnetic properties of quasi-random structures
- Developing physically self-assembled systems for applications
- Conduction avalanches in dynamic devices & analog computing

What methods or research skills will you learn?

- Electromagnetic simulation
- Spectroscopy & ellipsometry
- Advanced physical deposition
- Multiphysics experimental design
- Network analysis & machine learning
- Electron & light microscopy

Our team:

Angelo Vitaliti (PhD student), Ed Saribatir (PhD student)

I will co-supervise projects with:

- Cuong Ton That, Chris Poulton, Irina Kabakova, Alex Solntsev (UTS)
- David Cortie (ANSTO)
- Oscar Nieves (CSIRO)

Dr Sujeewa De Silva

Lecturer
Physics
Sujeewa.DeSilva@uts.edu.au

Sujeewa is currently a lecturer in MaPS. She joined UTS in 2014 as a postdoctoral fellow after receiving the PhD from the University of Wollongong, under the supervision of Prof. Shi X. Dou. Her PhD research was on "Investigating and improving the properties of graphene doped magnesium diboride superconductors"

Sujeewa's current research is focused on the applications of metals and their alloys & compounds in Plasmonics and nanotechnology.

Keywords: Plasmonics, metals and intermetallic compounds, metals/ metal oxide nanostructures and thin films, superconductors and electronic materials

Honours programs: Bachelor of Science (Honours)

I supervise Honours projects on:

- Understanding the optical properties of thin films and nano structures of various metals and intermetallic compounds
- Improving plasmonics by fine tuning the dielectric properties of metals via doping
- Developing nano-porous films for various applications such as sensors, supercapacitors etc.

What methods or research skills could you learn?

- Thin film fabrication using magnetron sputtering
- Ellipsometry and other spectroscopic techniques for optical measurements
- Scanning electron microscopy and EDS for morphology and elemental analysis
- Structural characterization of materials using XRD
- Structural refinements using suitable software

Our team:

- Sanaa Abdullah, PhD student
- Fatima Matar, PhD student
- Dinushi Munasingha, PhD student

I co-supervise projects with:

- Michael Cortie
- Annette Dowd
- Matthew Arnold
- Danica Solina
- Cuong Ton-That
- Steven Langford

Dr Annette Dowd

Senior Lecturer, Associate Head of School (Education and Students)
Physics
Annette.Dowd@uts.edu.au

Dr Dowd also has interests are in the area of development optical and structural characterisation techniques for nanostructured materials, particularly biomaterials and advanced materials. She collaborates with chemists and biologists to gain new understanding about their systems using nuclear and synchrotron techniques. She is also interested in the development of innovative laboratory-based activities to enhance student learning in mathematics and science.

Keywords: biomaterials, nanotechnology, spectroscopy, modelling, science education

Honours programs: Bachelor of Biomedical Physics (Hons), Bachelor of Science (Applied Physics, Nanotechnology) (Hons), other degrees considered

I supervise Honours projects on:

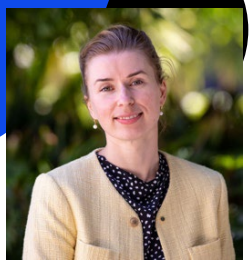
- Coral and shell microanalysis to evaluate the impact of environment on growth
- Structural analysis of bioinspired molecules
- Synthesis of high surface area nanoporous sponges as supercapacitors
- VR platform development to enhance learning of multidimensional concepts in maths and physics
- Radiotherapy simulation

What methods or research skills will you learn?

- X-ray diffraction, X-ray fluorescence, synchrotron techniques
- Infrared and visible spectroscopy, capacitance spectroscopy
- Density functional theory modelling (CRYSTAL)
- VR, Unity, MATLAB
- Monte Carlo modelling of radiation (Geant4)

I co-supervise projects with:

- Matthew Arnold
- Sujeewa de Silva
- Camille Dickson-Deane
- Climate Change Cluster, UTS
- Human Health, Australian Nuclear Science and Technology Organisation
- πLab, Faculty of Engineering and IT
- Institute of Molecular Sciences, University of La Trobe
- Many other nice people at UTS and beyond



A/Prof Irina Kabakova

Associate Head of School (Education and Students)
Chair, Honours Committee
Physics
Irina.Kabakova@uts.edu.au

I am an Optical Physicist working in the field of Advanced Microscopy/Spectroscopy and run a *Brillouin Microscopy Lab* at UTS. Brillouin Microscopy is a new field of research that unites optics and acoustics, and looks at mechanical properties of materials at the microscale. In this way the mechanical parameters of the materials are read out by using only a focused beam of light, making it into a versatile and safe technique to use with biological materials such as tissues and cells. We explore how pathological processes in cells and tissues represent themselves in changes in tissue elasticity. These findings are key to understanding disease progression at the microscale as well providing means for early disease diagnostics.

Keywords: microscopy, spectroscopy, Brillouin light scattering, light-sound interactions

Honours programs: Bachelor of Science (Honours) in Physics and Chemistry

I supervise Honours projects on:

- **Optimisation of Brillouin microscopy setups for fast imaging of biological materials.** Although very useful, Brillouin microscopy can be a very slow measurement when we need to map large areas/samples. Instrument optimisation by signal multiplexing and signal enhancement techniques can help this problem.
- **Getting more out of Brillouin data.** Using machine learning and signal processing techniques enable us to get more information from existing data thus guiding data analysis and interpretation process.
- **Applications of Brillouin microscopy to study respiratory diseases and cancers.** Studying cellular processes and their connection to disease from a mechanical point of view can lead to deeper understanding of the disease and treatment improvements.
- **Complex systems and emergent phenomena.** Complex systems exhibit emergent phenomena by which new properties of the whole system emerge from interaction of its parts. Such interactions drive many cellular processes, e.g. cell division, and is fundamental to existence of life.

What methods or research skills will you learn?

- Confocal microscopy, optical system alignment, interferometry
- Brillouin microscopy, Raman microscopy
- Data processing including line shape fitting, statistical analysis, clustering and other methods, matlab programming

Our team:

- Dr Hadi Mahmodi (Technical Officer)
- Laura Vettori, Maryam Alsadat Rad, Mathew Lesley, William Hansen (PhD students)

I collaborate with:

- Matthew Arnold (MaPS), Alex Solntsev (MaPS), Carmine Gentile (FEIT), Peter Su (FEIT).
- Garvan Institute of Medical Research
- Woolcock Institute of Medical Research
- University of Sydney, Macquarie University, University of Queensland, RMIT University, Imperial College London and Nanyang Technological University

Dr Mehran Kianinia

UTS Vice Chancellor Fellow
Physics
Mehran.kiainia@uts.edu.au

Mehran completed PhD at University of Technology Sydney investigating optically active point defects in solid state materials such as diamond and hexagonal boron nitride. His research is focused on study of quantum emitters for application in quantum technology. He is currently focusing on quantum optics with two dimensional materials. Mehran supervises a team of PhD and honours students working on spectroscopy of quantum emitters at cryogenic temperature (4K) and confocal microscopy of quantum sensors for magnetic sensing at atomic scale.

Keywords: quantum optic, single photon emitter, optically detected magnetic resonant, spin defect, quantum sensing.

Honours programs: Physics

I supervise Honours projects on:

- **Cryogenic spectroscopy of quantum emitters**
  The project involves study of single photon sources and perform one and two photon interference measurement.

- **Quantum sensing at atomic scale**
  The project involves optical control of single electron bound to a point defect and use it to sense magnetic field from nucleus of nearby atoms.

- **Two dimensional devices**
  The project involves fabrication of electro optical devices using atomically thin (2D) materials.

What methods or research skills will you learn?

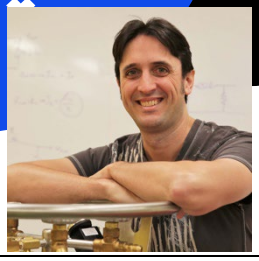
- Understanding the process of making quantum emitters.
- Spectroscopy of quantum emitters using confocal microscopes.
- Cryogenic measurement of quantum emitter
- Performing quantum experiments such as quantum interference
- Photolithography and electron beam lithography and clean room.
- Scanning electron microscopy and atomic force microscopy
- Two-dimensional materials transfer and device fabrication.

Our team:

- Simon White (Post doc)
- Jake Horder (PhD)
- Ivan Zhigulin (PhD)
- Ben Whitefield (Honours)

I co-supervise with:

- Prof Igor Aharonovich
- Prof Milos Toth



A/Prof Nathan Langford

Associate Professor,
Circuit Quantum Science group (CirQuS)
nathan.langford@uts.edu.au

After completing a PhD in photonic quantum information processing at the University of Queensland, Nathan worked as a postdoctoral research fellow in top quantum science groups across Europe, including at the University of Vienna, University of Oxford, and Technical University of Delft, before joining UTS as a lecturer and ARC Future Fellow. Nathan's research in superconducting quantum circuits focusses on developing and testing improved quantum algorithms and experimental hardware for quantum computing applications like quantum simulations and control. Nathan runs a dynamic, friendly research group (CirQuS) that works in the exciting new Millikelvin Quantum Science laboratory covering areas from nanofabrication, cryogenics, microwave electronics to precision measurement, quantum theory and advanced quantum modelling.

Keywords: quantum computing, quantum simulation, superconducting microwave quantum circuits, quantum tomography, cryogenic quantum devices

Honours programs: Bachelor of Science (Honours), Master of Science (Research), Bachelor of Mathematical Sciences (Honours), Bachelor of Engineering (Honours)

We supervise Honours projects on:

- Understanding the performance limits of real-world digital quantum simulators
- Designing and fabricating microwave quantum electronic devices and interfaces
- Developing advanced control techniques for superconducting quantum systems
- Design and fabrication of millikelvin quantum-limited amplifiers
- Superconducting thin-film fabrication and characterisation
- Superconducting qubit design and characterization
- Quantum system tomography
- Simulation and modelling of quantum experiments and devices

What methods or research skills could you learn?

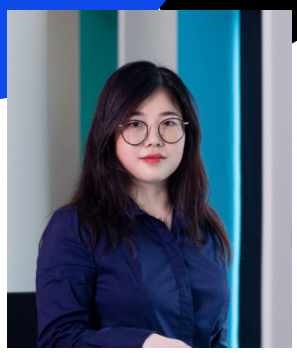
- Experimental techniques: nanofabrication, cryogenics, microwave measurements and analysis, experiment computer control, advanced data acquisition and analysis, hardware design and assembly, electronics, experiment engineering
- Theory techniques: electromagnetic simulations, experimental quantum modelling, software development, theory of quantum computing, simulations, control and tomography, also novel phenomena like quantum chaos and phase transitions

Our CirQuS team:

- PhD students: A Manatuly, G Gemisis, A Di Lonardo, T Srivipat

We collaborate and/or co-supervise with:

- Harley Scammell: on theory and quantum dynamics of quantum phase transitions
- Chris Poulton: on electromagnetic simulations and modelling of microwave circuits
- James Brown: on statistical methods in quantum computing & system tomography
- Other fellow members of the UTS Centre for Quantum Software and Information
- Quantum experiment and theory colleagues across the Sydney Quantum Academy



Dr Jiayan Liao

Position: NHMRC EL1 Fellow | Chancellor's Research Fellow
Discipline: Luminescence Biomaterials
Website: https://profiles.uts.edu.au/Jiayan.Liao;
https://scholar.google.com.au/citations?user=L1Josa4AAAAJ&hl=en
Email: Jiayan.Liao@uts.edu.au

Dr Jiayan Liao completed her PhD at UTS. She is currently a NHMRC EL1 Fellow and Chancellor's Research Fellow at Faculty of Science. Her experience covers nanomaterials, polymer-based bio-/nano-interface engineering, analytical chemistry, and instrumentation development. She has published over 80 peer-reviewed papers, including Nature Photonics, Nature Nanotechnology, Advanced Materials, ACS Energy Letters, Nano Letters, Laser & Photonics Reviews and JPCL, et al. Integrating cutting-edge nanotechnology with point-of-care testing strategy, Dr Liao aims to develops a non-invasive, highly sensitive diagnostic tool capable of detecting multiple cancer markers, such as nucleic acid and protein biomarkers, thereby transformative approach to bioanalytical analysis.

Keywords: Functional nanomaterials, Surface Functionalization, Microscopic imaging, Nanotechnology, Cancer Biomarkers Detection, Lateral Flow Immunoassay.

Honours programs: Bachelor of Science (Honours), Master of Research (Chemistry)

I supervise Honours projects on:

Advanced Early Cancer Detection Method: A Novel, One-Stop, nanotechnology-based Point-of-Care System

The diagnosis of cancer remains one of the most significant challenges in modern medicine. Despite the development of various diagnostic approaches over the years, the search for more effective and targeted treatments continues. In recent years, nanotechnology has emerged as a promising avenue for early cancer diagnosis using nanoparticles with unique properties. Among these, upconversion nanoparticles (UCNPs) have shown great potential due to their ability to convert low-energy photons into high-energy emissions, making them ideal candidates for sensitive early diagnosis. In this research project, we aim to develop a novel and highly sensitive tool for early cancer detection. The proposed project will involve the synthesis, modification, and thorough characterization of targeting UCNPs, followed by the detection of biomarkers using established laboratory procedures. The utilization of UCNPs without photobleaching represents a significant advancement over conventional probes, which often suffer from photobleaching, background fluorescence, and low chemical stability. This research holds the promise of revolutionizing cancer diagnosis and treatment through the utilization of innovative and precise nanotechnology-based approaches.

What methods or research skills will you learn?

- Synthesizing upconverted fluorescent nanoparticles as nanoprobes.
- Structure/optical characterization of nanoprobes: TEM/XRD/ imaging system.
- Surface functionalization of probes: FIRT, DLS, Zeta potential, NTA.
- Bioimaging and detection: Test strip preparation device, nanoprobes-based lateral flow assay, confocal/wide-field fluorescence microscopy system.

We collaborate with:

- Prof. Dayong Jin, A/Prof Yuen Yee Cheng (MaPS)
- Prof. Deborah Marsh (School of Life Sciences), Dr Ying Zhu (FEIT)
- Dr Hien Duong (Faculty of Medicine and Health, USYD)

Dr Gungun Lin

Senior lecturer | Faculty of Science
Institute for Biomedical Materials & Devices
gungun.lin@uts.edu.au

Dr. Lin is a senior lecturer and ARC DECRA fellow at the Institute for Biomedical Materials and Devices. He received multi-national and multi-disciplinary training in China, Germany, and Australia. He obtained his PhD degree from Chemnitz University of Technology in Germany.

His research interests encompass fundamental and applied aspects of functional micro- and nanomaterials, as well as Micro-electro-mechanical System (MEMS) technologies for biomedical fields. Specifically, his focus lies in investigating structure-property relationships (e.g., magneto-electrical and mechanics) of responsive micro- and nanostructures, aiming to advance new-generation biosensors, bio-manipulation, and medical micro-robotic technologies. Dr. Lin's expertise spans materials and device physics and chemistry, micro- and nanofabrication, as well as micro & nanotechnology and analytical chemistry.

Keywords: Bio-MEMS, Micro-robots, Magnetic Tweezers, Lab on a Chip, Biosensing

Honours programs: Bachelor of Biomedical Physics, Bachelor of Science in Applied Physics, Bachelor of Chemistry, Bachelor of Biotechnology, Bachelor of Science in Nanotechnology

I supervise Honours projects on:

- Developing magnetic tweezers for manipulation of biomolecules and cells
- Studying the interaction of magnetic field and micro-scale particles for the manipulation (sorting) of biomolecules and cells
- Design, fabrication and characterization of smart magnetic micro-robots
- Developing biosensors for detection of emerging biomarkers (ctDNA, mRNAs and EVs)

What methods or research skills will you learn?

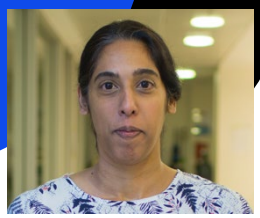
- Micro- and nanofabrication (lithography, thin-film deposition etc.)
- Materials characterization techniques (electron microscopy and spectroscopy etc.)
- Software programming and system automation
- Microscopy, cell culture and analytical (bio-conjugation) chemistry methods
- Data processing and analytics

Our team:

- Jawairia Khan (Postdoctoral research associate)
- Ming Lu (PhD student), Zhichao Yang (PhD student)

I collaborate/co-supervise projects with:

- A/Prof. Yuen Yee Cheng (Molecular and cellular biologists, School of MaPs)
- Prof. Jiajia Zhou (Spectroscopy, School of MaPS)
- Dr Lana McClements (School of Life Sciences)
- School of Biomedical Engineering (Prof. Majid Warkiani, Dr Ying Zhu)



Prof Charlene Lobo

Discipline Leader
Physics
Charlene.lobo@uts.edu.au

I am Discipline leader of Physics and have a research group working in the field of fabrication and properties of advanced and emerging materials such as phosphorene, graphene, hexagonal boron nitride, and boron hydrogen clusters and nanoparticles. My group explores the applications of these materials in new technologies for optoelectronics, green energy, wearable devices, and quantum communications, among other areas.

Keywords: nanofabrication, electron and ion beam techniques, device engineering, two-dimensional materials, emerging materials.

Honours programs: Bachelor of Advanced Science (Quantum Technology), Bachelor of Science (Physics), Bachelor of Science (Chemistry).

I supervise Honours projects on:

- Applications of emerging and advanced materials (eg. in optics, photonics, quantum technologies, energy storage).
- Development of new materials for green energy technologies (eg. energy efficient devices, hydrogen storage technologies).
- Design and fabrication of wearable sensors and devices (eg. for biomedical applications).

What methods or research skills could you learn?

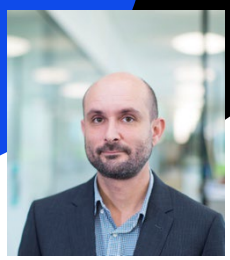
- Material and device fabrication (eg. exfoliation, device engineering, electron and ion beam microscopies).
- Optical spectroscopies (eg. Raman spectrometry, photoluminescence, cathodoluminescence, ATR-FTIR, UV-VIS, X-ray photoelectron spectroscopy).
- Electrical characterization (eg. photocurrent, Hall effect, I-V characterization, electrical excitation and analysis methods).

My team:

- Ivan Zhigulin, Parya Reyhanian, Dominic Scognamiglio (PhD students)
- Yanan Huang (Research assistant)

I co-supervise projects with:

- UNSW Dept. of Materials Science and Engineering (Nagajaran Valanoor and others)
- RMIT university (Sumeet Walia and others)
- ANU Dept. of Electronic Materials Engineering (Lan Fu and others)
- UTS FEIT and Business School (Zhenguo Huang, Simon Darcy, Helen Xu and others)
- Other MAPS and SOLS staff (including Igor Aharonovich, Milos Toth, Chris Poulton)



Prof Chris Poulton

Professor
Mathematical Sciences
Chris.Poulton@uts.edu.au

Chris is either a theoretical physicist or an applied mathematician, depending on your point of view. His main research area is the interaction of light and sound on the nanoscale. He does a lot of numerical research, building mathematical models that describe waves in complex materials. He works with experimental physicists at UTS and at the University of Sydney, as well as in Germany.

Keywords: Photonics, Nonlinear optics, Electromagnetic waves, Elastic waves

Honours programs: Bachelor of Mathematical Sciences (Honours), Bachelor of Science (Honours)

I supervise Honours projects on:

- **Waves at the extremes of nonlinear optics**
  Metals are interesting materials in wave physics – not only are they highly reflective, but they also support waves that travel along edges. Interestingly, there is another family of waves that travel along edges: these are Rayleigh waves, which are mechanical vibrations that often arise in earthquakes. At very high frequencies and on the nanoscale these two types of waves can interact – this project will explore what happens when they do.

- **Ultra-long-wavelength waveguides**
  Everybody knows that optical fibres can be used to guide light. However weird things happen when the frequency of the light becomes really small. This project will examine and get to the bottom of this weirdness, looking at waveguides for both light and sound.

What methods or research skills will you learn?

- Advanced optical physics
- Advanced Electromagnetic theory
- Elasticity theory
- Numerical modelling of complex systems
- Programming (Python or Matlab)

Collaboration within the School:

I usually work and supervise students with:

- A/Prof. Matthew Arnold, A/Prof. Irina Kabakova, A/Prof. Alex Solntsev, A/Prof. Mikhail Lapine, A/Prof. Nathan Langford

External Collaborators:

- Prof. Michael Steel (MQ), Dr Mikolaj Schmidt (MQ)
- Dr Moritz Merklein (U.Syd)
- Prof. Markus Schmidt (Jena, Germany)
- Prof. Birgit Stiller (Max Planck, Germany)

Dr Harley Scammell

Senior Lecturer
Physics
harley.scammell@uts.edu.au

Harley is a theoretical condensed matter physicist who joined UTS in 2023 as a Senior Lecturer. He completed his PhD in Theoretical Physics at the University of New South Wales in 2017, focusing on Quantum Phase Transitions. He went to Harvard University (2018-2020) as a Fulbright Postdoctoral Fellow to research quantum and topological phases of matter. In 2020, Harley joined the ARC Centre of Excellence in Future Low-Energy Electronic Technology as a postdoctoral researcher to explore the theoretical underpinnings of future quantum technologies.

Harley's research focuses on two-dimensional materials, topological condensed matter, quantum phase transitions, and unconventional superconductivity. He uses a combination of analytical formalisms such as diagrammatic quantum field theory, statistical mechanics, and lattice gauge field theories, along with argumentation from group representation theory. In addition, he utilises numerical techniques, including Monte Carlo simulations, exact diagonalisation, and machine learning, to supplement his research. His work aims to uncover fundamental aspects of these systems and phenomena, as well as explore novel functionalities that could be harnessed for future quantum technologies.

Keywords: quantum phase transitions, topological matter, strongly-correlated electrons, two-dimensional materials, quantum technology

Honours programs: Bachelor of Science (Honours), Master of Science (Research), Bachelor of Mathematical Sciences (Honours)

I supervise Honours projects on:

- Quantum phase transitions and topological order in two-dimensional systems
- Quantum mechanics of unsupervised machine learning

What methods or research skills will you learn?

- Theory of quantum critical phenomena
- Theory of topological states of matter
- Numerical modelling of quantum systems

I collaborate with:

- University of New South Wales
- Harvard University
- Boston University
- University of Innsbruck
- Free University

Dr Danica Solina

Lecturer
Mathematics/Physics
Danica.Solina@uts.edu.au

Danica completed a PhD in 2002 at the University of Technology Sydney on the X-ray reflectivity of multilayers for use as monochromators before taking a post-doc in Germany at the GKSS Research Centre, now called Helmholtz-Zentrum Hereon. At GKSS, she expanded her skills to include neutron scattering of magnetic systems that include antiferromagnetic (AFM) materials. AFMs are used in the creation of spin valves which are used in magnetic data storage systems.

Danica's present work extends her research on antiferromagnets into the realm of AFM Spintronics with gold-manganese her system of choice. She also has a number of side projects for fun such as trying to grow tetrataenite through deposition, and the ion beam adaption of magnetic systems for use in sensors. Recently Danica's work expanded to include the study of boron nitrite nanoparticles and their feasibility for use as an agent for the cancer treatment called boron neutron capture therapy. The last is a collaboration between the MaPS and SoLS.

Keywords: SAXS, XRR, Magnetic Materials, Spintronics, Thin Films

Honours programs: Bachelor of Science-Applied Physics (Honours)

I supervise Honours projects on:

- Comparative study of RefNX, GenX3 and SimulReflec for the simulation of X-ray Reflectivity data at UTS.
- X-ray Reflectivity (XRR) study on single and bilayer film systems.
- XRR study on diffusion of layer film systems.
- Development of Small Angle X-ray Scattering (SAXS) for nano-scale films at UTS
- Study of nanoparticles for the use in boron neutron capture therapy.

What methods or research skills might you learn?

- X-ray Scattering Techniques
- Modelling of reflectivity data
- Deposition of thin films
- Scanning Electron Microscopy/EDS
- Neutron Scattering

People I work with:

- Dr. Sujeewa De Silva
- Prof. Michael Cortie
- Assoc. Prof Matthew Arnold
- Assoc. Prof. Charlene Lobo
- Dr. Andrew Care
- Prof. Deborah Marsh
- Dr. Fehmida Kanodarwala
- Dr. David Cortie
- Dr. Mark Lockrey
- Dr. James Bishop

A/Prof Alexander Solntsev

Associate Professor,
Associate Head of School (Research)
Physics
Alexander.Solntsev@uts.edu.au

Alex is an optical physicist with expertise in quantum technology, optical analysis, and nano-photonics. He is working with light at the nanoscale, diving into the fascinating world of photon interactions and applying new fundamental discoveries to telecom.

Keywords: lasers, optics, nano, quantum, telecom

Honours programs: Bachelor of Science (Honours) in Applied Physics and Nanotechnology

I supervise Honours projects on the questions:

- How to turn a red beam of light into blue?
- How to create and entangle photons?
- How to make telecommunications of the future faster, safer, and greener?

What methods or research skills will you learn?

- Programming (Labview, Matlab), numerical modelling, data analysis
- Lasers, spectroscopy, microscopy, imaging

I collaborate with:

- Finisar Australia, subsidiary of II-VI
- Defense Innovation Network, including Igor Aharonovich (UTS), Milos Toth (UTS), Arne Laucht (UNSW), Robert Malaney (UNSW) and Rich Mildren (Macquarie)
- UTS Math, including Chris Poulton and Mikhail Lapine
- The Australian Research Council Centre of Excellence for Transformative Meta-Optical Systems (TMOS)
- Leading optical scientists: Andrea Blanco-Redondo (Nokia Bell Labs), Rachel Grange (ETH Zurich), Yuri Kivshar (ANU), Andrey Miroshnichenko (UNSW), Xian-Min Jin (Shanghai Jiao Tong)

A/Prof Cuong Ton-That

Associate Professor
Physics
Email: Cuong.Ton-That@uts.edu.au

My research is primarily centered around the development of wide bandgap semiconductors, oxide materials, nanostructures and junction devices. These efforts are directed towards applications in hydrogen production, optoelectronics and power electronics.

Typically, my research group consists of 4-6 PhD students and a research assistant working in various aspects of materials science and engineering including the growth and characterisation of oxide and nitride semiconductors. Our research interests also include the development and implementation of advanced optical and electrical characterisation techniques. I collaborate closely with researchers at two semiconductor fabrication companies Nanovation and 3D-Oxides.

Keywords: water splitting, optoelectronics, power electronics, nanoscale devices

Honours programs: Bachelor of Science (Honours)

I supervise Honours projects on:

- **High quality gallium oxide materials for power electronics**
  This research, supported by an Australian Research Council (ARC) Discovery Project grant, involves materials development and characterisation studies aimed at optimising p-type doping in Ga_2O_3 thin films and nanostructures.

- **Photocatalysts for water splitting in hydrogen production**
  This project aims to lead the development of integrated semiconductor arrays and single-atom catalysts for unassisted water splitting.

What methods or research skills will you learn?

- Materials fabrication, plasma processing, ion implantation, electron microscopy, synchrotron-based X-ray spectroscopies, chemical analysis, cathodoluminescence, photoluminescence, Raman spectroscopy

Our team:

- Curtis Irvine, Fatima Matar, Amar Salih, Somayeh Rafiezadeh, Raja Elrahoumi

I collaborate with:

- A/Prof Matthew Arnold, Dr Sujeewa De Silva, Prof Matthew Phillips, Prof Long Nghiem (UTS, FEIT), Prof Kourosh Kalantar-Zadeh (USyd), Dr Jianbo Tang (UNSW), and others.

Prof Milos Toth

Professor
Physics
Milos.Toth@uts.edu.au

Milos works in the fields of nanofabrication and quantum photonics. He has worked in both industry and academia, and his research includes "blue-sky" physics research as well as technology development done in collaboration with industry partners. He supervises a team of postdocs and undergraduate/honours/PhD students who collaborate with a broad range of researchers based in Australia and abroad - see, for example the Centre of Excellence for Transformative Meta-Optical Systems.

Honours programs: Bachelor of Science (Honours) in Physics or Chemistry

I supervise Honours projects on:

- Nanofabrication techniques.
- Nano-chemistry at surfaces driven by electron/ion beams.
- 2D materials.
- Optoelectronic devices.
- Single photon emitters.

What methods or research skills will you learn?

- Material growth (e.g., chemical vapour deposition).
- Nanofabrication techniques such as electron/optical lithography, reactive ion etching, 3D printing using electron/ion beams.
- Fabrication and manipulation of quantum emitters.
- Fabrication of optoelectronic devices based on 2D materials.
- Fabrication of optical structures such as photonic crystal cavities.
- Microscopy and spectroscopic techniques such as electron microscopy, atomic force microscopy, confocal scanning laser fluorescence microscopy, Raman spectroscopy, photoluminescence and cathodoluminescence spectroscopy.

Our team:

The immediate team is a medium-size research group of ~4 postdocs, ~10 PhD students and 2-6 undergraduate/honours students. You will be embedded in this team and will have the opportunity to work with a broad range of external collaborators in Australia and abroad. Examples of our recent work can be found here (author lists on these papers illustrate the diversity of our collaborators).

I work/co-supervise with:

- Researchers at UTS and domestic universities, including ANU, USYD, RMIT
- Researchers at overseas universities, including NTU (Singapore), MIT (USA), TUB (Germany)
- Researchers at Thermo Fisher Scientific

To study the:

- Fabrication of materials and devices for integrated quantum photonics.
- Use of ion beams to modify materials.
- Use of an electron beam for "subtractive 3D printing" done using electron-driven chemical reactions that etch materials such as diamond and 2D boron nitride, or to study photonic materials and devices.

Prof Jiajia Zhou

Professor
Institute for Biomedical Materials & Devices
jiajia.zhou@uts.edu.au

Jiajia's research interests focus on lanthanide nanophotonics, fluorescence nanothermometry, fluorescence microscopy in life-sciences, luminescent sensors based on inorganic systems, rare earth spectroscopy, up/down conversion, quantum cutting and point-of-care diagnostic technologies, with a recent expansion into rapid COVID-19 antigen tests. Dr Zhou has published more than 100 peer-reviewed papers and her work has attracted more than 5,000 citations. She is the winner of the 2019 Sturge Prize for her outstanding contribution to the spectroscopy of rare earth based up-conversion nanoparticles; she was a finalist in the Australian Museum Eureka Prizes for Outstanding Early Career Researcher in 2019, and a finalist for the 2020 Eureka Prize Emerging Leader in Science; she was shortlisted for the 2022 Australian Academy of Science Pawsey Medal. She is the winner of the 2022 MAPS Award for Research Excellence in the MCR category and the 2023 David Syme Research Prize.

Keywords: single nanoparticle spectroscopy, nanothermometry, point-of-care testing, rapid COVID-19 antigen test, milk protein test

Honours programs: Bachelor of Science (Hons) in Physics and Chemistry

I supervise Honours projects on:

- Luminescent nanoprobes: synthesis, surface modification, and optical imaging
- Nanothermometry: unique thermometers and super-resolution sensing technology
- Protein test in food, such as milk, meat
- COVID antigen test

What methods or research skills will you learn?

- Lateral flow assay
- Microscopic optical imaging
- Cell imaging
- Luminescence spectroscopy
- Immunofluorescence and ELISA
- DLS/Zeta potential/FTIR

Our team:

- PhD Students: Mr Yangjian Cai, Miss Ziwei Wu, Miss Yitong Zhao, Mr Maoxin Zhang

I work/co-supervise with:

- Prof Yuri Kivshar (ANU), Dr David Bishop (Science), Dr Peter Su (FEIT), Dr Gungun Lin (Science)
- Milk industry
- COVID team including Distinguished Prof Dayong Jin (Science, UTS), Prof Majid Warkiani (FEIT, UTS), Dr Olga Shimoni (Alcolizer Technology)

Mathematics and Statistics Supervisors and Information

(supervisors in alphabetical order)

General information – Mathematical Science

This section relates to the following award:

Bachelor of Mathematical Science (Honours) (BMathSc(Hons))

The Bachelor of Mathematical Science (Honours) is an introduction into research training and advanced study in the areas of mathematics, statistics, data science, finance, and industrial optimisation. There is focus on independent learning fostering professional skills such as effective time management through the hands-on experience of managing a creative project. This course focuses on the application of cutting-edge mathematical techniques to real-world problems through the completion of student led learning. The course challenges students to exercise more initiative and independence, and to develop greater depth of knowledge and advanced analytical skills, all attributes that are highly sought after by employers.

For further inquiries please email to the program director:

Dr Joanna Wang (joanna.wang@uts.edu.au)

The course comprises 48 credit points of study, consisting of advanced coursework together with a substantial research project. The project involves a major piece of independent study, providing students with the opportunity to apply the skills developed in their coursework. Students will choose three subjects (may include an AMSI course, taken as Mathematics seminar subject) from the following list:

- 35003 Modern algebra
- 35004 Mathematical analysis with applications
- 37010 Statistical and financial econometrics
- 37457 Advanced Bayesian methods
- 37400 Postgraduate optimization
- 37007 Probability theory and stochastic processes
- 37401 Machine learning: mathematical theory and applications
- 35002 Mathematics seminar: AMSI subject (summer school subject or ACE network subject)

The results of the project are presented in an oral seminar and in a written thesis, both of which are formally assessed. Students may enroll in the course for Autumn or Spring intake. Other professional development activities and seminars are scheduled throughout the year and will be advertised via the Canvas subject sites.

Dr Ara Asatryan

Lecturer
Mathematics
Ara.Asatryan@uts.edu.au

Ara completed his PhD in 1988 at Yerevan State University, Armenia. The subject of his thesis was the construction of short wavelength asymptotic solutions of the wave equation and characterization of wave fields at foci and caustics. After postdoctoral positions at Macquarie University (1997) and the University of Sydney (2000), Ara took the position of research fellow at the University of Technology Sydney in (2001). He is currently a Lecturer at the department of Mathematical and Physical Sciences at UTS. The main area of his research is mathematical modelling of complex artificial materials like photonic crystals and metamaterials. Ara has more than 100 publications in world leading journals and his current citation h-index is 30 on Google Scholar with total citations just short of 2900.

Keywords: Photonic crystals, Topological Photonics, Metamaterials, Anderson Localization, Quantum Optics

Honours programs: Bachelor of Mathematical Sciences

I have previously supervised Honours projects on:

- Gaussian beam scattering on photonic crystals
- Characterization of two dimensional photonic crystals infiltrated with liquid crystals

What methods or research skills will you learn?

- How to use mathematics to describe wave scattering in modern complex and exciting structures
- Write simple FORTRAN codes to find numerical solutions for derived equations

Activities within the Discipline:

- Currently I am teaching several Mathematics subjects at different levels at UTS.

I have collaborated with world leading researchers in the field such as:

- Prof S. Fan from the Stanford University
- Prof H. Cao from the Yale University
- Prof V. Freilikher from the Ben Gurion University
- Locally, with Prof C. Poulton from the Maths department

Prof James Brown

Head of Discipline | Professor of Official Statistics
Mathematical Sciences
james.brown@uts.edu.au

James completed his PhD in 2001 looking at estimation and adjustment of census coverage for the 2001 Censuses of the UK, and he has over 25 years experience collaborating with government statistical agencies. He also has general interests in applied statistics with applications in health, education, and law; and works on approaches to population size estimation and use of administrative data in official statistics. He moved to Australia and UTS in 2013 and maintains connections to ABS.

Keywords: applied statistics, surveys, population census, health, education

Honours programs: Bachelor of Mathematical Sciences (Honours), Master of Philosophy (Mathematical & Statistical Data Science)

I supervise Honours projects on:

- Statistical modelling applied to health / education / law applications
  My current work is focusing on legal needs of people with HIV / Hepatitis, but happy to work with students on data that interests them.
- Use of (non-random) surveys in official statistics
  Traditional survey inference relies on the design-based approach of random selection but how can we do acceptable inference with non-random surveys?

What methods or research skills will you learn?

- The application (and extension) of statistical modelling skills you have developed in your studies so far.
- Statistical computing skills

Activities within the Discipline:

- I currently supervise (jointly) two PhD students; one working on population size estimation and one looking at small area estimation using surveys. Within the Discipline, I typically work with Dr Joanna Wang and A/Prof Stephen Woodcock.

I collaborate with:

- Dr David Carter in Law
- Australian Bureau of Statistics
  - a direct project with ABS is possible for Australian Citizens
  - working on things of ‘interest’ to ABS is possible for any student

Prof Sally Cripps

Professor of Mathematics and Statistics
Director of Technology at Human Technology Institute
sally.cripps@uts.edu.au

I am the Director of Technology at the Human-Technology Institute (HTI) at UTS. I am also a professor of mathematics and statistics with expertise in Bayesian machine learning and statistics. At HTI we have a large research grant to study the educational pathways of Australian school children to learn what interventions impact outcomes. We do this using Directed Acyclical Graphs (DAGs) and the impact of interventions on the structure of the graph. We have 4 research scientists as well as several scholarships for HDR students from the Next Gen AI program administered by CSIRO.

Keywords: Bayesian machine learning, graphical models, causal inference

Honours programs: mathematics and statistics

I supervise Honours projects on:

- Bayesian Graphical Models; jointly learning the structure and impact of interventions with application to educational outcomes.
- Mixture models for heterogenous Directed Acyclical Graphs with application to mental health outcomes

What methods or research skills will you learn?

- Causal Inference and uncertainty quantification, probability theory, Markov chain Monte Carlo

Our team (optional):

- Roman Marchant

[I/we] collaborate with (optional):

- The Brain and Mind Centre at the University of Sydney; The Centre for Transforming Early Education and Child Health at Western Sydney University; The Paul Ramsay Foundation

Prof Anthony Dooley

Professor
Mathematics
Anthony.dooley@uts.edu.au

My research area is in mathematical analysis, notably harmonic analysis on Lie groups, and ergodic theory of non-singular group actions. I did my PhD at ANU, have held positions at UNSW, University of Bath and have been at UTS since 2016. I have supervised 23 PhD theses and 35 Honours/Masters projects over a wide range of mathematical topics ranging from mathematical foundations of quantum mechanics, through contractions of Lie groups, calculus of variations, algebraic geometry, to applications in finance. I'm interested in applications of analysis in data science.

My UTS profile is available here.

Keywords: Mathematical analysis, harmonic analysis, differential equations, Lie groups, ergodic theory

Honours programs:

I supervise Honours projects on:

- Fourier analysis and its extensions to harmonic analysis on Lie groups, including representation theory, and geometrical methods.
- Ergodic theory and Dynamical Systems is the study of how systems transform under a transformation or group of transformations. Random dynamical systems introduce randomness or noise.
- Current interests include mathematical models in biology including enzyme kinetics.

What methods or research skills will you learn?

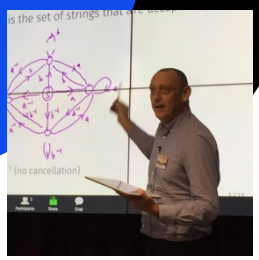
- Expertise in a range of mathematical techniques spanning analysis, geometry with links to probability and stochastic calculus. Advanced techniques for solving systems of differential equations. Some of these are relevant to mathematical finance, and biological modelling.

Our team:

- PhD students: Tim Guo, Jie Jin, Faisal Arlwile, Greg Cave, Ghali Hussein

I collaborate with:

- Join the Groups Analysis Geometry seminar, which meets every fortnight to discuss student and staff projects.



Prof Murray Elder

Professor
Mathematics
Murray.Elder@uts.edu.au

My research lies at the intersection of pure mathematics (algebra, geometric group theory, enumerative combinatorics) and theoretical computer science (computational complexity, algorithms, formal language theory). Please see my webpage for papers and more information.

Previous students have worked on

- pattern-avoiding permutations
- geodetic graphs
- growth functions for groups
- automata groups
- random walks on groups

Keywords: geometric group theory, complexity theory, automata and formal language theory, enumerative combinatorics, pattern-avoiding permutations

Programs: AMSI Vacation Research Scholarship program; 32931 Technology Research Methods; C09129 Bachelor of Mathematical Sciences (Honours); C03026 Master of Science (Research) in Mathematical Sciences; C02030 Doctor of Philosophy

Useful background/skills:

- Programming skills (Python, C++, Rust, etc.)
- LaTeX
- Interest in pure mathematics or theoretical computer science
- UTS Subjects: 37181 Discrete Mathematics; 41080 Theory of Computing Science; 37233 Linear Algebra; 35003 Modern Algebra; 68105 Algebra

My team:

- Jerry Shen, PhD student

I collaborate with:

- Alex Bishop (Geneva, Switzerland)
- Laura Ciobanu (Heriot-Watt, UK)
- Volker Diekert (Stuttgart, Germany)
- Andrew Duncan (Newcastle, UK)
- Mengfan Lyu (WSU)
- Adam Piggott (ANU)
- Youming Qiao (FEIT, UTS)
- Kane Townsend (ANU)
- Armin Weiss (Stuttgart, Germany)

Dr Len Patrick Garces

Lecturer, Program Director (PG Quantitative Finance)
Mathematical Sciences
LenPatricDominic.Garces@uts.edu.au

Len's research interests lie within the field of financial and actuarial mathematics, primarily on the applications of probability theory and stochastic analysis to tackle financial and actuarial problems and the development of numerical and statistical methods to solve these problems. His current research is on continuous-time stochastic mortality models and their applications to actuarial valuation, the design and valuation of retirement income products, robust consumption and investment problems, and indifference pricing of mortality-linked securities.

Keywords: financial mathematics, insurance studies, mortality modelling, probability theory, stochastic analysis

Honours programs: Bachelor of Mathematical Sciences (Honours), Master of Philosophy (Mathematical and Statistical Data Science), Master of Data Science in Quantitative Finance

I supervise Honours projects on:

- **Pricing of financial derivatives:** Given some assumptions on the evolution of financial asset prices and other risk factors, we are interested in pricing contracts whose value is dependent on the value of simpler financial assets and in quantifying and managing the risk exposures related to these products
- **Design and valuation of innovative insurance or retirement income products:** In view of increasing mortality and longevity risks, there is also an increasing demand for innovative products to help supplement one's retirement income. This project seeks to design optimal retirement income products and use mathematical methods to price these contracts.

What methods or research skills will you learn?

Depending on the project, you will learn:

- How to apply stochastic analysis and probability concepts (and extend those that you have learned) to formulate and solve problems in finance and insurance studies
- How to design and implement numerical methods to solve ODEs and PDEs in Matlab or Python
- Visual, written, and oral communication of results arising from an applied mathematics research project

I collaborate with:

- Academics from the School of Risk and Actuarial Studies, UNSW Sydney
- Quantitative finance researchers in the School of Mathematical and Physical Sciences, UTS.

Dr Hanyu Gu

Senior Lecturer
Mathematical Science
hanyu.gu@uts.edu.au
https://profiles.uts.edu.au/Hanyu.Gu

My research interests are focused on solving large-scale combinatorial optimisation problems using decomposition methods, stochastic programming, integer programming, hybrid meta-heuristics and machine learning. Since joining UTS in 2013, I have worked with industries on education timetabling, train maintenance planning, vehicle routing, and project scheduling for underground mining. I have a PhD in Power Engineering from Shanghai Jiao Tong University and have worked in several companies including NICTA.

Keywords: combinatorial optimisation, integer programming, stochastic programming, machine learning, planning and scheduling

Honours programs: Bachelor of Science (Honours), Master of Philosophy (Mathematical Science)

I supervise Honours projects on:

- Solving large industrial optimisation problems arising in mining, transportation, manufacturing, and supply chain
- Decision under uncertainty including stochastic programming and reinforcement learning
- Machine learning for optimisation including Bayesian optimisation and neural network.
- Optimisation for machine learning
- Theory and algorithms on combinatorial optimisation and scheduling

What methods or research skills could you learn?

- Advanced theory and algorithms for various optimisation problems
- Techniques for solving real-world problems
- Computer programming skills for solving complex optimisation problems

I co-supervise projects with:

- Julia Memar

A/Prof Mikhail Lapine

Associate Professor
Mathematical Sciences
Mikhail.Lapine@uts.edu.au

Mikhail is exploring a wide range of research directions related to artificial materials, metamaterials and metasurfaces, which are assembled of specifically designed "meta-atoms". Such materials provide a route to unusual properties such as negative refractive index, extreme diamagnetism, dispersion compensation, etc., and operate predominantly in the areas of electromagnetism and acoustics.

Keywords: Metamaterials, Metasurfaces, Nonlinear optics, Effective material parameters, Optoacoustics

Honours programs: Bachelor of Mathematical Sciences (Honours), Bachelor of Science (Honours)

I am offering projects on:

• Effective material parameters of unconventional structures.
Design of metamaterials and metasurfaces has been typically performed along the lines of relatively simple shapes which permit a clear theoretical description (such as conducting rings, for example). However such designs do not necessarily offer optimal characteristics. In this projects, more sophisticated shapes will be explored for resonant metamaterials as well as non-resonant diamagnetics, combining theoretical and numerical approaches for the analysis.

• Mesoscopic material parameters for large finite structures
If at all, material properties are best understood for two extreme situations: when we have a piece of material with so many atoms that it can be treated effectively "infinite" and analysed on average, or when we have a few specific structural elements which can be directly modelled in a precise way. However, there is size / scale gap between the two simple limits, systems with many thousands of meta-atoms. In this project, semi-analytical and numerical methods are being developed for such structures.

What methods or research skills will you learn?
• Electromagnetic theory
• Nonlinear optics
• Numerical modelling of large systems
• Programming in Matlab

Collaboration within the School:
I normally work and co-supervise students with:
Prof Chris Poulton, A/Prof Alex Solntsev, and A/Prof Matthew Arnold

External Collaborators:
• Prof Yuri Kivshar (Australian National University, Canberra)
• Prof Pavel Belov (ITMO University, Saint Petersburg, Russia)
• Prof Andrey Bogdanov (Harbin University of Technology, Qingdao, China)
• Prof Pavel Ginzburg (Tel-Aviv University, Israel)
• Prof Tim Liedl (Lüdwig-Maximillian-University, München, Germany)

Dr Julia Memar

Lecturer
Mathematical Sciences
Julia.Memar@uts.edu.au

Julia is an applied mathematician with interests in approximate and exact algorithms for scheduling problems, flow shop problems with a buffer, Lagrange relaxation methods, complexity theory. Julia's recent project is concerned with applications of stochastic scheduling for underground mining.

Julia has been teaching mathematics at UTS for more than ten years, and she also runs the UTS Mathematics Bridging courses and Mathematics and Science Study center that provides support in introductory mathematical and quantitative areas including statistics and selected first-year science subjects.

Julia holds Master's degree in applied mathematics from Moscow State University and PhD in Operations Research from UTS.

Keywords: operations research, optimization, scheduling, complexity theory, stochastic programming

Honours programs: Bachelor of Science (Honours), Master of Philosophy (Mathematical Science)

I supervise Honours projects on:

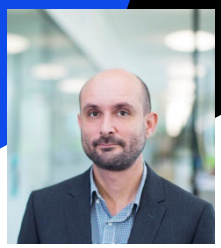
- Theory and combinatorial optimization and scheduling algorithms
- Decision under uncertainty including stochastic programming

What methods or research skills will you learn?

- Theory and algorithms for optimization and scheduling problems
- Methods and approaches for solving applications
- Computer programming skills

I co-supervise projects with:

- Dr. Hanyu Gu



Prof Chris Poulton

Professor
Mathematical Sciences
Chris.Poulton@uts.edu.au

Chris is either a theoretical physicist or an applied mathematician, depending on your point of view. His main research area is the interaction of light and sound on the nanoscale. He does a lot of numerical research, building mathematical models that describe waves in complex materials. He works with experimental physicists at UTS and at the University of Sydney, as well as in Germany.

Keywords: Photonics, Nonlinear optics, Electromagnetic waves, Elastic waves

Honours programs: Bachelor of Mathematical Sciences (Honours), Bachelor of Science (Honours)

I supervise Honours projects on:

- **Waves at the extremes of nonlinear optics**
  Metals are interesting materials in wave physics – not only are they highly reflective, but they also support waves that travel along edges. Interestingly, there is another family of waves that travel along edges: these are Rayleigh waves, which are mechanical vibrations that often arise in earthquakes. At very high frequencies and on the nanoscale these two types of waves can interact – this project will explore what happens when they do.

- **Ultra-long-wavelength waveguides**
  Everybody knows that optical fibres can be used to guide light. However weird things happen when the frequency of the light becomes really small. This project will examine and get to the bottom of this weirdness, looking at waveguides for both light and sound.

What methods or research skills will you learn?

- Advanced optical physics
- Advanced Electromagnetic theory
- Elasticity theory
- Numerical modelling of complex systems
- Programming (Python or Matlab)

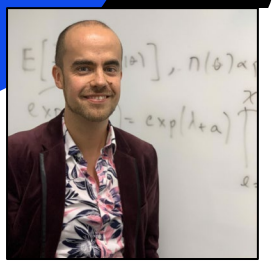
Collaboration within the School:

I usually work and supervise students with:

- A/Prof. Matthew Arnold, A/Prof. Irina Kabakova, A/Prof. Alex Solntsev, A/Prof. Mikhail Lapine, A/Prof. Nathan Langford

External Collaborators:

- Prof. Michael Steel (MQ), Dr Mikolaj Schmidt (MQ)
- Dr Moritz Merklein (U.Syd)
- Prof. Markus Schmidt (Jena, Germany)
- Prof. Birgit Stiller (Max Planck, Germany)



Dr Matias Quiroz

Senior Lecturer
Mathematical Sciences
Matias.quiroz@uts.edu.au

My research interests lie in the area of computational statistics, which is closely related to machine learning. You can find out more about my research on www.matiasquiroz.com.

Keywords: Statistical computation, Bayesian inference, complex models

Honours programs: Bachelor of Mathematical Sciences (Honours), Master of Philosophy (Mathematical & Statistical Data Science)

I supervise Honours projects on:

- **Speeding up Markov chain Monte Carlo for large datasets**:
  Markov chain Monte Carlo is arguably the state-of-the-art algorithm for sampling from the posterior distribution in Bayesian statistics. This project will study some of the existing approaches and novel areas of application of the methodology.
- **Bayesian variable selection for large datasets**:
  One approach to Bayesian variable selection in regression models is to augment each covariate/variable with a binary indicator that determines if the variable is included in the model. The posterior distribution of this binary indicator gives the probability that the variable is included in the model, conditional on the observed data. While a closed form solution exists for the Gaussian case, the posterior is prohibitively expensive to evaluate for large datasets. This project will explore a variational approach combined with data subsampling to obtain a tractable approximation of the posterior distribution of the binary indicator.

What methods or research skills will you learn?

- A deep understanding of state-of-the-art simulation and optimisation algorithms.
- A solid knowledge of implementing, analyzing, and validating algorithms.

My team:

- I currently supervise HDR students Thomas Goodwin and Zixuan Wang, and honours student Bailey Britton.

Dist Prof Matt Wand

Distinguished Professor of Statistics
Mathematical Sciences
Matt.Wand@uts.edu.au

Keywords: Linear mixed models, nonparametric regression, variational inference, statistical computing.

I supervise Honours projects on:

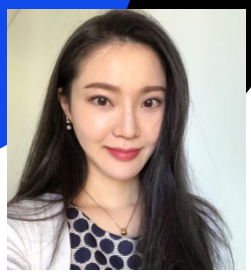
Statistical methodology, theory and computing geared towards large and complicated data sets. The project could involve any of these three facets. A possible area of application is electronic commerce.

What methods or research skills might you learn?

Depending on the project, you may learn about advanced distribution theory, graph theory, Markov chain Monte Carlo algorithms, variational inference algorithms, algorithmic development and implementation in computer languages such as R and C++, R packaging, statistical theory involving e.g. matrix algebra and asymptotic expansion.

I collaborate with:

Several researchers in Statistics and other areas, in various universities around the world.



Dr Joanna Wang

Senior Lecturer, Honours and Masters in Mathematical Science Program Director
Mathematical Sciences
joanna.wang@uts.edu.au

Joanna completed her PhD at the University of Sydney investigating ways to improve econometric models for financial time series data. Before joining UTS in 2019, I worked as a research statistician at the Bureau of Crime Statistics and Research. My research primarily focuses on applied statistics, with applications in health, epidemiology and crime. My current research program focuses on the analysis of crime data for undertaking rigorous evaluations to evaluate the effectiveness of justice programs and policies.

Keywords: applied statistics, crime data, policy evaluation, health and epidemiology

Honours programs: Bachelor of Mathematical Sciences (Honours), Master of Philosophy (Mathematical & Statistical Data Science)

I supervise Honours projects on:

- Statistical modelling applied to health / crime data
- Use of interrupted time series model for evaluation studies

What methods or research skills will you learn?

- Statistical methods for modelling time series data
- Statistical methods for intervention evaluation
- Statistical computing skills

I collaborate with:

- Professor James Brown
- Bureau of Crime Statistics and Research
- Crime and Security Science research group in Faculty of Arts and Social Sciences

A/Prof Stephen Woodcock

Associate Professor
Mathematical Sciences
stephen.woodcock@uts.edu.au

Stephen joined UTS in 2010 after studying at the University of Glasgow and the University of Oxford in the UK. During this time, he has enjoyed strong collaborations with a diverse group of researchers, mainly in the health and environmental sciences and brings skills in applied probability, applied statistics and theoretical ecology to a diverse range of problems. His research is centred on the applied sciences and always aims for real-world impact. He has a strong record of successful student supervision at Honours, Masters and PhD level, including several past Honours graduates going on to subsequent PhD study after graduation.

Keywords: applied probability, applied statistics, mathematical biology, environmental modelling, sport and exercise science, game theory

Honours programs: Bachelor of Mathematical Sciences (Honours), Master of Philosophy (Mathematical & Statistical Data Science)

I supervise Honours projects on:

- Applications of probability theory and statistics to biological systems. This covers a broad range of topics with applications in the health sciences and environmental sciences. These can be very applied, data-driven projects in close collaboration with field or laboratory researchers or can be more theoretical, for example modelling interspecies competition from a game theory perspective.

What methods or research skills will you learn?

- Interdisciplinary communication and collaboration
- Statistical computing skills

I collaborate with:

- Particularly on projects in the health sciences, I collaborate within the Discipline, primarily with Prof. James Brown.
- Researchers in the Climate Change Cluster (C3), specifically coral biologists interested in the health of the Great Barrier Reef
- Researchers in the School of Life Sciences, including the Seafood Safety Group, looking at improving the sustainability and profitability of Australia's seafood industry, maintaining high levels of safety for the human food supply.
- Sports and exercise scientists within the Human Performance Research Centre (HPRC) in the Faculty of Health, based at UTS's Moore Park campus. This work is focused on both health and performance outcomes at all levels, from elite professional sports to grassroots participation.