Each of the projects listed below have a scholarship available funded by the supervisors’ research grants and awards. Further scholarships are listed on the University Scholarships website.

If you are interested in a project, send the supervisor of a project an up-to-date CV, your transcripts, and a short description of why you are interested in the project.

**Faculty of Engineering PhD Scholarship Opportunities by School**

**Aerospace, Mechanical and Mechatronic Engineering** ............................................................... 4

- Design and development of sustainable and high-performance alloys via nanostructure engineering........................................................................................................4
- Improving mechanical properties of metallic materials via combined compositional and structural heterogeneities ..............................................................................................................4
- Advanced characterisation of hydrogen embrittlement in pipeline and vessel steels .......................5
- Characterisation of material mechanical properties in extreme environments..............................6
- Nanomaterials Engineering for Bioelectronics, Organic Photovoltaics and Beyond ..........................7
- Detection and Treatment to Prevent the Progression of Coronary Artery Disease (CAD) ..................8
- State Estimation and Planning in Dynamic Environments ..................................................................9
- Robotic Perception Lab Scholarships ................................................................................................10
Advanced Shape Measurement for Aerodynamics and Flight ............................................................... 11
Novel High-Performance Copper-Based Materials via Additive Manufacturing .................................... 12
Microstructure and Mechanical Behaviour of Advanced High-Entropy Alloys ..................................... 13
Trusted Autonomous Marine Systems ................................................................................................... 13
Multiscale Modelling and Nondeterministic Optimisation for Reliable Stents (ARC DP180104200) .... 14
Microstructural-Functional Effect of Advanced Biomaterials (collaborated with SDI Pty Ltd) (ARC LP180101352) ......................................................................................................................................... 15
The impact of a-site dopant on the electromechanical properties of ferroelectric materials.............. 15

Biomedical Engineering .......................................................................................................................... 16
Bioengineering Advanced Cell and Tissue Therapeutics for Tissue Regeneration Degeneration........ 16
MRI-compatible robotic platform for dynamic imaging and therapy applications ................................ 16
Lameness detection and characterisation in athlete horses .................................................................... 16
Advanced motion tracking for motion-compensated positron emission tomography ......................... 17
AI-based motion correction for PET brain studies ................................................................................... 17
BREEZE: Better neuroimaging for children with cerebral palsy ......................................................... 18
Unobtrusive Sensor Systems for Healthcare ............................................................................................ 18
Data Processing for Sleep Monitoring .................................................................................................... 19
Sensing Technology ................................................................................................................................ 20
Develop single-cell mechanobiological methods for discovering molecular mechanisms of cardiovascular and neuronal mechanical force sensing ......................................................... 20
Develop point-of-care microfluidic technologies for cardiovascular and cerebrovascular diseases .... 22
Molecular dynamics simulation and computational design for anti-thrombotic peptide drugs .......... 23
Develop single-molecule and super-resolution microscopy imaging technologies in the cardiovascular disease ............................................................................................................................... 24
Real-time cell mass identification of cellular processes to build the next generation of diagnostics ... 25
Thermal Optimisation of Gigascale Solar Photovoltaics ........................................................................ 25
Thin Film Coatings and Hydrogels for Cell Culture Microenvironments ............................................. 27
Plasma Polymerised Nanoparticles for Diagnostics and Therapeutics .................................................. 27
Surface Functionalisation for Microfluidic Devices .................................................................................. 28
Interfaces for Biosensing ........................................................................................................................ 28
Scaffolds and tailored environments for tissue regeneration and disease modeling ........................... 29
Biomolecule patterning for guided biomolecule and cell responses ....................................................... 29
The role of surface charge and electric fields in biomolecule interactions .......................................... 30

Chemical and Biomolecular Engineering ............................................................................................. 30
Improving the stability of carbon electrocatalysts in fuel cells and electrolyzers ................................. 30
SmartCrete CRC Postgraduate Scholarships .......................................................................................... 31
Classification and repurposing wastes into concrete ............................................................................ 32
Performance assessment of repurposed concrete in water asset pipes ............................................... 33
Servicing-life or performance models for water assets .............................................................................. 33
Sensing water asset conditions ...................................................................................................................... 34
Fundamental Mechanism of Protein Phase Behaviour .............................................................................. 34
Biomaterials from Protein/Peptides Manipulation ...................................................................................... 34
Chemical Recycling of Mixed Waste Plastics .............................................................................................. 35
Advanced Food Engineering – Smart Food Packaging .............................................................................. 35
Advanced Food Engineering – Biosensors for applications in medicine, food and agriculture .......... 36
Computational Modelling for Designing Optimum Structural, Mechanical, and Physical Properties of Materials for a Heart Valve ....................................................................................... 36
Engineering Processable Tough Hydrogels ................................................................................................. 37

Civil Engineering Projects ........................................................................................................................... 37
Biogeochemical modelling of soil organic and inorganic carbon ............................................................... 37
Design of Flexible Public Transport Networks .............................................................................................. 38
Corrosion investigation of steel-reinforced concrete and composite bridges .............................................. 40
Experimental study of atmospheric winds in and above forested canopies ................................................. 40
Computational study of the convective daytime atmospheric boundary layer ............................................. 41
Advanced composite building technology for prefabricated construction .................................................. 42
Behaviour of built-up cold-formed steel members and buildings ............................................................... 42
Material characterisation and residual stresses of 3D-printed steel structures .......................................... 43
Developing new methods for the characterisation of nanoplastics in solids and liquids ............................ 44

Computer Science Projects .......................................................................................................................... 45
Adaptive Resource Management for Sustainable Edge Computing Systems ............................................. 45
Adaptive and Ubiquitous Trust Framework for Internet of Things interactions ........................................... 45
Deep Learning Theory .................................................................................................................................. 46
Fundamental Trade-offs between Data, Computation, and Privacy ............................................................. 46
System ML, IoT/edge Driven ML Adaptation ............................................................................................... 47
Large-Scale Transformer Neural Networks in the Real World ..................................................................... 47
Beyond Worst-Case Analysis: Tools for Developing Practical Algorithms ..................................................... 47
Resilient and Secure Edge Computing for Untrusted Distributed Systems .................................................... 48
Geometric Networks in the Presence of Obstacles ..................................................................................... 49

Electrical and Information Engineering Projects ............................................................................................... 50
Quantum Topological Photonics ..................................................................................................................... 50
Grid integration of inverter-interfaced energy resources .............................................................................. 50
Powering Community Batteries for Power System Transition ................................................................. 51
Augmented Reality for the Visually Impaired – Sensory Augmentation ......................................................... 51
Real-Time Magnetic Resonance Imaging for Vocal Tract Analysis ......................................................... 53
Direct Signal Processing .......................................................................................................................... 54
Logic Development of MAC Systems for Wireless Communications ..................................................... 55
Nanophotonic radiation control for sustainable energy ........................................................................ 56
Frontiers of Nanophotonics .................................................................................................................... 56

**Project Management Projects** ........................................................................................................57
Project analytics and the delivery of major projects Project Conception and Future Making .......... 57
Project Conception and Future Making.................................................................................................. 58
Digital delivery in project-based industries ............................................................................................ 58
Aerospace, Mechanical and Mechatronic Engineering

Design and development of sustainable and high-performance alloys via nanostructure engineering

Supervisor:
Dr Xianghai An – xianghai.an@sydney.edu.au

Research Areas:
Materials Engineering; Metallic Materials; Mechanical Behaviour; Nanostructures; Infrastructure and transportation.

Project Description:
High-performance alloys are the backbone of decarbonising innovations in manufacturing, infrastructure, energy, and transportation. There is an accelerated demand for high-strength materials to produce lighter, more-reliable structural components. Stronger alloys will substantially improve mechanical and energy efficiencies, which can benefit our economy and environment directly. However, high-strength materials typically have low ductility and are more vulnerable to fracture. Furthermore, they are also susceptible to hydrogen embrittlement (HE) in many service environments for renewable energy applications such as hydrogen transportation and the bearings of wind turbines. Hydrogen-induced embrittlement can lead to unpredictable and catastrophic failures at relatively low applied stresses. These critical shortcomings cause serious safety concerns but cannot be readily addressed by traditional materials development approaches that generally render materials property trade-offs between strength and ductility/HE resistance.

Gradient structures are an emerging material-design paradigm inspired by nature that has great potential to overcome these alloy design trade-offs. This project aims to develop an innovative design strategy of gradient segregation engineering (GSE) to produce high-performance alloys by synergistically introducing a chemical gradient via grain boundary (GB) segregation and a physical gradient by nanostructure control. The novel GSE will entail a synergy of multiscale strengthening mechanisms that offer an exceptional strength-ductility combination and simultaneously enable the hierarchical HE-resisting mechanisms to notably enhance the hydrogen tolerance.

Further Information:
Please send your CV, transcript, and a brief description of motivation to xianghai.an@sydney.edu.au

Improving mechanical properties of metallic materials via combined compositional and structural heterogeneities

Supervisor:
Professor Xiaozhou Liao – xiaozhou.liao@sydney.edu.au

Research Area:
Materials Science and Engineering; Metallic materials; Heterogeneous Structures; Mechanical Properties; Electron Microscopy
Project Description:
Strength and ductility are among the most important mechanical properties of materials. Materials with high strength and high ductility are desirable for many structural applications. However, strength and ductility are usually mutually exclusive, i.e., high strength is usually accompanied by poor ductility and vice versa. Significant worldwide efforts have been made looking for solutions to overcome the paradox of strength and ductility. One possible solution is to introduce combined compositional and structural gradients. This project aims to explore how different gradient structures affect deformation behaviour and mechanical properties. Electron microscopy including in-situ straining electron microscopy will be a key research tool of the project.

Further information:
One PhD scholarship is available, and the project can be started immediately. Applicants should include their CV and transcripts in their application.

Advanced characterisation of hydrogen embrittlement in pipeline and vessel steels

Supervisor:
Dr Eason (Yi-Sheng ) Chen – yi-sheng.chen@sydney.edu.au

Research Areas:
Materials Engineering, Microscopy, Hydrogen

About the opportunity:
Australia has committed to achieving a carbon-free economy by 2050 to preserve our climate for future generations. Replacing fossil fuels with clean hydrogen fuel is key to this transition but presents a challenge in terms of infrastructure, as conventional steels fracture easily when they come into contact with hydrogen. The project aims to develop new steels that are safe to use in high-pressure hydrogen pipes. It will focus on understanding the interaction between steel microstructure and hydrogen, ultimately enabling the production of a safe gas infrastructure necessary for a hydrogen economy.

This prestigious scholarship is directly supported by the Deputy Vice Chancellor (Research) of the University of Sydney as part of the Australian Research Council Linkage Project. The selected researcher will be involved in a collaborative network, including international steel manufacturers and world-leading researchers, having opportunities to attend international conferences. For more information, please visit:


Offering:
This scholarship is offered to both international and domestic PhD applicants for 3.5 year (fulltime) at the RTP stipend rate of $37,207 p.a. and includes tuition fees.

Female applicants are strongly recommended to apply.
Successful candidates must:

- Have a Bachelor degree (Honours or Honours Class 1 equivalent) or a Master degree,
- Have a degree or track records in Materials, Mechanical Engineering, or Physics,
- Have experience in experimental research, academic writing, and using microscopes for microstructure characterisation,
- Be able to commence fulltime by the 20 October 2023.

How to Apply:

To apply, please email yi-sheng.chen@sydney.edu.au, with the subject line “PhD Application:” and your name. Include the following:

- CV and cover letter
- Transcripts (can be unofficial)

Characterisation of material mechanical properties in extreme environments

Supervisor:

Dr Eason (Yi-Sheng) Chen – yi-sheng.chen@sydney.edu.au

Research Areas:
Materials Engineering, Materials Characterisation, Mechanics

About the opportunity:

This PhD project aims to establish and apply the state-of-the-art facility to conduct mechanical testing under in-situ observation at small scales in high-resolution microscopes to understand material behaviours under various extreme environments such as high and low temperatures, high-cyclic loading, highly abrasive and corrosive environment, or hydrogen. The outcomes will provide valuable insights of how microstructures affect mechanical properties at the conditions, providing a guide to develop structural materials that can withstand the conditions, underpinning the advancement of Australia’s advanced manufacturing and sustainable energy sectors.

This scholarship is co-funded by the Future Fuels CRC program and the Australian Research Council. The selected researcher will conduct research primarily at the Australian Centre for Microscopy and Microanalysis and the School of Aerospace, Mechanical and Mechatronic Engineering of the Faculty of Engineering. The candidate will be involved in a collaborative network, including world-leading researchers and international industry partners producing high-end microscopes and mechanical testing facilities. The candidate will also have regular opportunities to attend international conferences with funding support.

Offering:

This opportunity is open to domestic and international students, with priority given to domestic applicants. The scholarship is for 3.5 year (fulltime) at the RTP stipend rate of $37,207 p.a. and includes tuition fees. Female applicants are strongly recommended to apply.

Successful candidates must:

- Have a Bachelor degree (Honours or Honours Class 1 equivalent) or a Master degree,
- Have a degree or track records in Materials, Mechanical Engineering, or Physics,
- Have experience in experimental research, academic writing, and using microscopes for microstructure characterisation,
- Be able to commence fulltime by the 20 October 2023 or early in 2024.

**How to Apply:**
To apply, please email yi-sheng.chen@sydney.edu.au, with the subject line “PhD Application:” and your name. Include the following:
- CV and cover letter
- Transcripts (can be unofficial)

**Nanomaterials Engineering for Bioelectronics, Organic Photovoltaics and Beyond**

**Supervisor:**
Dr Natalie Holmes – natalie.holmes@sydney.edu.au

**Research Areas:**
Nanomaterials, Organic Electronics, Advanced Microscopy

**About the opportunity:**
This PhD research project will develop nanomaterials synthesised from organic semiconductors and bioactive molecules for applications in bioelectronics (artificial retina), organic photovoltaics (solar cells) and beyond. The research project is funded by an Australian Research Council (ARC) Discovery Project grant and will be conducted within the Australian Centre for Microscopy and Microanalysis. This project will utilise advanced microscopy tools (electron microscopy and synchrotron-based X-ray nanoscale microscopy) to form a feedback loop that informs smart nanomaterials design for future flexible electronics. The expected outcomes of this project include new high performance nanoengineered materials, measurement tools and fabrication approaches. Students in the engineering, chemistry and/or physics stream would be suitable candidates for this PhD project. The candidate will undertake their research as part of a multidisciplinary team within the University of Sydney Faculty of Engineering. The candidate will have access to the university's flagship research facilities - the Sydney Nanoscience Hub and Sydney Microscopy & Microanalysis.

**Offering:**
Full-time 3.5 year PhD with a stipend of $37,207 p.a.

**About you:**
The University values courage and creativity; openness and engagement; inclusion and diversity; and respect and integrity. As a PhD student, you will work under broad direction and will be expected to utilise your experience, technical expertise, scientific knowledge and training/qualifications to resolve matters that arise across the research laboratory to meet the strategic directions of the project.

We are seeking a domestic or international student, who holds an honours/masters degree in addition to a Bachelors degree in materials engineering, chemistry, physics, or equivalent.
How to apply:
To apply, please email Natalie.Holmes@sydney.edu.au, with the subject line “PhD Applications” and your name. Include the following:
- CV and cover letter
- Transcripts (can be unofficial)

Open date:

Detection and Treatment to Prevent the Progression of Coronary Artery Disease (CAD)

Supervisor:
Professor Stefan Williams – stefan.williams@sydney.edu.au

About the opportunity
Are you excited by the opportunity to apply machine learning techniques to discover new solutions to human health?

Early detection and treatment can prevent the progression of coronary artery disease (CAD) and, consequently, heart attacks. While this can help individuals who display traditional risk factors such as diabetes, hypertension, high cholesterol, and smoking, many people develop CAD over years without the presence of any obvious risk factors. They remain unaware of their susceptibility to the disease and miss out on the opportunity to reduce their risk of a heart attack through taking lifesaving drugs.

CAD Frontiers is an Australian-led, global team composed of clinicians, researchers, data scientists, healthcare and industry leaders with a track record of discovery, innovation and translation. CAD Frontiers is partnering with the Digital Sciences Initiative (DSI) at the University of Sydney to explore the convergence of digital sciences in information, algorithms and machine learning for enhancing the impact and success of diagnostic intervention. By partnering with DSI, CAD Frontiers will build capacity to achieve rapid and demonstrable outcomes in research and commercialisation. The Digital health imaging team within DSI will support CAD Frontiers to improve the understanding, diagnosis and treatment of subclinical disease through developing multimodal AI algorithms that incorporate multiple data sources. AI algorithms for cardiac imaging data, co-designed with multidisciplinary domain expertise, can aid in image understanding and in extracting 'deep' image feature for 'image-omics' - an approach that associates imaging features with complementary -omics data for new biomarker discoveries. This work will revolutionise the clinical approach to early diagnosis of CAD through the discovery of novel biomarkers and the more efficient and affordable analysis of diagnostic imaging data. DSI's established dynamic digital business ecosystem is expected to provide CAD Frontiers with an important interface with start-ups through to multinational industry partners during the commercialisation phase. The partnership aims to maximise industry investment, competitiveness and the likelihood of delivering economic and health outcomes.

We have secured funding through the Vonwiller Foundation to support up to three Vonwiller stipends to support PhD students to develop novel clinical and data science approaches to CAD diagnostics. Working collaboratively, these students will accelerate research in applied machine learning to ultimately identify the molecular biosignatures of patients with silent atherosclerosis, and the application of these AI algorithms to imaging held in data banks such as BioHeart. Working in an interdisciplinary manner will bring
together medical, computer science and engineering mindsets to apply a smart digital solution to a devastating physical problem.

For more information on the CAD Frontiers, see here. More information about the DSI research-oriented mission in medical imaging can be found here.

About you

The University values courage and creativity; openness and engagement; inclusion and diversity; and respect and integrity. As such, we see the importance of recruiting talent aligned to these values and are looking for students interested in working to develop either one of the following skill sets:

Student 1

- tertiary qualifications in Medical Informatics, Computer Science, Machine Learning / Deep Learning / AI
- skills in software development including work with Python, C/C++ and the latest machine learning packages
- prior experience working with medical imaging modalities, in particular coronary artery disease imagery and related biomarker data, is desirable

Student 2

- tertiary qualifications in Data Science, Bioinformatics, Computer Science, applied machine learning or similar
- skills in applied machine learning development with medical imaging data using R or Python packages
- prior experience on recent platforms of omics data such as next generation sequencing or mass spectrometry is desirable
- high-dimension data analysis experience is desirable

We are looking for the following from all candidates:

- skills and experience necessary to manage the processes for testing and validation of machine learning algorithms in a clinical environment
- ability to conduct research / scholarly activities as part of a multidisciplinary research team
- experience managing large volumes of multi-modality data and a demonstrated track record of supporting high quality academic publications and clinical uptake
- the ability to liaise effectively with both scientific/technical and clinical colleagues
- ability to assist researchers from other disciplines as well as working with PhD students.

State Estimation and Planning in Dynamic Environments

Supervisor:

Dr Viorela Ila – viorela.ila@sydney.edu.au

Research Areas:

Robotics, Computer Vision, Optimization
**Project Description:**

In robotics, the conventional solutions for mapping dynamic environments focus on either trying to remove the data associated with moving objects, or detect and track the moving objects separately using traditional object tracking approaches. Ignoring dynamics in applications where the environment is cluttered with moving objects can drastically affect the safety of operations in such environments. Separately tracking moving objects, on the other hand, will produce representations of the world where the static and moving parts of the scene are decoupled. This can drastically affect the accuracy of the information used by the navigation and path planning algorithms, and in consequence the safe operation of autonomous vehicles.

The aim of this project is to develop an integrated framework to estimate and generate virtual representations of dynamic scenes that can be directly used by autonomous vehicles and intelligent systems to plan and perform tasks in a safe manner. [https://robotics.sydney.edu.au/our-research/robotic-perception/](https://robotics.sydney.edu.au/our-research/robotic-perception/)

**Further Information:**

Successful candidates will have:

- A bachelor’s degree in a relevant discipline
- Good mathematics and programming background.

**How to Apply:**

To apply, please email viorela.ila@sydney.edu.au, with the subject line “PhD Application:” and your name. Include the following:

- CV and cover letter
- Transcripts (can be unofficial)

**Robotic Perception Lab Scholarships**

**Supervisor:**

Dr Viorela Ila – viorela.ila@sydney.edu.au

**Research Area:**

Sensing, mapping and planning in dynamic environments.

**Project Description:**

The projects aim to develop and deploy on real robots theoretically well-founded solutions to robot localization, mapping and planning in dynamic environments.

Depending on interest and ability, candidates will investigate one or more of:

- Robust techniques for motion segmentation and tracking
- Novel spatial-temporal representations of dynamic environments
- Robust estimation and reconstruction of the dynamic scene
- Heterogeneous sensing for dynamic environments
Research Environment:

Embedded in the Australian Centre for Field Robotics, the Robotic Perception Lab is focused on delivering fundamental methodologies to sensing, mapping and planning in real-world dynamic environments.

The ACFR offers specialised labs and facilities, robotic platforms (underwater, agriculture, electric vehicles) and robotic field labs on-campus and in nearby off-campus sites. You will have access to mechanical and electronics workshops and a pool of technical staff to help realise your research ambitions. The University of Sydney offers a rich academic setting in a world class city, and the ACFR has strong ties to a network of nearby and international academic and industrial collaborators.

Further Information:

Successful candidates will have:

- A bachelor’s degree in a relevant discipline
- Interest in robotics
- Strong background in mathematics and programming
- Excellent communication and interpersonal skills
- Hands-on experience with robotic platforms, ROS, Python, C++, and/or deep learning frameworks would also be an asset
- Creativity, curiosity, rigour and passion

How to Apply:

To apply, please email viorela.ila@sydney.edu.au, with the subject line “PhD Application:” and your name. Include the following:

- CV and cover letter
- Transcripts (can be unofficial)
- A link to a 2 minute video covering your strongest engineering, mathematical, programming skills and what you enjoy most about research.

Advanced Shape Measurement for Aerodynamics and Flight

Supervisor:

Associate Professor Nicholas Lawson – nicholas.lawson@sydney.edu.au

Research Area:

Aerodynamics; Instrumentation; Sensors

Project Description:

Future aircraft will have increasing flexible structures, dominated by advanced composite materials. This presents challenges to the aerodynamics of the vehicle, which are closely coupled to the vehicle shape. The introduction of these new materials, also require more advanced health monitoring over the life of the structure.

Fibre optic based sensors provide the opportunity to measure many properties that are critical to the aerodynamics of the vehicle, including strain, temperature, pressure and shape. They can also be embedded into the composite structures, to provide health monitoring of the structure. Shape
measurement can now be performed using a combination of fibre optics, mounted into a sensor rod, which is secured onto an aerodynamic structure.

This research project will apply a fibre optic shape sensing system to a number of aerodynamic test structures, including a wing and fuselage. Several different sensor rods will be used to develop a bending and twist measurement system, through a series of representative model designs, tested in the University of Sydney Aerospace Engineering wind tunnels. The fibre optic shape system will be supplied from a research partner in the UK, Cranfield University. Different sensor configurations will need to be tested to find the highest performance shape and wing test, sensing system. Any performance will be validated using an alternative shape measurement method, such as photogrammetry or image pattern correlation methods. If the measurement performance of the shape system is acceptable, it will also be applied to the University of Sydney flying Jabiru experimental aircraft in a series of flight tests, potentially with the involvement of an industrial partner.

Further information:
We are looking for a talented and motivated individual to join our team to complete this 3 year PhD research project. It is essential that the candidate have a strong background, from their first degree, in Aerospace or Mechanical engineering and be prepared to complete both the theoretical and practical aspects of this project to a high standard. Previous experience in CAD and / or computational methods is also preferred.

This position is available to start from January 2022. Applications should send a cover letter explaining why they are suitable for this position, along with an updated CV to Associate Professor Nicholas Lawson (nicholas.lawson@sydney.edu.au)

Novel High-Performance Copper-Based Materials via Additive Manufacturing

Supervisor:
Dr Keita Nomoto – keita.nomoto@sydney.edu.au

Research Area:
Materials Science; Additive Manufacturing; Copper Alloys

Project Description:
A really exciting project, “Developing new rocket engine parts made of copper-based material via metal 3D printing,” is launching. Copper rocket engine parts are critical components in the revolution of the space industry, where low-cost and quickly produced space applications play a vital role. This project aims to develop novel high-performance copper-based materials produced by additive manufacturing (3D printing), which will provide significantly higher mechanical performance, superior electrical and thermal properties and enable flexible complex shape options. Atomic-scale microstructural analysis using advanced microscopy techniques, various mechanical tests, and simulation work will reveal profound insights into the process-structure-property relationship. Expected outcomes include new understandings of the fundamental physics of new functional materials, a new design of cost-effective products, and an ability to facilitate the increasingly widespread use of 3D printed copper-based materials in space.
Further information:

There is a full scholarship available for this project. If you are interested in fabricating new materials and using state-of-the-art equipment in the Sydney Manufacturing Hub and Australian Centre for Microscopy & Microanalysis, this project is an excellent opportunity for your PhD journey and future career. Students are advised to email their CV, transcript, and a brief description of why they are interested to keita.nomoto@sydney.edu.au

Microstructure and Mechanical Behaviour of Advanced High-Entropy Alloys

Supervisor:
Dr Xianghai An - xianghai.an@sydney.edu.au

Research Area:
Advanced materials; nanoscale characterization; Nanomechanics

Project Description:
Unlike the traditional alloying strategies that are basically epitomised by the single-major-element approach, the novel metallurgical design paradigm of high-entropy alloys (HEAs) is based on incorporating multi-principal elements in near equiatomic concentrations that generally form compositionally complex solid solutions. This new class of materials have triggered tremendous research interests in materials community since they empower us to break through to a new level of materials effectiveness’s, which are difficult to attain in conventional alloys, and they open a new avenue of alloy design that has been little explored. In this project, we will apply advanced characterization techniques to understand the origins of their superior mechanical properties. The outcomes will not only advance our knowledge about the deformation mechanisms of HEAs, but also will create an empowering map for the mechanistic HEA design to push the property boundary of possibility for enriching their potential applications.

Further information:
This project is supported by Dr. Linlin Li’s DECRA project which aims to start July - October 2021. There are 2 scholarships available and if you are interested, please send your CV, transcript and a brief description of why you are interested to xianghai.an@sydney.edu.au (Dr. Xianghai An, who will be the main supervisor and Dr Linlin Li's DECRA collaborator in USYD). Highly self-motivated candidates with background of mechanical and materials engineering are warmly welcomed.

Trusted Autonomous Marine Systems

Supervisor:
Professor Stefan B. Williams – stefan.williams@sydney.edu.au

Research Area:
Robotics; Autonomous Underwater Vehicles; Littoral survey
Project Description:

The University of Sydney’s Australian Centre for Field Robotics (ACFR) is one of Australia’s leading robotics research groups and undertakes fundamental and applied research in the area of field robotics. Their marine systems group is focused on the development of novel imaging payloads, sensors and vehicle systems for marine survey, visualisation, clustering and classification of extensive marine-based image archives, characterisation of change in multi-year surveys and adaptive mission planning for multi-vehicle systems. They lead Australia’s Integrated Marine Observing System (IMOS) AUV facility and undertake marine surveys at sites around Australia and overseas. They are also a core member of the Defence Cooperative Research Centre (DCRC) in Trusted Autonomous Systems (TAS), led by Thales Australia.

The ACFR has funding available through the DCRC TAS program to support a PhD stipend to undertake fundamental and applied research related to the development, design and deployment of novel AUV systems for littoral survey. The project will explore vehicle design, navigation, perception and control systems that will allow teams of vehicles to operate in nearshore environments. Applications include rapid environmental assessment and mine counter measures operations but also extend to environmental monitoring, marine archaeology, deep-sea geology and asset inspection.

Multiscale Modelling and Nondeterministic Optimisation for Reliable Stents (ARC DP180104200)

Supervisor:

Professor Qing Li – qing.li@sydney.edu.au

Research Area:

Finite element analysis and design optimisation; Biomechanics, Tissue engineering, Biomaterials; Additive manufacturing, Biofabrication

Project Description:

Multiscale Modelling and Nondeterministic Optimisation for Reliable Stents. Intravascular stents signify a class of lifelong micro-devices to support blood vessel for restoring circulation. Despite its remarkable initial outcome, the high rate of long-term mechanical failure remains a major concern. This project aims to study multiscale modelling and nondeterministic optimisation for a more reliable design of stents. It will tackle a series of fundamental yet challenging mechanics issues in design sensitivity for reliability analysis and optimisation. Those involve plasticity, fatigue damage and fracture across different length scales. The proposed nondeterministic optimisation is expected to minimise incidence of failure under uncertain conditions, thereby enhancing the longevity and reliability of stent therapy.

Further information:

Three scholarships are available for both international (if ranked high enough for tuition scholarship in the Faculty) and domestic students, immediately. Strong interest, motivation, and diligence are required for undertaking a high-quality PhD. Research experience would be preferable.
Microstructural-Functional Effect of Advanced Biomaterials (collaborated with SDI Pty Ltd) (ARC LP180101352)

Supervisor:
Professor Qing Li – qing.li@sydney.edu.au

Research Area:
Finite element analysis and design optimisation; Biomechanics, Tissue engineering, Biomaterials; Additive manufacturing, Biofabrication

Project Description:
Microstructural-Functional Effect of advanced biomaterials (collaborated with SDI Pty Ltd). This project aims to develop a fundamental understanding at the nanostructural level of the factors that contribute to the enhanced mineralisation and mechanical properties of dentine and enamel following the treatment with silver diammine fluoride (SDF). A variety of advanced nanomechanical, tomographic and microscopic techniques will be used to characterise sound, carious and SDF treated tissue. The new biomechanical evidence on the underlying mechanisms, alternative protocols, delivery systems enable to optimise the treatment. The scientific insights into arresting/repairing damage processes will provide critical data for developing minimal intervention protocols for pediatric and geriatric populations.

Further information:
Three scholarships are available for both international (if ranked high enough for tuition scholarship in the Faculty) and domestic students, immediately. Strong interest, motivation, and diligence are required for undertaking a high-quality PhD. Research experience would be preferable.

The impact of a-site dopant on the electromechanical properties of ferroelectric materials

Supervisor:
Professor Xiaozhou Liao – Xiaozhou.Liao@sydney.edu.au

Research Area:
Materials Science and Engineering; Ferroelectrics; Transmission electron microscopy

Project Description:
With outstanding ferroelectric properties, relaxor ferroelectric materials are ideal for many electromechanical devices, including sensors, actuators, and transducers. They can also be used for non-volatile memories and energy harvest. The ferroelectric properties of relaxor ferroelectric materials can be manipulated via varying the crystal structures and microstructures of the materials. This project aims to apply state-of-the-art ex-situ and in-situ transmission electron microscopy techniques to explore elemental doping effects on the crystal structure, microstructure and electromechanical properties of ferroelectric materials. The PhD student will be supervised by Prof. Xiaozhou Liao together with Prof. Shujun Zhang of the University of Wollongong and Assistant Prof. Zibin Chen of The Hong Kong Polytechnic University.
Further information:
One PhD scholarship is available and the project can be started ASAP. The candidate should have been in Australia. Applicants should include their CV and transcripts in their application.

**Biomedical Engineering**

**Bioengineering Advanced Cell and Tissue Therapeutics for Tissue Regeneration Degeneration**

**Supervisor:**
Professor Hala Zreiqat – hala.zreiqat@sydney.edu.au

**Research Areas:**
Cell and Tissue Therapeutics; Additive Manufacturing Building Organoids; Biomedical Engineering; 3D Printing

**Project Description:**
This project involves utilizing cutting-edge nanoscale printing technology for bioengineering the next generation of cell and tissue therapeutics.

**MRI-compatible robotic platform for dynamic imaging and therapy applications**

**Supervisor:**
Dr Andre Kyme – andre.kyme@sydney.edu.au

**Project Description:**
The goal of this project is to design, build and validate a highly dynamic multi degree-of-freedom robotic platform meeting the requirements of motion correction and quality assurance applications in magnetic resonance imaging (MRI) and MRI-assisted therapy (e.g. MRI-Linac). This project is ideally suited a student with a background in biomedical and mechatronic engineering.

**Collaborator:** A/Prof Shin Shing Cheng, Dept Mechanical and Automation Engineering, Chinese University Hong Kong (CUHK).

**Note:**
- Projects are available to scholarship holders only
- $5k-10k /annum top-up is available to eligible scholarship holders
- 6-12 month visits to collaborating partner institutions is possible for relevant projects

For more information contact andre.kyme@sydney.edu.au

**Lameness detection and characterisation in athlete horses**

**Supervisor:**
Dr Andre Kyme – andre.kyme@sydney.edu.au
**Project Description:**

The goal of this project is to develop an end-to-end neural network solution for lameness characterisation in athlete horses based on video data. It will enable the detection and prevention of catastrophic injuries much more reliably than current methods. The project requires a strong background in Python and neural network principles and architectures.


**Note:**

- Projects are available to scholarship holders only
- $5k-10k /annum top-up is available to eligible scholarship holders
- 6-12 month visits to collaborating partner institutions is possible for relevant projects

For more information contact andre.kyme@sydney.edu.au

---

**Advanced motion tracking for motion-compensated positron emission tomography**

**Supervisor:**

Dr Andre Kyme – andre.kyme@sydney.edu.au

**Project Description:**

The goal of this project is to design and optimise motion tracking capability for the MousePET scanner, a next-generation system for simultaneous brain imaging and behavioural analysis in freely moving rodents. Motion tracking is a crucial component of motion-corrected brain imaging and has particularly challenging specifications for this application. The MousePET system will be the first of its kind and will dramatically enhance the types of experiments exploring the relationship between brain function and behaviour in mammals.

Collaborator: Prof Simon Cherry, University of California Davis, USA

**Note:**

- Projects are available to scholarship holders only
- $5k-10k /annum top-up is available to eligible scholarship holders
- 6-12 month visits to collaborating partner institutions is possible for relevant projects

For more information contact andre.kyme@sydney.edu.au

---

**AI-based motion correction for PET brain studies**

**Supervisor:**

Dr Andre Kyme – andre.kyme@sydney.edu.au

**Project Description:**

The goal of this project is to develop a complete pipeline for neural network-based motion correction of brain PET studies in the image domain. A solution will require novel data simulation approaches, neural network architectures and clever use of multi-modal data. It will facilitate much easier clinical translation of motion
correction than hardware-based approaches, and enable massive archives of legacy PET data to be reprocessed.

Collaborator: Prof Arman Rahmim, University of British Columbia, Canada

Note:

- Projects are available to scholarship holders only
- $5k-10k /annum top-up is available to eligible scholarship holders
- 6-12 month visits to collaborating partner institutions is possible for relevant projects

For more information contact andre.kyme@sydney.edu.au

BREEZE: Better neuroimaging for children with cerebral palsy

Supervisor:
Dr Andre Kyme – andre.kyme@sydney.edu.au

Project Description:
The goal of this project is to translate prospective MRI head motion correction to the clinic in combination with eye-gaze technology, enabling accurate brain imaging of children with CP without the need for sedation and with the benefit of eye-gaze communication with caregivers and technologists. This technology would dramatically improve the experience for these children and expand the options for families to have routine brain imaging for diagnosis and treatment monitoring.

Note:

- Projects are available to scholarship holders only
- $5k-10k /annum top-up is available to eligible scholarship holders
- 6-12 month visits to collaborating partner institutions is possible for relevant projects

For more information contact andre.kyme@sydney.edu.au

Unobtrusive Sensor Systems for Healthcare

Supervisor:
Associate Professor Omid Kavehei – omid.kavehei@sydney.edu.au
Professor Wei Chen – w.chen@fudan.edu.cn

Research Areas:
Wearable sensors, unobtrusive sensing, embedded systems, health monitoring.

About the project:
This project aims to create unobtrusive sensor systems to monitor physiological and behavioural data of human body. The signals include EEG, ECG, EOG, EMG, respiration, SpO2, temperature, activities, etc.. The candidate will develop innovative wearable sensing or non-contact sensing techniques with new sensing materials and embedded systems for biomedical data acquisition and processing. Lightweight AI algorithms
and software for embedded sensor systems will be proposed for intelligent healthcare systems. The potential applications will be sleep monitoring, neonatal monitoring and smart rehabilitation, etc..

Successful candidates must have:

- Bachelor’s or a Master’s degree majoring in electrical and electronic engineering, biomedical engineering, microelectronics, telecommunication engineering, mechanical engineering, computer engineering and related disciplines,
- Good at circuit and system (PCB) design,
- Good communication skills,
- Good at teamwork and collaboration.

How to Apply:

If you are interested, please email a copy of your transcript and CV to omid.kavehei@sydney.edu.au and w_chen@fudan.edu.cn with the subject line “PhD Application:” to discuss your suitability for this project.

Data Processing for Sleep Monitoring

Supervisor:

Associate Professor Omid Kavehei – omid.kavehei@sydney.edu.au
Professor Wei Chen – w.chen@fudan.edu.cn

Research Areas:

Signal processing, AI and deep learning, sleep staging and sleep disease analysis.

About the project:

This project focuses on development of signal processing and AI methods and algorithms for sleep staging and sleep disorder analysis. The scope will include proposing dedicated AI and data science methods to explore and analyse relevant biomarkers and features with high sensitivity and specificity from physiological and behavioural signals; building data analytical models to enhance the learning performance, proposing approaches to improve model generalization; investigating explainable AI methods; developing information and computing schemes and algorithms for precise sleep disease detection and prediction.

Successful candidates must have:

- Bachelor’s or a Master’s degree majoring in computer and data science, electrical and electronic engineering, biomedical engineering, microelectronics, telecommunication engineering, and related disciplines,
- Good at signal processing and AI technologies,
- Good communication skills,
- Good at teamwork and collaboration.

How to Apply:

If you are interested, please email a copy of your transcript and CV to omid.kavehei@sydney.edu.au and w_chen@fudan.edu.cn with the subject line “PhD Application:” to discuss your suitability for this project.
**Sensing Technology**

**Supervisor:**
Associate Professor Omid Kavehei – omid.kavehei@sydney.edu.au

**Research Area:**
Circuit and system (PCB) design; signal processing; microelectronic design-flow

**Project Description:**
If you have an interest and educational background in Electronic Engineering and experimentation, with the following skills and expertise:

**Key skills requirements:**
- You have circuit and system (PCB) design experience, preferably high-frequency and antenna design.
- You have foundational knowledge and experience in signal processing and time-series data analytics, preferably in Python.

**Desired expertise:**
- Knowledge and expertise in #microelectronic design-flow.
- Prior experience with FPGA.

**Further information:**
If you are interested, email omid.kavehei@sydney.edu.au with your resume attached, to discuss your suitability for a #SensingTechnology project.

---

**Develop single-cell mechanobiological methods for discovering molecular mechanisms of cardiovascular and neuronal mechanical force sensing**

**Supervisor:**
Associate Professor Arnold Lining Ju – arnold.ju@sydney.edu.au

**Research Area:**
Mechanobiology; Cardiovascular Engineering; Neuroengineering

**Project Description:**
In view of the high complexity and dynamics of protein complexes that perform important physiological functions, it is difficult to visualise and characterise their kinetic and signalling processes on single living cells using traditional biochemical and biophysical techniques. It is therefore urgent to develop high-resolution bioimaging and single-molecule manipulation technologies to observe life activities in native cellular environments at nanoscale.

Over the last 5 years, Dr Ju has developed the state-of-the-art pico-force (10^{-12} Newton) BFP technique as the first of its kind in Australia. Using this powerful nanotool, he has made conceptual advances on the inner workings of many mechanosensory proteins including the platelet integrin receptor in thrombosis (Nature Materials 2019; Nature Communications 2018; eLife 2018), the Apolipoprotein A-IV (Nature Communications...

This project will combine BFP with high-resolution microscopy leading to a more advanced BFP imaging platform. It will become the first in the world capable of correlating the mechanical stimulation profile with the real-time cellular responses of a single platelet with the superior temporal, spatial, and force resolutions at 0.7 milli-second, 3 nano-meter, and 1 pico-newton respectively. The whole system provides precise controls and quantitative readouts in both mechanical and chemical terms, which is particularly suited for live-cell mechanosensing studies over the traditional methods in biochemistry and cell biology that are usually population-averaged and non-real-time. In future, it will further upgrade the platform in the combination of patch clamp to realise the single-molecule electrophysiology, imaging and manipulation in one system.

The lab will apply these cutting-edge technologies for the following biomedical application: 1) define the mechanosensing functions of key protein players in the cardiovascular system such as integrin receptors and mechanosensitive ion channels, and elucidate their contributions to the cardiovascular diseases - particularly thrombosis and guide the development of new anti-thrombotic therapeutic strategies; 2) investigate the transmembrane conduction of mechanical forces in neurology. In particular, the generation and regulation of force signals during membrane fusion such as the formation and regulation of SNARE complexes during neurotransmitter release. This study will provide fundamental biological insights for ongoing sensory bionics and implantable neuroprosthesis research.

Further information:

We are looking for candidates with the following skills and experience:

- Academic knowledge in the discipline of biophysics, biomechanics, electrophysiology, cell biology and biochemistry.
- Experience of instrumenting or operating single-molecule force spectroscopies such as atomic force microscopy, optical tweezers, magnetic tweezers, patch clamp electrophysiology systems, micromanipulation and microinjection systems, or other biomedical experimental devices such as rheometers and parallel plate flow chambers.
- Familiar with using two or more of Labview, ImageJ, AutoCAD, MATLAB, 3D-max, PRO-E, SolidWorks and other software.

Preferred experience includes:

- Solid basic knowledge of biology and hands-on experience in PC2 biological laboratory, using flow cytometer, ELISA, Western blots, protein-protein interaction assays, protein/antibody purification and functional characterisations.
- Capability of independently output processing models and drawings, be capable of CNC programming, use other conventional processing platform equipment to manufacture mechanical parts, and use 3D printers for part manufacturing.
- Pre-doctoral track records with publications, conference papers, reports, professional or technical contributions with evidence of independent research ability.
- Excellent oral and written communication skills.
Develop point-of-care microfluidic technologies for cardiovascular and cerebrovascular diseases.

Supervisor:
Associate Professor Arnold Lining Ju – arnold.ju@sydney.edu.au

Research Areas:
Mechanobiology; Cardiovascular Engineering; Neuroengineering

Project Description:
Excessive clotting (thrombosis) leads to cardiovascular diseases such as heart attack and stroke—the No.1 world-wide killer, killing one Australian every 12 minutes. It has long been recognized that platelets play a central role in thrombosis and are unique in their ability to form stable adhesive interactions under conditions of rapid blood flow. We have recently discovered a new ‘biomechanical’ prothrombotic mechanism that highlights the remarkable platelet sensitivity to the shear stress gradients of blood flow disturbance. Importantly, we found that the current anti-thrombotic drugs such as Aspirin, Plavix® or Brilinta®, have limited effect against this biomechanical thrombosis.

To address this pressing need, we are developing simple-to-use, high-throughput and highly-informative microfluidic biochips to understand sequences of molecular events underlying biomechanical thrombosis (mechanobiology). We are also developing computational fluid dynamics (CFD) simulation to correlate the haemodynamic parameters with thrombotic phenotypes. We are assembling a team of bioengineers and clinicians at the newly-launched Biomedical Engineering School and Charles Perkins Centre—the national flagship research hub for cardiovascular diseases and diabetes. The anticipated outcome could translate into point-of-care tools that facilitate physicians' decisions on diagnosis, follow disease progression, optimise treatment courses, or even deploy on ambulance to improve patient care.

Further information:
We are looking for candidates with the following skills and experience:

- Academic knowledge in the discipline of biophysics, biomechanics, electrophysiology, cell biology and biochemistry.
- Capability of using two or more of ANASYS, Comsol, Labview, AutoCAD, MATLAB, 3D-max, PRO-E, SolidWorks, ZEMAX and other software.
- Experience with the use of computational fluid dynamics (CFD) for haemodynamics or PIV analysis of haemorheology.

Preferred experience includes:

- At least one year of experience in clean room micro/nano processing and soft lithography;
- Experience in theoretical simulation using and Matlab or Comsol, or Labview programming to control equipment and devices.
- Capability of independently output processing models and drawings, be capable of CNC programming, use other conventional processing platform equipment to manufacture mechanical parts, and use 3D printers for part manufacturing.
- Pre-doctoral track records with publications, conference papers, reports, professional or technical contributions with evidences of independent research ability.
- Excellent oral and written communication skills.
Molecular dynamics simulation and computational design for anti-thrombotic peptide drugs

Supervisor:
Associate Professor Arnold Lining Ju – arnold.ju@sydney.edu.au

Research Areas:
Mechanobiology; Cardiovascular Engineering; Neuroengineering

Project Description:
An estimated 1.2 million (5.6%) Australian adults aged 18 years and over had 1 or more conditions related to heart or vascular disease in 2017–18, where myocarditis, stroke and encephalopathy can potentially result in mortality. Increasing number of studies demonstrate the elevating shear in blood flow mediates the activation of proteins like von Willebrand factor (VWF) and FVIII as a key event in hemostasis and thrombosis. The current view indicates that this phenomenon is related to an autoinhibitory mechanism regulated by the flanking regions. Yet, detailed mechanism is still elusive since limited knowledge on the fully resolved structure of these proteins.

To address the unknown, this project intends to use molecular dynamic (MD) simulation to visualize and study the single molecular interaction with the aid of the recent introduced AlphaFold, which is a deep learning based predictor for protein structure and has incredible accuracy in simulating conformation of protein (an average 95% RMSD-Cα to the experimental structure of less than 1Å). We aim to use steered MD simulation to investigate autoinhibition effect of flanking region on the binding interface between ligands and their receptors, and thereafter detailly elucidate the activating mechanism of VWF and FVIII in high-shear environment. Since the current thrombotic drug such as Aspirin, Plavix® or Brilinta® has limited effect against biomechanical thrombosis and increased the risk of bleeding, the protein structural finding of this theme will be further implemented to design and screen new anti-thrombotic peptide drug, which will effectively impede thrombosis but has minimum complication which interfere hemostasis.

Further information:
We are looking for candidates with the following skills and experience:

- Academic knowledge in the discipline of biophysics, biomechanics, electrophysiology, cell biology and biochemistry.
- Experience of Linux/Unix commanding line (Unix shell).
- Capability of using two or more of GROMACS, Hex, LabVIEW, Python, AutoCAD, MATLAB and other software.

Preferred experience includes:

- Solid basic knowledge of biology and hands-on experience in PC2 biological laboratory, using flow cytometer, ELISA, Western blots, protein-protein interaction assays, protein/antibody purification and functional characterizations.
- Experience in theoretical simulation using and MATLAB or COMSOL, or LabVIEW programming to control equipment and devices.
- Capability of independently output processing models and drawings, be capable of CNC programming, use other conventional processing platform equipment to manufacture mechanical parts, and use 3D printers for part manufacturing.
- Pre-doctoral track records with publications, conference papers, reports, professional or technical contributions with evidence of independent research ability.
- Excellent oral and written communication skills.

**Develop single-molecule and super-resolution microscopy imaging technologies in the cardiovascular disease**

**Supervisor:**
Associate Professor Arnold Lining Ju – arnold.ju@sydney.edu.au

**Research Areas:**
Mechanobiology; Cardiovascular Engineering; Neuroengineering

**Project Description:**
This project will focus on development, improvement, and application of single-molecule tracking and super-resolution imaging, such as TIRF, HiLo, PALM, STORM, Lattice Light-Sheet Microscopy and other technologies, for the analysis of key proteins in the process of thrombosis and platelet activation, dynamic processes such as molecular conformational changes (i.e. integrin receptors, cytoskeletons, and mechano-sensitive ion channels), protein assembly and relocation, and protein-protein interactions. We aim to make technological breakthroughs in time, space and multiple dimensions, and draw the platelet "molecular interactome" of healthy people and cardiovascular patients with diabetes, obesity and metabolic syndromes. Finally, the high-volume 2D-3D image data analyses are combined for anti-platelet drug screenings.

**Further information:**
We are looking for candidates with the following skills and experience:

- Skilled in using at least one optical design software such as ZEMAX, Lighttools, Codev, TRACEPRO.
- Master basic optical theory, diffractive optics, Fourier optics, photoelectric information processing and other basic theories, and understand the design principles of microscope imaging systems.
- Familiar with the design of optoelectronic system architecture. Experience in microscope and imaging optical system design and production is preferred.
- Responsible for optical system design and component selection, assembly and debugging of optical systems.
- Solid basic knowledge of biology and rich experience in the PC2 biological laboratory, applicants with related scientific backgrounds such as pathological imaging diagnosis, intracellular organ imaging mechanism analysis, bioprobe labeling, targeted therapy, etc.

**Preferred experiences include:**

- Optical microscopy imaging, optical super-resolution imaging, adaptive optics, the principles and characterization of fluorescent materials, and the principle of photon matter interaction.
- Using spatial light modulator, deformable mirror device, and acoustic optical deflector.
Real-time cell mass identification of cellular processes to build the next generation of diagnostics

Supervisor:
Dr David Martinez Martin – david.martinezmartin@sydney.edu.au

Research Area:
Nanobiotechnology; Cellular biophysics; Physical Biology

Project Description:
Cell growth and mass regulation is a fundamental process for all living organisms, yet it is poorly understood – partly due to our inability to detect changes in mass at cellular level. We develop technologies that measure and monitor cell growth in real time at the single-cell level, enhancing our understanding of cell development. Considering that dysregulation of cell mass is a critical underlying force in the development and progression of many diseases, understanding how cells regulate their mass has enormous potential to transform the way we diagnose, monitor and treat disease conditions such as cancer, diabetes, obesity, cardiovascular disease, ageing or infectious diseases. Our research is at the interphase of engineering, biology and physics, and involves working with exciting methods and techniques of microfabrication, nanotechnology, advanced optical microscopies, programming, cell biology, atomic force microscopy, etc.

https://www.sydney.edu.au/research/opportunities/opportunities/2789

Further information:
Starting date to be discussed and after June 2021

Thermal Optimisation of Gigascale Solar Photovoltaics

Supervisor:
Dr Declan Keogh – declan.keogh@sydney.edu.au
Professor Marcela Bilek – marcela.bilek@sydney.edu.au

Research Areas:
Computational Fluid Dynamics; Heat Transfer; Photovoltaics; Engineering; Solar Farms

Project Description:
This work is funded by Australian Research Council in collaboration with two leading start-ups in the renewable energy sector: Sun Cable and SB. The project aims to improve the feasibility, efficiency, and performance of gigascale solar photovoltaics. To achieve this, we will collaborate directly with SB and Sun Cable using data from one of the world’s first gigascale solar fields, the Australia-Asia Power Link (AAPowerLink), to optimise its performance, as well as the performance of individual photovoltaic modules. By optimising the feasibility and performance of the AAPowerLink, this project will enhance the viability of gigascale solar projects in the future.

- Project 1: Simulations of thermal performance at module and sub-array level.
The candidate will develop a numerical model to simulate the thermal behaviour of 5B’s MAVERICK (MAV) photovoltaic array. The candidate will validate these models against experimental data obtained by 5B and Sun Cable at their Technology Research Park. The model must consider the effects of free convection, forced convection, radiation and moisture transport on the MAV array under various conditions and orientations. This model will then be used to explore optimisation strategies of the MAV’s design, with the goal being to develop a new thermally efficient photovoltaic array.

- **Project 2:** Simulations of the PV Heat Island effect at field (120 km²) scale.
The candidate will develop a numerical model to investigate how the photovoltaic heat island effect affects performance at the field scale. Computations will be performed that resolve the atmospheric boundary layer and account for shear and buoyancy-induced turbulence as well as the surface roughness caused by the MAV arrays. The model will be validated against temperature readings taken by 5B and Sun Cable at their technology research park and then used to optimise the thermal performance of a 2000 m² MAV field. This includes simulating how wind penetration and by-pass, orientation and air moisture affect the temperatures of the field. The candidate will directly contribute to the final layout of the solar farm.

The project will employ the commercial Computational Fluid Dynamics (CFD) software COMSOL Multiphysics. The candidates will be trained in CFD best practice, including model building, meshing and validation, preparing them for a career in both academia and industry. In particular, successful candidates will gain strong capabilities in modelling-for-design with industry exposure and collaboration with leading start-ups.

**Further Information:**

The start date of the project is expected to be between July and September 2023

**Successful candidates:**

- Must have a bachelor’s degree Engineering or Science and have an excellent academic track record.
- Should have prior research experience, e.g. an Honours degree (First Class), a Master’s degree, a research assistant job, or equivalent industry experience.
- Will require a strong interest in computational fluid dynamics and experience in the physical sciences (physics, maths, computer science).
- That demonstrate proficiency in fluid mechanics, numerical methods for partial differential equations and the finite element/volume method would be highly desired but not essential.
- Must be able to demonstrate strong written and oral communication skills and the capacity to work independently and as part of a team

**How to Apply:**

To apply, please email declan.keogh@sydney.edu.au, with the subject line “PhD Application:” and your name. Include the following:

- CV and cover letter
- Transcripts (can be unofficial)
Thin Film Coatings and Hydrogels for Cell Culture Microenvironments

Supervisor:
Professor Marcela Bilek – marcela.bilek@sydney.edu.au

Research Area:
Surface Engineering; Thin Film Deposition

Project Description:
These projects are all linked to an Australian Research Council Laureate Research Program entitled "Plasma surface engineering for break-through technologies in biomedicine". This research program focuses on development and demonstration of new technologies for biomedical applications using biologically functional surfaces and materials created by environmentally sustainable plasma processes. Projects are available in the areas of nanotechnology, microfluidics, biosensing, implantable biomedical devices, organ-on-a-chip as well as the development of novel materials and plasma processes are available. Techniques employed include computational modelling and experimental studies utilising a wide range of plasma processes and diagnostics; processing discharges; surface and materials analysis techniques; as well as cell culture and biochemical studies.

Further information:
Applicants should have good communication skills and an interest to work in multidisciplinary teams will be advantageous.

Plasma Polymerised Nanoparticles for Diagnostics and Therapeutics

Supervisor:
Professor Marcela Bilek – marcela.bilek@sydney.edu.au

Research Area:
Plasma polymerisation; Plasma processing; Biomolecule Functionalisation

Project Description:
These projects are all linked to an Australian Research Council Laureate Research Program entitled "Plasma surface engineering for break-through technologies in biomedicine". This research program focuses on development and demonstration of new technologies for biomedical applications using biologically functional surfaces and materials created by environmentally sustainable plasma processes. Projects are available in the areas of nanotechnology, microfluidics, biosensing, implantable biomedical devices, organ-on-a-chip as well as the development of novel materials and plasma processes are available. Techniques employed include computational modelling and experimental studies utilising a wide range of plasma processes and diagnostics; processing discharges; surface and materials analysis techniques; as well as cell culture and biochemical studies.
Further information:
Applicants should have good communication skills and an interest to work in multidisciplinary teams will be advantageous.

**Surface Functionalisation for Microfluidic Devices**

**Supervisor:**
Professor Marcela Bilek – marcela.bilek@sydney.edu.au

**Research Area:**
Functional Materials; Composite and Hybrid Materials; Surface Coatings

**Project Description:**
These projects are all linked to an Australian Research Council Laureate Research Program entitled "Plasma surface engineering for break-through technologies in biomedicine". This research program focuses on development and demonstration of new technologies for biomedical applications using biologically functional surfaces and materials created by environmentally sustainable plasma processes. Projects are available in the areas of nanotechnology, microfluidics, biosensing, implantable biomedical devices, organ-on-a-chip as well as the development of novel materials and plasma processes are available. Techniques employed include computational modelling and experimental studies utilising a wide range of plasma processes and diagnostics; processing discharges; surface and materials analysis techniques; as well as cell culture and biochemical studies.

Further information:
Applicants should have good communication skills and an interest to work in multidisciplinary teams will be advantageous.

**Interfaces for Biosensing**

**Supervisor:**
Professor Marcela Bilek – marcela.bilek@sydney.edu.au

**Research Area:**
Surface Coatings; Plasma processing; Composite and Hybrid Materials

**Project Description:**
These projects are all linked to an Australian Research Council Laureate Research Program entitled "Plasma surface engineering for break-through technologies in biomedicine". This research program focuses on development and demonstration of new technologies for biomedical applications using biologically functional surfaces and materials created by environmentally sustainable plasma processes. Projects are available in the areas of nanotechnology, microfluidics, biosensing, implantable biomedical devices, organ-on-a-chip as well as the development of novel materials and plasma processes are available. Techniques employed include computational modelling and experimental studies utilising a wide range of plasma processes and diagnostics; processing discharges; surface and materials analysis techniques; as well as cell culture and biochemical studies.
processes and diagnostics; processing discharges; surface and materials analysis techniques; as well as cell culture and biochemical studies.

Further information:

Applicants should have good communication skills and an interest to work in multidisciplinary teams will be advantageous.

Scaffolds and tailored environments for tissue regeneration and disease modeling

Supervisor:
Professor Marcela Bilek – marcela.bilek@sydney.edu.au

Research Area:
Biomolecule Functionalisation; Biofabrication

Project Description:
These projects are all linked to an Australian Research Council Laureate Research Program entitled "Plasma surface engineering for break-through technologies in biomedicine". This research program focuses on development and demonstration of new technologies for biomedical applications using biologically functional surfaces and materials created by environmentally sustainable plasma processes. Projects are available in the areas of nanotechnology, microfluidics, biosensing, implantable biomedical devices, organ-on-a-chip as well as the development of novel materials and plasma processes are available. Techniques employed include computational modelling and experimental studies utilising a wide range of plasma processes and diagnostics; processing discharges; surface and materials analysis techniques; as well as cell culture and biochemical studies.

Further information:

Applicants should have good communication skills and an interest to work in multidisciplinary teams will be advantageous.

Biomolecule patterning for guided biomolecule and cell responses

Supervisor:
Marcela Bilek – marcela.bilek@sydney.edu.au

Research Area:
Biomolecule Functionalisation; Biofabrication

Project Description:
These projects are all linked to an Australian Research Council Laureate Research Program entitled "Plasma surface engineering for break-through technologies in biomedicine". This research program focuses on development and demonstration of new technologies for biomedical applications using biologically functional surfaces and materials created by environmentally sustainable plasma processes. Projects are available in the areas of nanotechnology, microfluidics, biosensing, implantable biomedical devices, organ-
on-a-chip as well as the development of novel materials and plasma processes are available. Techniques employed include computational modelling and experimental studies utilising a wide range of plasma processes and diagnostics; processing discharges; surface and materials analysis techniques; as well as cell culture and biochemical studies.

**Further information:**

Applicants should have good communication skills and an interest to work in multidisciplinary teams will be advantageous.

**The role of surface charge and electric fields in biomolecule interactions**

**Supervisor:**

Professor Marcela Bilek – marcela.bilek@sydney.edu.au

**Research Area:**

Surface Activation; Electrical Discharges

**Project Description:**

These projects are all linked to an Australian Research Council Laureate Research Program entitled "Plasma surface engineering for break-through technologies in biomedicine". This research program focuses on development and demonstration of new technologies for biomedical applications using biologically functional surfaces and materials created by environmentally sustainable plasma processes. Projects are available in the areas of nanotechnology, microfluidics, biosensing, implantable biomedical devices, organ-on-a-chip as well as the development of novel materials and plasma processes are available. Techniques employed include computational modelling and experimental studies utilising a wide range of plasma processes and diagnostics; processing discharges; surface and materials analysis techniques; as well as cell culture and biochemical studies.

**Further information:**

Applicants should have good communication skills and an interest to work in multidisciplinary teams will be advantageous.

**Chemical and Biomolecular Engineering**

**Improving the stability of carbon electrocatalysts in fuel cells and electrolyzers**

**Supervisor:**

Professor Yuan Chen – yuan.chen@sydney.edu.au

**Project Description:**

An exciting Ph.D. scholarship opportunity is available for cutting-edge research into improving the stability of carbon electrocatalysts in fuel cells and electrolyzers at the Advanced Carbon Research Lab at the University of Sydney.
“Green” hydrogen generated by water electrolysis can be used as a clean fuel for fuel cells to drive electric vehicles and as stationary power supplies. However, high cost and low durability are their key application barriers. Over 40% of the total cost of current fuel cells comes from expensive precious metal catalysts. While transition metal (M) and nitrogen (N) co-doped carbon (M-N-C) catalysts can be a cost-effective alternative, the key bottleneck is the lack of understanding of their fast degradation. This Australian Research Council-funded Discovery Project will address this gap by providing this fundamental understanding and paving the way for developing stable and efficient M-N-C catalysts. The project will support two full-time Ph.D. students. The students are expected to work on catalyst synthesis, characterization, and degradation tests on multiple realistic fuel cell/electrolyzer platforms. The students will also collaborate with collaborators at Tohoku University in Japan on functional theory calculations to better understand the catalyst degradation mechanism.

About You:

To be suitable for this role, you will need to have experience in the below key accountabilities:

- Analytical and numerical analyses
- Hand-on experimental skills in electrocatalyst synthesis and characterization
- Preparing written research documents and oral presentations on research activities and outcomes
- Preparing and submitting publications from research activities to peer-reviewed journals
- Participate in group development and research activities and contribute to other projects within the team

Qualifications:

A bachelor’s degree honors and/or a research master’s degree in chemical engineering, inorganic material, electrochemistry, organic synthesis, or theoretical chemistry with excellent grades.

We welcome and encourage applicants from diverse backgrounds to apply. Candidates with previous research training and publications in high-quality journals will be considered favourably. Candidates currently in Australia and can start their Ph.D. in March 2023 will be considered favourably.

More information

- Annual Stipend $35,940 (tax-free) for 3.5 years, starting from March 2023
- Full-time on campus at the University of Sydney
- For international students, tuition fees will be covered.
- Two scholarships are available.

SmartCrete CRC Postgraduate Scholarships

Supervisor:
Professor Marjorie Valix – marjorie.valix@sydney.edu.au

Research Areas:
Asset management, corrosion, sensing, concrete, circular economy
Background:
If you are a current final year undergraduate in Engineering or Science and have a WAM at 75 or above and are interested in a cross-disciplinary applied research in asset management and driving the circularity principles, gaining practical experience in supply value chain optimisation and broad insight into business decisions, regulatory framework, and asset performance assessments within the water, mining, roads and concrete industries, a number of Smartcrete CRC funded scholarships co-funded by multiple industries and the Faculty of Engineering at the University of Sydney are being offered in the following areas:

- **Development and Engineering Assessment of Specialty Concrete with Repurposed Wastes** where research into improving the sustainability and durability of materials of constructions for civil infrastructure. This will involve the development and assessment of ‘new’ specialty concrete with repurposed wastes and in-service field testing to verify the performance of pre-commercial prototypes of high performing specialty and waste repurposed concrete as civil infrastructure assets (e.g., pipes, road & pavements, mine back fill).

- **Decision Tools in Managing Water Assets** where research into the development of asset management decision tools to support medium and large water utilities in operating, upgrading, and rehabilitating physical water assets that balances risk, cost, and benefits.

- **Sensing Water Asset Conditions** where research into the development of monitoring and managing concrete assets/structures (e.g., pipes, roads & pavements, mine backfill). The aim is to create protocols and safe and reliable methods to non-destructively inspect/monitor and provide qualitative & quantitative assessments of asset health.

Offering:
The scholarships are valued at $37,500 p.a. and/or a top-up to $50,000 for students with primary scholarships (e.g., RTP or equivalent) adjusted yearly for a period of 3 years, commencing in 2023-2024

Further Information:
Successful candidates must have:
- A bachelor’s degree in a relevant discipline

How to Apply:
To apply, please email marjorie.valix@sydney.edu.au, with the subject line “PhD Application: SmartCrete CRC Postgraduate Scholarships” and include the following documents:
- CV
- Transcripts (can be unofficial)
- Short introduction about why you are interested in these areas.

Classification and repurposing wastes into concrete

Supervisor:
Professor Marjorie Valix – marjorie.valix@sydney.edu.au
**Project Description:**

These scholarships will support the research into the classification of various waste streams (e.g., mining wastes, glass, waste plastics) in terms of their suitability as replacement material for specialty concrete. In this project advanced material & analytical methods, and artificial Intelligence (AI) approaches will be employed to understand the micro and macro-mechanical behaviour of the repurposed waste concrete and the factors that influence this behaviour. This project is part of a broader study that will examine the business decisions, regulatory framework, and performance of repurposed waste concrete with various industry stakeholders.

If you are interested, email the project supervisor Professor Marjorie Valix (marjorie.valix@sydney.edu.au) with your transcripts, a CV and short introduction about why you are interested. These projects will be jointly supervised by academics from the School of Chemical and Biomolecular, Civil, Electrical and Mechanical Engineering and industry personnel.

**Performance assessment of repurposed concrete in water asset pipes**

**Supervisor:**
Professor Marjorie Valix – marjorie.valix@sydney.edu.au

**Project Description:**

This scholarship will support in-service field testing to verify the performance of pre-commercial prototypes of high performing specialty and waste repurposed concrete as civil infrastructure assets, specifically as water asset pipes. This will involve using advanced material and analytical methods and sensing to understand the durability and service life of the assets both through lab and field testing. Learnings will be used to support the development of material specification and codes of practice for use of specialty concrete and waste repurposed concrete in construction of civil infrastructure in the water industry.

If you are interested, email the project supervisor Professor Marjorie Valix (marjorie.valix@sydney.edu.au) with your transcripts, a CV and short introduction about why you are interested. These projects will be jointly supervised by academics from the School of Chemical and Biomolecular, Civil, Electrical and Mechanical Engineering and industry personnel.

**Servicing-life or performance models for water assets**

**Supervisor:**
Professor Marjorie Valix – marjorie.valix@sydney.edu.au

**Project Description:**

These scholarships will support the research into the development of evidence-based service life models of wastewater and water assets and performance models of corrosion controls. The project will be based on evidence data modelled by physical and chemical approaches, AI, and data analytics. This project will be used to support medium and large water utilities in creating a decision platform that offers a systematic process, based on informed decisions, for operating, upgrading, and rehabilitating their physical water assets that balances risk, cost, and benefits.
If you are interested, email the project supervisor Professor Marjorie Valix (marjorie.valix@sydney.edu.au) with your transcripts, a CV and short introduction about why you are interested. These projects will be jointly supervised by academics from the School of Chemical and Biomolecular, Civil, Electrical and Mechanical Engineering and industry personnel.

**Sensing water asset conditions**

**Supervisor:**
Professor Marjorie Valix – marjorie.valix@sydney.edu.au

**Project Description:**
This scholarship will support the research into the development of monitoring protocols and safe and reliable methods to non-destructively inspect/monitor and provide qualitative & quantitative assessment of asset health. This project will involve the development of condition assessment prototypes based on telemetry and communications systems that mimic current condition assessment protocols and decision making for water assets that rely on existing codes of defect. The proposed sensing approach will employ environmental sensing, asset sensing, artificial Intelligence (AI) and communications using advanced cellular networks.

If you are interested, email the project supervisor Professor Marjorie Valix (marjorie.valix@sydney.edu.au) with your transcripts, a CV and short introduction about why you are interested. These projects will be jointly supervised by academics from the School of Chemical and Biomolecular, Civil, Electrical and Mechanical Engineering and industry personnel.

**Fundamental Mechanism of Protein Phase Behaviour**

**Supervisor:**
Dr Yi Shen – yi.shen@sydney.edu.au

**Research Area:**
Protein liquid-liquid phase separation; Microfluidics; Biomaterials

**Project Description:**
The key focus of this project will be on understanding the mechanisms behind protein phase behaviour through physical parameters (e.g. temperature, size and interface), and identifying the methods to prevent the pathological transition.

**Further information:**
Planned start date: October 2021. Email your CV, transcript and research interests.

**Biomaterials from Protein/Peptides Manipulation**

**Supervisor:**
Dr Yi Shen – yi.shen@sydney.edu.au
Research Area:
Protein Liquid-Liquid Phase Separation; Microfluidics; Biomaterials

Project Description:
Development of biomaterials for microplastic replacement by taking advantage of protein phase behaviour.

Further information:
Planned start date: October 2021. Email your CV, transcript and research interests.

Chemical Recycling of Mixed Waste Plastics

Supervisor:
Professor Ali Abbas – ali.abbas@sydney.edu.au

Research Area:
Chemical Engineering; Computational Fluid Dynamics; Heterogeneous Chemical Kinetics

Project Description:
Waste plastic is a growing problem in Australia and elsewhere in the world. Many plastics are uneconomic to process using conventional physical recycling technologies.

Recent advances have already demonstrated that thermochemical approaches can convert waste contaminated plastic into a feedstock for remanufacturing plastic.

The Scale-up, Optimisation and Modelling of Chemical Recycling of Mixed Waste Plastics Postgraduate Research Scholarship has been established to provide financial assistance to PhD students who are undertaking research in using advanced engineering reactors to become the next generation of processing technology that specifically targets the conversion of mixed and contaminated (non-recyclable), post-consumer waste plastic into feedstock materials for the virgin plastics manufacturing industry.

Further information:
Suitable for students with a background in Engineering or Science

Advanced Food Engineering – Smart Food Packaging

Supervisor:
Professor Fariba Dehghani – fariba.dehghani@sydney.edu.au

Research Area:
Technologies for nutritional food products
**Project Description:**

Food is at the centre of many of society's global challenges: ensuring a safe, sustainable and secure food supply for growing populations; addressing the increasing incidence of chronic diseases; and meeting the issues arising from an ageing population.

There is also an increased demand for high-quality food, the need to minimise food waste and to ensure that the Australian food industry remains competitive in the global marketplace.

The Centre for Advanced Food Enginomics (CAFE) aims to meet these challenges by providing innovative solutions in food products, processes and supply chains to promote human wellbeing globally.

Scholarships are available to support students conducting research into smart food packaging sensors.

**Further information:**

Suitable for students with a background in Biochemistry, Physics, Chemical Engineering or Bioengineering.

---

**Advanced Food Engineering – Biosensors for applications in medicine, food and agriculture**

**Supervisor:**

Professor Fariba Dehghani – fariba.dehghani@sydney.edu.au

**Research Area:**

Biosensors for the detection of biomolecules at the point-of-care

**Project Description:**

This collaborative research project involves engineers and a biochemist from the University of Sydney and Padova University (Italy) and aims to develop a new class of biosensors with potential applications in medical, food and agriculture. The project aims to design a miniaturised cascade sensor for detection of biomolecules particularly enzymes at point-of-care.

In this project the candidate will acquire experience in electrochemistry, polymer chemistry, engineering, advanced manufacturing, and biochemistry to develop miniaturised sensors for biological systems. The candidate will work with prominent researchers and will have access to excellent advanced manufacturing facilities at the University of Sydney.

**Further information:**

Suitable for students with a background in expertise in electrochemistry or sensors. Having knowledge of biochemistry particularly enzymatic reactions is desirable in this project.

---

**Computational Modelling for Designing Optimum Structural, Mechanical, and Physical Properties of Materials for a Heart Valve**

**Supervisor:**

Professor Fariba Dehghani – fariba.dehghani@sydney.edu.au
Research Area:  
Computational Modelling  

Project Description:  
In this project, fluid structure simulations of flow through a heart valve will be performed to understand the impact of design parameters and the properties of novel materials. There will be an opportunity to perform experimental work to collect flow data for use in model validation. Also, there is the possibility to be involved in other projects for in silico gut models.  

Further information:  
Suitable for students with a background in Engineering or Applied Mathematics  

Engineering Processable Tough Hydrogels  

Supervisor:  
Professor Fariba Dehghani – fariba.dehghani@sydney.edu.au  

Research Area:  
Polymer Engineering  

Project Description:  
This project will aim to design a type of hydrogel with broad applications in soft robotic, medical devices such as heart valves, vasculature, and development of in vitro model that mimic physical properties of digestion system including colon, intestine and stomach.  

Further information:  
Suitable for students with a background in Polymer Engineering or Chemistry  

Civil Engineering Projects  

Biogeochemical modelling of soil organic and inorganic carbon  

Supervisor:  
Associate Professor Federico Maggi – federico.maggi@sydney.edu.au  

Research Areas:  
Environmental engineering, Soil carbon modelling, Net zero land management.  

About the opportunity:  
We are looking for highly qualified and motivated students to join our environmental engineering research group in the School of Civil Engineering at the University of Sydney for a full-time research project leading to a PhD degree. The project is a collaboration with the Sydney Institute of Agriculture (SIA).
The project is broadly covering the biogeochemistry of soil carbon, but emphasizes the interactions between the organic and inorganic components under environmental constraints. The aim of the project is to develop and use computational tools to model organic and inorganic soil carbon compounds, water and heat flow, and understand the mechanisms of their interactions. The project may cover various cross-disciplinary topics, including environmental engineering, agricultural sciences, hydrological processes, and land and soil management. The project can have wide applications including in soil carbon dynamics, nutrient cycles, soil physics, biogeochemistry, sustainability, and climate change.

Offering:
This scholarship is offered to both international and domestic PhD applicants for 3.5 year (fulltime) at the RTP stipend rate of $37,207 p.a.

Successful candidates must have:
- A bachelor’s degree (Honours or Honours Class 1 equivalent) or a Master degree.
- Good proficiency in programming languages and computational skill.

Candidates with the following skills will be considered favourably:
- Background in theoretical or computational biogeochemistry, eco/hydrology, or soil physics, and
- Be willing to learn mathematical concepts needed to develop advanced computational tools including biology, chemistry, and chemical kinetics.
- Be willing to undertake occasional high workload to meet milestones and project deadline commitments.

How to Apply:
To apply, please email federico.maggi@sydney.edu.au, with the subject line “SOC 2023” and your name. Include the following:
- 1 page expression of interest cover letter (the document is to be named as: YOURFIRSTNAME_YOURFAMILYNAME_SOC_2023.pdf)
- CV
- Transcripts (can be unofficial)

Closing date:
30 June 2023.

Design of Flexible Public Transport Networks

Supervisor:
Dr Andres Fielbaum – andres.fielbaum@sydney.edu.au

Research Areas:
Public transport, On-demand mobility, Transport networks.
**Project Description:**

Private cars induce most of the transport-related externalities. They produce lots of emissions, make inefficient use of scarce public space, push cities to be more sprawled, and increase social inequity. The opposite of private mobility is sharing a vehicle. Whether it is traditional public transport or emerging on-demand systems, when more passengers share their trips we build more sustainable cities. However, this implies coordinating up to thousands different users, each of them with their own origins and destinations, and desiring to complete their trips as soon as possible.

This theme means studying to do this efficiently and in a way that attract users.

Designing shared systems implies questions in different realms, such as:

- **Public transport:** How to decide the routes and frequencies of the lines? Which modes to offer? Should some vehicles operated on-demand?
- **On-demand ridepooling:** How to coordinate thousands of users and vehicles online? What are the overall impacts of a mode that is more sustainable than private cars but less than public transport mass vehicles?
- **Users’ behaviour:** What are the main problems preventing users to switch to public transport? What new behavioural aspects should be considered when studying on-demand transport?
- **Pricing:** What are the fairest and most efficient ways to set fares for shared modes? Should subsidies or taxes be implemented?

**Further Information:**

This is a project about designing public transport networks that include fixed routes and on-demand mobility. It contains problems related to network design, routing, behaviour, economics, among others. Further information relating to the scholarship opportunity is available on [https://transportlab.sydney.edu.au/home/research/share/](https://transportlab.sydney.edu.au/home/research/share/)

Successful candidates will have:

- A MSc or equivalent in Transport Engineering, Operations Research, Transport Economics, or a related topic,
- Good programming skills,
- prior knowledge of public transport, operations research, or transport economics would be advantageous.

**How to Apply:**

To apply, please email andres.fielbaum@sydney.edu.au, with the subject line “PhD Application:” and your name. Include the following:

- CV,
- Transcripts (can be unofficial),
- A 1-page research proposal,
- Two recommendation letters sent to the same email address.
Corrosion investigation of steel-reinforced concrete and composite bridges

Supervisor:
Dr Ali Hadigheh – Ali.Hadigheh@sydney.edu.au

Research Areas:
Corrosion; Reinforced concrete; Composite; Durability; Modelling; Experiments

Project Description:
The project will develop innovative methods for improving corrosion resistance of steel-reinforced concrete and fibre-reinforced polymer (FRP) composite bridge structures in marine environments. The project involves experimental, numerical and machine learning techniques. The project will be based within Smart Materials and Sustainable Structures (SMS2) group at the School of Civil Engineering. The School presents a broad research profile with significant impact both nationally and internationally. The School is home to some high-profile academics and is particularly strong in structural engineering, composite and materials science, which is at the core of this project. This project will be carried out in collaboration with an industry partner.

About the Candidate:
The preference is with applicants that have a track record in steel reinforced-concrete structures, composite materials (e.g., fibre reinforced polymer (FRP) composites), material characterisation, mechanical testing or finite element modelling.

Scholarship holders must be enrolled full time and on campus. This opportunity is open to candidates of any nationality. Successful applicants will be expected to enrol by 1 August 2023.

Enquiries and submission:
For enquiries and submission of your interest, please email ali.hadigheh@sydney.edu.au

Submission documents checklist:
Expression of interests shall comprise:
- A cover letter that includes a brief statement of the applicant’s suitability;
- A curriculum vitae, including a list of qualifications (with overall mark), any published works, conference presentations, relevant work experience, and contact details of two academic referees;
- A PDF document, including all published works (journal/conference papers and research theses)

Experimental study of atmospheric winds in and above forested canopies

Supervisor:
Dr Michael Heisel – michael.heisel@sydney.edu.au

Research Areas:
Atmospheric Boundary Layer, Turbulence, Wind Tunnel
**Project Description:**

Turbulent winds within forested canopies are critical to the exchange of water vapor and gases between plants and the atmosphere. At the same time, the canopy significantly alters atmospheric winds above the canopy. There is limited predictive theory for these flow alterations, despite the direct implication for the performance of global weather and climate models that have grid points close to the canopy. This experimental project will measure turbulent winds within and above idealized scale-model forested canopies in a wind tunnel setting. The goals of the project are to improve our understanding of turbulent phenomena in the presence of canopies and to advance predictive models for the mean wind conditions. The project will be conducted in collaboration with international researchers and may involve analysis of field-scale measurements to supplement the wind tunnel experiments.

**Further Information:**

In addition to earning a PhD in Civil Engineering, the student will develop an expertise in atmospheric turbulence and experimental methods for fluid mechanics, e.g. particle image velocimetry and hotwire anemometry. The opportunity will cover the cost of tuition (pending application) and provide a scholarship stipend of $37,207 for 3.5 years. It is open to both Australian and international students. Preference will be given to students with a strong background in fluid dynamics and experience using high-level programming languages such as matlab or python.

Potential applicants should send a copy of their CV/resume, academic transcript, and a short description of their interest in the project to Dr. Heisel. Please note the project will be co-supervised by another member of the school.

---

**Computational study of the convective daytime atmospheric boundary layer**

**Supervisor:**

Dr Michael Heisel – michael.heisel@sydney.edu.au

**Research Areas:**

Atmospheric Boundary Layer, Turbulence, Large-Eddy Simulations

**Project Description:**

Much of the natural world and human-built environments exist within the lowest portion of the atmosphere known as the planetary boundary layer. Conditions in the atmosphere are often thermally unstable during the daytime, leading to large convective turbulent motions throughout the boundary layer that significantly enhance transport and dispersion of scalars like moisture, gases, and pollutants. Our understanding of turbulent phenomena in these conditions is changing as high-resolution simulations of the atmosphere become increasingly affordable. This computational project will use large-eddy simulations to investigate structural and statistical similarity in the convective atmospheric boundary layer. Similarity is an important tool for the development of predictive models and reduced-order representations of the atmosphere commonly applied in forecasting and engineering design.

**Further Information:**

In addition to earning a PhD in Civil Engineering, the student will develop an expertise in atmospheric turbulence and computational methods for fluid mechanics, e.g. large-eddy simulations and the use of...
high-performance computing resources. The opportunity will cover the cost of tuition (pending application) and provide a scholarship stipend of $37,207 for 3.5 years. It is open to both Australian and international students. Preference will be given to students with a strong background in fluid dynamics and experience using programming languages such as fortran or C.

Potential applicants should send a copy of their CV/resume, academic transcript, and a short description of their interest in the project to Dr. Heisel. Please note the project will be co-supervised by another member of the school.

Advanced composite building technology for prefabricated construction

Supervisor:
Professor Gianluca Ranzi – gianluca.ranzi@sydney.edu.au

Research Area:
Advanced building technology for prefabricated construction

Project Description:
This scholarship will provide support for 3 years (with possible 6-month extension) on a full-time basis for a research project leading to a PhD to be carried out within the scope of an ARC Linkage project funded by the Australian Government and underway in collaboration with leading industry partners Brickworks, Austral Precast and Hillside Engineering. This project focuses at the development of a new prefabricated composite brick-concrete panel technology that will exploit cutting-edge manufacturing capabilities for the production of bricks and concrete components. The project is expected to generate new robust design methodologies by relying on advanced theoretical modelling and testing. The outcomes of the project are expected to transform the current brick industry by replacing traditional labour-intense brick construction with advanced and cost-effective prefabricated technologies.

Further information:
Applicants should have an Honours degree in engineering. Experience/background in carrying out modelling and experimental work in integrated building design or structural engineering would be an advantage.

The scholarship is open to domestic and international applicants.

Interested candidates should submit the following documents to Professor Gianluca Ranzi by email (gianluca.ranzi@sydney.edu.au): detailed CV, academic transcripts and a cover letter describing why they are interested in this project.

Behaviour of built-up cold-formed steel members and buildings

Supervisor:
Professor Kim Rasmussen – kim.rasmussen@sydney.edu.au

Research Area:
Stability and nonlinear analysis
Project Description:
This opportunity is supported by the Australian Research Council and seeks to investigate the possibility of constructing mid-rise buildings from light gauge cold-formed steel members. The main challenge lies in controlling drift deformations under wind and seismic loading; in particular accounting for the effects of partial composite action provided by the fasteners and complex buckling modes. Innovative solutions to designing built-up members and shear panels with high lateral stiffness will be a focus. The project builds on a previous ARC project on built-up sections, refer: https://structuresgroup-eng.sydney.edu.au/built-up-cold-formed-steel-structures/.

Further information:
We are seeking a motivated domestic or international student with solid training in mechanics and nonlinear structural analysis to start as early as possible. You will join another PhD student already assigned to the project and be part of an international team which includes Prof Kim Rasmussen and Dr Mani Khezri at Sydney University and Prof Ben Shafer at Johns Hopkins University.

Material characterisation and residual stresses of 3D-printed steel structures

Supervisor:
Professor Anna Paradowska – anna.paradowska@sydney.edu.au

Research Area:
3D printed structures; steel structures; material characterisation

Project Description:
Successful 3D-printing of steel structures requires optimisation of the printing process which in this project consists of wire-arc additive manufacturing (WAAM). The project will investigate the influence of weld track spacing and overlapping, scanning sequence, heat input, wire feed rate and pause time between track depositions. Test specimens will be 3D-printed for selected combinations of process parameters, and weld residual stresses will be measured in-situ on the neutron strain scanner at ANSTO, allowing the residual stress evolution to be investigated. The development of the residual stresses will be then modelled using finite element (macroscale) simulations that predict the overall residual stress field and distortion of WAAM-printed components. After verifying the accuracy of the numerical predictions against experimental results, the models will be used to uncover the interdependency between the weld process variables, including voltage, amps, speed, patterning, dwell time and interpass temperature, and the mechanical properties and residual stress fields, thereby enabling the rapid optimisation of WAAM-process variables.

Further, to understand the microstructure of WAAM-printed materials, optical, Scanning Electron Microscopy (SEM) and Electron Back-Scatter Diffraction (EBSD) procedures will be used for identification of microstructure, and neutron radiography and imaging will be used to study the efficiency of the printing process and the formation of volumetric defects such as porosity and inclusions. Based on these observations, a parameter set that minimises defects and optimises for residual stress, required microstructure and strength will be identified. The project will provide the successful candidate with cutting-edge and industry sought-after knowledge about the material characterisation of 3D-printed steel structures. It is part of a larger project supported by the Australian Research Council which comprises
multiple PhD projects including research on the crystal plasticity mechanisms that control microstructure and mechanical properties, and the macroscopic testing and analysis of structural connections.

Further information:
The scholarship is available to domestic and international students. The start date is flexible.

Developing new methods for the characterisation of nanoplastics in solids and liquids

Supervisor:
Dr Elizabeth Carter – elizabeth.carter@sydney.edu.au
Professor Abbas El-Zein – abbas.elzein@sydney.edu.au

Research Area:
Spectrometry; Soil Chemistry; Geoenvironmental Engineering

Project Description:
A PhD scholarship is available at the Geoenvironmental Laboratory of the University of Sydney, working with Dr Elizabeth Carter at Sydney Analytical and Prof Abbas El-Zein at the School of Civil Engineering, to investigate nano- and microplastics in landfills and surrounding environments. The opportunity is open to Australian citizens and residents, as well as international students. This is one of two PhD projects currently open, funded by the Australian Research Council (ARC), and undertaken in collaboration with researchers located at Monash and Deakin Universities as well as Queen’s University in Canada. Microplastics (MP) and nanoplastics (NP) are persistent polymeric contaminants. They have been found in many ecosystems on Earth, including rivers, forests, agricultural soils, beaches, deep oceans, as well as the food chain and water sources of many species including humans. 60% of all plastic ever produced is now buried in landfills and, recently, municipal waste landfills have been found to be a large sink, and a potential source, of MP/NP. The aim of this PhD project is to design, test and validate protocols for the measurement of MP/NP in solid and leachate samples. A range of characterisation techniques including dynamic light scattering, vibrational spectroscopy and mass spectrometry (ICP-MS, LC-MS and GC-MS, respectively) will be tested for this project. Successful applicants will be joining two world-leading research groups at Sydney Analytical and the Geoenvironmental Laboratory of the University of Sydney. Successful applicants must have a BSc or BEng Honours degree or equivalent, with research projects in Chemistry, Physics, Material Science, Civil or Chemical Engineering or a closely related discipline. Preferably, they have experience with one or more of the above listed characterisation techniques. Applicants must have excellent analytical and communication skills, in written and spoken forms. They are able to work both independently and as members of a research team, while demonstrating a collaborative attitude. They are able to write high-quality research proposals and to review, and engage with, interdisciplinary studies. They are driven by curiosity and are highly motivated about working at the interface between fundamental and applied research.

Interested students are advised to email Dr Elizabeth Carter, cc to Prof Abbas El-Zein, following these steps:

- write in the email’s subject line "Nanoplastic PhD – Expression of Interest”,
- state in the body of the email why you are interested in this opportunity, and
- attach a CV and relevant transcripts, including, for international students from non-English speaking backgrounds, any available results of English testing (e.g., TOEFL etc.).
Computer Science Projects

Adaptive Resource Management for Sustainable Edge Computing Systems

Supervisor:
Dr Wei Li – weiwilson.li@sydney.edu.au

Research Area:
Sustainable Computing; Task Scheduling; Distributed Computing

Project Description:
This project aims to develop adaptive resource management solutions in edge computing systems for efficient management of the use of limited computing resources and varying renewable energy resources without compromising the stringent needs of emerging Internet of Things applications. These resources will be jointly managed on the diverse, dispersed, often independently owned and operated edge devices with a set of prediction, scheduling and energy saving techniques. The expected outcome is to realise a sustainable edge computing system to reduce both operational cost and negative environmental impact of the system.

We have two scholarships available for applicants. The successful applicants are expected to start by 2022. Both international and domestic students are welcome to apply.

Further Information:
Two PhD scholarships are available. Send Dr Li your CV, transcript and a brief description of why you are interested in this project.

Adaptive and Ubiquitous Trust Framework for Internet of Things interactions

Supervisor:
Professor Athman Bouguettaya – athman.bouguettaya@sydney.edu.au

Research Area:
Trust; Internet of Things (IoT); Crowdsharing

Project Description:
These PhD scholarships are funded by the Australian Research Council (ARC) Discovery Projects (DP) grant. The project’s aim is to address the trust challenges in Internet of Things (IoT) environments, thus enabling the wide deployment of potentially billions of IoT devices. This project will generate new knowledge in the area of IoT Trust by developing novel techniques to establish trust in highly dynamic crowdsourcing IoT environments.

The project’s main outcomes include the development of a ubiquitous and adaptive multi-component trust framework reflecting trust perspectives. The developed solutions will allow the establishment of trusted
interactions among crowdsourced IoT devices and wider deployment of convenient and just-in-time services, thus enabling the development of novel applications, such as the crowdsourcing of green energy.

The successful applicants will be working in a world leading lab which focuses on services, clouds, and sensors focusing on the use of a range of techniques that span IoT and advanced machine learning techniques. Further information about the research conducted in the lab can be found at: http://scslab.net

Further Information:
Up to two PhD scholarships will be available.

Deep Learning Theory

Supervisor:
Dr Tongliang Liu – tongliang.liu@sydney.edu.au

Research Area:
Deep learning algorithms; Error bounds

Project Description:
Deep learning algorithms have given exciting performances e.g., painting pictures, beating GO champions and autonomously driving cars, among others, showing that they have very good generalisation abilities (small differences between training and test errors). These empirical achievements have astounded yet confounded their human creators. Why do deep learning algorithms generalise so well on unseen data? It lacks mathematical elegance. We do not know the underlying principles that guarantee it’s success. Let alone to interpret or pertinently strengthen its generalisation ability. We are interested in analysing error-bounds, e.g., generalization-error-bound and excess-risk-bound.

Fundamental Trade-offs between Data, Computation, and Privacy

Supervisor:
Dr Clement Canonne – clement.canonne@sydney.edu.au

Research Area:
Computational Learning

Project Description:
Computational learning theory, or the theoretical study of what learning algorithms (broadly construed) can achieve, is a well established field, drawing among many others from the works of Valiant (PAC learning), Kearns (Statistical Query learning), and Goldreich, Goldwasser and Ron (property testing). However, statistical and computational aspects of learning and testing tasks (how much data is required, and how much time the algorithms take) are no longer the only resources one has to take into account. In many settings, we need to consider other crucial constraints, such as the privacy of data (e.g., as captured in the framework of differential privacy), the memory used by the algorithms (e.g., in the streaming setting), the amount of communication involved between parties (in distributed settings), or the
robustness to malicious noise or misspecification. Balancing all those constraints leads to a much richer, and theoretically challenging, algorithmic landscape. This Ph.D. project aims to characterize the inherent trade-offs between those different aspects: establishing the theoretical limits of what algorithms can achieve, under which computational models, and how these different information or computation constraints affect the complexity of the task.

**System ML, IoT/edge Driven ML Adaptation**

**Supervisor:**
Associate Professor Shuaiwen Song – shuaiwen.song@sydney.edu.au

**Research Area:**
Machine Learning; Internet of Things; Neural Networks & Architecture

**Project Description:**
The topics include but are not limited to: Machine learning model deployment, large-scale system optimisation, software-hardware co-designing for training and inference, recommendation models and their deployment, emerging neural networks and models exploration and deployment, neural architecture search, real time optimisation on power and performance efficiency, tiny ML, compiler-hardware co-design, system design and prototyping, symbolic AI + compilation optimisation on small devices.

**Large-Scale Transformer Neural Networks in the Real World**

**Supervisor:**
Dr Chang Xu – c.xu@sydney.edu.au

**Research Area:**
Neural Networks; Computer Vision

**Project Description:**
Transformer neural networks have received impressive success in Natural Language Processing, and recently also demonstrated promising performance on different Computer Vision tasks. To further boost Vision Transformer performance, we tend to introduce more inductive bias specific to computer vision tasks into the formulation of this special type of deep neural network. Also, we will conduct a thorough comparison between the classical convolutional neural network and the new fashion of transformer neural networks and deliver new designs of some hybrid neural networks while investigating the challenges from the real-world vision applications.

**Beyond Worst-Case Analysis: Tools for Developing Practical Algorithms**

**Supervisor:**
Professor Joachim Gudmundsson – joachim.gudmundsson@sydney.edu.au
Research Area:
Algorithm Design

Project Description:
There is a well-known discrepancy between theoretically efficient algorithms and effective practical algorithms. The traditional goal of theoretical computer science is to prove that an algorithm performs well in the worst case: if one can prove that an algorithm performs well in the worst case, then one can be confident that it will work well in every domain. However, there are many examples of algorithms that work much better in practice than in the worst case. Understanding precisely why these algorithms work well empirically is essential to developing better practical algorithms. This project will fulfill the acute need for new analytical tools and models that will enable better design of practical algorithms.

Resilient and Secure Edge Computing for Untrusted Distributed Systems

Supervisor:
Dr Kanchana Thilakarathna – kanchana.thilakarathna@sydney.edu.au

Research Areas:
Computer Science, Cybersecurity, Distributed Systems.

Project Description:
Billions of intelligent devices (“things”) capable of communicating are being deployed in our physical environment, and embedded in device being worn by humans. This led to the new era of Internet of Things (IoTs) where these lightweight devices – some are intelligent and some only marginally so – collecting and sending vital information to Cloud Data Centres (CDCs) for further processing and decision making. IoT has already begun to transform our industries and many mission critical tasks such as in electricity networks, in crisis response, in factories, in supply chain networks. The data collected from the sensors will enable optimised operations to automate and support various critical tasks such as coordinated defensive actions, ISR operations (Intelligence, Surveillance and Reconnaissance) and rescue missions. The continuous coordination of thousands, if not millions, of heterogenous things will place strict latency bounds and security requirements in dynamically changing often untrusted environments.

To address these concerns, it has been proposed to bring cloud-like resources closer to the edge of the network (Edge Computing), as it allows the delivery of delay-sensitive context-aware services by pushing the frontier of applications, data, and services away from centralised models and to distributed extremes of a network. The benefits of EC also come with additional risks: adding more data-generating devices to a network in more locations—particularly those that are physically remote or aren't well monitored—can lead to additional cyber security risks. Security at the edge remains a huge challenge, primarily because most IoT devices do not have software and hardware support for standard security protocols as such the security software updates which are often needed through the lifecycle of the device may not be present. This project focuses on developing resilient and secure distributed edge technologies with an improved performance, cheaper operating cost, and ease of deployment.
Further Information:
This scholarship is only available for Australian citizens, Australian Permanent Residents or New Zealand Special Category Visa holders.
Successful candidates will have:

- A bachelor’s degree in a relevant discipline

How to Apply:
To apply, please email kanchana.thilakarathna@sydney.edu.au, with the subject line “PhD Application:” and your name. Include the following:

- CV
- Transcripts (can be unofficial)
- Cover letter

Geometric Networks in the Presence of Obstacles

Supervisor:
Dr André van Renssen – andre.vanrenssen@sydney.edu.au

Research Area:
Algorithms; Computational Geometry; Graph Theory

Project Description:
Geometric networks are networks where every node has a location associated with it. When two nodes are connected, they know each other’s location. These networks are quite well understood and most networks allow for modifications in order to enhance it, such as guaranteeing a certain maximum degree for each node, bounding the number of hops needed to reach any other node, or having efficient routing algorithms. However, when there are obstacles that block communication between nodes on opposite sides, far less is known about these networks. In this project, we aim to shed some light on these networks in the presence of obstacles in order to design networks that have additional good properties and/or allow for efficient routing algorithms.

Further information:
A strong background in discrete math and/or algorithms is strongly recommended for this project.
Electrical and Information Engineering Projects

Quantum Topological Photonics

Supervisor:
Dr Alex Song – alex.song@sydney.edu.au

Research Areas:
Topological Phases; Quantum Optics; Nanophotonics

Project Description:
Quantum states of light have been extensively studied for various applications such as quantum computation, quantum communication, and metrology. Yet, the media that carry and transport the nonclassical light are typically fibres, dielectric cavities or waveguides, or vacuum, which are themselves topologically trivial. We will study the quantum effects of light in the presence of non-trivial topology. To this end, we will design and fabricate nanophotonic structures with different topological phases. Both Hermitian and non-Hermitian topological bands will be employed on this platform. We will examine the dynamics of single photons, entanglement, and quantum noise under the tailored density of states, dispersion, and chirality. We will engage in both theoretical and experimental studies. With the new topological degrees of freedom, we hope to address pressing issues such as robustness and scaling in quantum information processing.

Further Information:
1-2 scholarships are available for this project. The start date is flexible. Applications from both domestic and international students are welcomed.

Grid integration of inverter-interfaced energy resources

Supervisor:
Professor Gregor Verbic – gregor.verbic@sydney.edu.au

Project Description:
The project aims to develop methods and tools for grid integration of inverter-interfaced energy resources to ensure the stability of a fully renewable electric power system.

The scholarship will be available in January 2023.

How to apply:
Email gregor.verbic@sydney.edu.au to discuss your suitability and how to apply.
Powering Community Batteries for Power System Transition

Supervisor:
Associate Professor Jin Ma – J.Ma@sydney.edu.au

Project Description:
Australia has seen a rapidly distributed energy resource (DER) uptake in the past decade with one in four households having a rooftop solar system. However, DERs also bring operational challenges to power system operations due to network constraints. This iPhD project aims to address these challenges by developing a community battery eco-system by investigating community batteries’ functionalities in providing both market and network services in order to make the operation of community batteries sustainable to help enable Australia’s renewable transition

About You:

Essential
- A Bachelor’s or Master’s degree in Electrical Engineering, Computer Science, Applied Mathematics, or other closely related fields.
- Knowledge and experience in power system modelling and analysis, via programming languages or available tools. Experiences in power system dynamic simulation is a plus.
- Advanced programming skills in Matlab/Julia is preferred. Skills in Python/Java/C is a plus.
- Excellent writing and communication skills, and willingness for collaboration.

Desirable
- Knowledge and experience in applying optimisation techniques in solving complex problems and in applying game theory in multi-agent competition and collaboration environments.

Program Package:
The Program includes:
- admission to a university PhD program
- a Scholarship Package totalling approx. $45,000 p.a. over four years
- a structured professional development and training program
- a Project Expense and Development package of $13,000 p.a. over four years
- a six month in-business component with the industry partner
- supervision by CSIRO, an industry partner, and the host university

How to apply:
Email J.Ma@sydney.edu.au to discuss your suitability and how to apply.

Augmented Reality for the Visually Impaired – Sensory Augmentation

Supervisor:
Associate Professor Craig Jin – craig.jin@sydney.edu.au
**Project Description:**

The Computing and Audio Research Lab at the University of Sydney, Australia has a fully-funded PhD position open in augmented reality for the visually impaired, in partnership with ARIA LLC.

Applicants with a strong background in Psychoacoustics, Computer Science, Software Engineering or similar programs are encouraged to apply.

Project ARIA, Augmented Reality in Audio, seeks to endow the visually impaired with a richer sense of their surroundings using a wearable augmented reality device. Building on technologies from robotics, augmented reality, and spatialised audio display, ARIA will deliver next-generation auditory sensory augmentation with the potential to improve the quality of life for millions of people affected by vision impairment worldwide.

There are multiple PhD projects available in Project ARIA. This Sensory Augmentation-focused project will advance the auditory sensory augmentation technologies required for the ARIA wearable device to perform reliably and efficiently in a breadth of usage scenarios.

We take a broad view of auditory sensory augmentation as comprised of three parts: (1) sensors and machine artificial intelligence extract information for a targeted objective; (2) this information is rendered via the auditory channel as sound; (3) we enable efferent feedback control via hand/wrist or other sensors. Experiments are run using motion capture and the latest AR/VR/XR equipment. The challenges are to convey navigation, social, or symbolic information via the auditory channel in perceptually consistent and meaningful ways.

The project’s aims include:

- Establishing a psychoacoustic simulation environment to support rapid development and evaluation of novel auditory sensory augmentation paradigms
- Adapting computational imaging technologies to propose novel methods for auditory sensory augmentation
- Characterising and calibrating auditory sensory augmentation paradigms via simulation, controlled lab experiments, and user trials
- Developing auditory sensory augmentation algorithms to best make use of incoming machine vision sensor information
- Supporting development of the high-level sensory augmentation algorithms and the full sensory augmentation pipeline

**Research Environment**

Embedded in the School of Electrical and Information Engineering, the Computing and Audio Research Lab (CARLab) is focused on auditory sensory augmentation, machine hearing, and morphoacoustics (morphoacoustics.org). We employ audio signal processing and machine learning techniques to develop new concepts and understandings that will provide new technologies for auditory sensory augmentation and machine hearing.

CARLab offers specialised acoustic facilities (anechoic chambers, semi-anechoic chamber, loudspeaker arrays, linear and spherical microphone arrays, AR/VR/XR platforms). You will have access to mechanical and electronics workshops and a pool of technical staff to help realise your research ambitions. You will also have the opportunity to work closely with Project ARIA’s engineers and make use of their extensive development and testing facilities. The University of Sydney offers a rich academic setting in a world-class...
city, and CARLab has strong ties to a network of nearby and international academic and industrial collaborators.

**Offering**

A fully funded 3-year PhD scholarship covering tuition fees and a stipend covering living expenses, with extension to 3.5 years contingent on availability of funding.

**About You**

Successful candidates will have:

- A bachelor’s degree in a relevant discipline
- Interest in developing novel auditory sensory augmentation systems and working with AR/VR/XR simulation environments
- Excellent communication and interpersonal skills
- Experience with one or more of psychoacoustics, computer science, software engineering, audio signal processing, sound design and engineering
- Hands-on experience with Python, Matlab, C++, and one or more video game simulation environments would be an asset

Domestic and international applicants are welcome.

**How to Apply**

Email craig.jin@sydney.edu.au to discuss your suitability and how to apply.

**Real-Time Magnetic Resonance Imaging for Vocal Tract Analysis**

**Supervisors:**

Associate Professor Craig Jin – craig.jin@sydney.edu.au
Professor Kirrie Ballard – kirrie.ballard@sydney.edu.au

**Project Description:**

The Computing and Audio Research Lab at the University of Sydney, Australia has a fully funded PhD position open to support real-time magnetic resonance imaging (rtMRI) and analysis together with acoustic-phonetic analysis. A particular focus for the imaging/acoustic processing and analysis is to support a study of the developmental trajectory of tongue control. This project is conducted in collaboration with University of York, Macquarie University, and the Discipline of Speech Pathology at the University of Sydney. Applicants with a strong background in Electrical, Computer Engineering, Computer Science, or similar programs are encouraged to apply.

This research seeks to develop rtMRI capabilities for vocal tract analysis in Australia, expand our knowledge of the morphoacoustics (morphoacoustics.org) of the vocal tract and assist with improved understanding and techniques within the field of Speech Pathology.

Challenges arise to validate, correlate, and relate the imaging and acoustic data obtained from vocal tract rtMRI (VT-rtMRI). We will be creating, collecting and analysing an Australian speech database. Research areas of interest are statistical and machine learning techniques to assist with the data analysis and
processing. In particular, VT-rtMRI offers the ability to form an improved understanding of the relationship between articulation, acoustics and perception.

The project’s aims include:

- Characterising the relationship between dynamic tongue configuration and speech acoustics, and how this relationship changes as the participants grow
- Developing computational imaging and acoustic analysis technologies for establishing these links including novel methods for processing rtMRI images of the vocal tract
- Supporting development of tools to support rtMRI vocal tract imaging and analysis

Research Environment

Embedded in the School of Electrical and Information Engineering, the Computing and Audio Research Lab is focused on signal processing and machine learning approaches to support morphoacoustic and auditory sensory augmentation research and offers rich collaboration and supervision spanning multiple departments and universities: (Amelia Gully, forensic and acoustics, University of York), (Kirrie Ballard, Speech Pathology, The University of Sydney), (Michael Proctor, speech production, perception, and phonological organisation, Macquarie University), (Luping Zhou, medical imaging and machine learning). We will conduct our research using imaging facilities at Westmead Hospital.

Offering

A fully funded 3.5-year PhD scholarship covering tuition fees and a stipend covering living expenses.

About You

Successful candidates will have:

- A bachelor’s degree in a relevant discipline
- Interest in developing acoustic and imaging analysis systems for VT-rtMRI.
- Excellent communication and interpersonal skills
- Experience with one or more of acoustics, audio signal processing, imaging, image processing and/or computer vision
- Hands-on experience with MATLAB, Python, and Deep Learning frameworks would be a strong asset

Domestic and international applicants are welcome.

How to Apply

Email craig.jin@sydney.edu.au to discuss your suitability and how to apply.

Direct Signal Processing

Supervisors:
Professor Xiaoke Yi – xiaoke.yi@sydney.edu.au
Dr Liwei Li – liwei.li@sydney.edu.au
**Research Area:**
Direct signal processing, IoT, Artificial Intelligence

**Project Description:**
The rolling out of the internet of things which seeks to connect and integrate billions of devices together, and the increasing need for artificial intelligent systems continually demand more bandwidth, higher speed signal processing. Direct signal processing in optical domain has the potential to realize orders of magnitude increase in instantaneous bandwidth, and a very high sampling frequency ability (over THz in comparison to around GHz with electronic technology), which lead to diverse applications for tackling problems of processing wideband signals, and for high-throughput sensing. This project focuses on light weight, small size and low power consumption integrated photonic circuits for signal processing and sensing, which has applications in environmental monitoring, broadband communications, datacenter, health care, quantum information processing.

Further information:
If you are interested, please email a concise CV (1 page), academic transcripts and a short description of why you are interested to Professor Yi by **15 July**.

---

**Logic Development of MAC Systems for Wireless Communications**

**Supervisor:**
Dr Wibowo Hardjana – wibowo.hardjawana@sydney.edu.au

**Research Area:**
Wireless Communications, 5G, 6G , Long-Range WiFi, IoT, Artificial Intelligence

**Project Description:**
This industrial PhD project will be jointly supervised with our industry partner, Morse Micro, a leader in the design and manufacturing of Wi-Fi HaLow solutions. Wi-Fi HaLow is based on the IEEE 802.11ah standard and targets long-range and wide-range wireless internet-of-things (IoT) applications with transmission rates ranging from 0.3 to 234 Mbps using the unregulated frequency band around 900MHz. Collision as a result of contention access has been identified as one of the issues that prevents achieving optimal wireless capacity in the above systems. The identified features that can control contention in IEEE 802.11ah are Target Wake Time (TWT), Restricted Access Window (RAW) and modulation coding rates (MCS). TWT permits an access point (AP) to define a specific time or set for individual stations to access the medium. RAW allows partitioning of the stations within a Basic Service Set (BSS) into groups and restricting channel access only to stations belonging to a given group at any given period. MCS determines the length of transmission frames. We will develop a mathematical formulation and artificial intelligence (AI) model for scheduler logic and validate the results via theoretical analysis and network simulators, culminating in hardware prototypes. The project will also investigate MAC level system performance for different operating bands (such as ISM 2.4 GHz band) and propose improvements on IEEE 802.11n MAC layers. The PhD candidate must be willing to spend between 50% and 75% of the time at the partner company offices when necessary and to adapt the research directions if needed.
Further information:
If you are interested, please email your up-to-date CV, transcript and a short description of why you are interested to Dr Hardjana

**Nanophotonic radiation control for sustainable energy**

**Supervisor:**
Dr Alex Song – [alex.song@sydney.edu.au](mailto:alex.song@sydney.edu.au)

**Research Area:**
Nanophotonics

**Project Description:**
This project will explore nanostructured approaches to sustainable energy, broadly defined. The need for energy efficiency, recycling, and harvesting is ever pressing in our modern society. Nano control of radiation provides unique opportunities for sustainable energy, with a wide range of applications such as in building cooling, engine heat reusing, and human-body cooling. This project expands from our series of works in nanostructured textiles, for example, in Science 353, 1019 (2016), Nature Sustainability 1, 105-112 (2018), Adv. Mater. 30, 1802152 (2018), ACS Photonics 7, 1729 (2020).

There is one scholarship available for this project. Start date is flexible. Applications from both domestic and international students are welcomed.

Further information:
For more information, please visit our website: [https://alexsong.group/](https://alexsong.group/)

**Frontiers of Nanophotonics**

**Supervisor:**
Dr Alex Song – [alex.song@sydney.edu.au](mailto:alex.song@sydney.edu.au)

**Research Area:**
Nanophotonics; Topology; Non-Hermicity; Non-reciprocity

**Project Description:**
This project will explore cutting-edge research topics in photonics including topological phases, non-Hermitian physics, and quantum optics. These are future-facing research thrusts that aim to lay the groundwork for next-generation integrated photonic platforms in sensing, communication, and information processing.

There is one scholarship available for this project. Start date is flexible. Applications from both domestic and international students are welcomed.
Further information:  
For more information, please visit our website: https://alexsong.group/

Project Management Projects

AI Techniques for Emergency Management and Critical Infrastructure

Supervisor:

Dr Nader Naderpajouh – nader.naderpajouh@sydney.edu.au  
Professor Jennifer Whyte – jennifer.whyte@sydney.edu.au

Research Areas:


About the opportunity:

Two PhD Scholarships opportunities to support research in "AI Techniques for Emergency Management and Critical Infrastructure" is being offered to Australian citizens or permanent residents. The scholarship includes a stipend of $41,650 p.a which includes training and, $5,000 for travel. The recipient will be required to undertake a six-month internship with the industry partner and undertake training courses from the CSIRO on AI and analytics.

Successful candidates must have:

● Bachelor’s degree or a master’s degree in the relevant discipline.
● Be an Australian or permanent resident.

How to Apply:

To enquire about this opportunity, please email nader.naderpajouh@sydney.edu.au, with the subject line “PhD Application:” and your name. Include the following:

● CV  
● Transcripts (can be unofficial)

Project analytics and the delivery of major projects Project Conception and Future Making

Supervisor:

Professor Jennifer Whyte – jennifer.whyte@sydney.edu.au

Research Area:

Project Analytics; Megaprojects

Project Description:

This doctoral research project will develop new insights from the data that is used on projects, enabling predictive rather than retroactive approaches to decision making. It will explore how project analytics could
help megaprojects move beyond capturing the data, allowing them to see how the projects are performing, predict what’s likely to happen, and inform the best action to take.

**Further information:**

There is one PhD Scholarship on offer. To be eligible for this doctorate, your 1st class honours degree or masters need to be in computer science or engineering and involve units on data analytics (and/or related topics such as machine learning). We will assess transcripts, CV, publications, references and 1 page on how you would develop this topic into a proposal [https://www.sydney.edu.au/study/how-to-apply/postgraduate-research/how-to-write-a-research-proposal-for-a-strong-phd-application.html](https://www.sydney.edu.au/study/how-to-apply/postgraduate-research/how-to-write-a-research-proposal-for-a-strong-phd-application.html)

Applications to be submitted to [jennifer.whyte@sydney.edu.au](mailto:jennifer.whyte@sydney.edu.au)

**Project Conception and Future Making**

**Supervisor:**

Professor Jennifer Whyte – [jennifer.whyte@sydney.edu.au](mailto:jennifer.whyte@sydney.edu.au)

**Research Area:**

Project Conception

**Project Description:**

This doctoral research project will empirically study how project sponsors make early decisions on which projects to invest in, how they manage portfolios and programs. It will draw on my recent published research on ‘future making’ as a process of inquiry, to analyse data on the practices of project conception, and how these involve and exclude relevant stakeholders.

**Further information:**

There is one PhD Scholarship on offer. To be eligible for this doctorate, your 1st class honours degree or masters need to be in sociology, management or related social sciences, and include units on qualitative research methods. We will assess transcripts, CV, publications, references and 1 page on how you would develop this topic into a proposal [https://www.sydney.edu.au/study/how-to-apply/postgraduate-research/how-to-write-a-research-proposal-for-a-strong-phd-application.html](https://www.sydney.edu.au/study/how-to-apply/postgraduate-research/how-to-write-a-research-proposal-for-a-strong-phd-application.html)

Applications to be submitted to [jennifer.whyte@sydney.edu.au](mailto:jennifer.whyte@sydney.edu.au)

**Digital delivery in project-based industries**

**Supervisor:**

Professor Jennifer Whyte – [jennifer.whyte@sydney.edu.au](mailto:jennifer.whyte@sydney.edu.au)

**Research Area:**

Digital Solutions; Supply Chain
**Project Description:**

This doctoral research project will map the dynamics as global software, as software companies work with project-based firms, projects and programs. It will develop interests in how software inscribes processes into organizations, and changes the way that projects are delivered and run, the supply-chains that are important for projects, and the relationships between projects and firms in project-based industries.

**Further information:**

There is one PhD Scholarship on offer. To be eligible for this doctorate, your 1st class honours degree or masters need to be in economics, management, engineering or the social sciences, and include units on innovation studies or project management. We will assess transcripts, CV, publications, references and 1 page on how you would develop this topic into a proposal [https://www.sydney.edu.au/study/how-to-apply/postgraduate-research/how-to-write-a-research-proposal-for-a-strong-phd-application.html](https://www.sydney.edu.au/study/how-to-apply/postgraduate-research/how-to-write-a-research-proposal-for-a-strong-phd-application.html)

Applications to be submitted to [jennifer.whyte@sydney.edu.au](mailto:jennifer.whyte@sydney.edu.au)