FACULTY OF ENGINEERING

PhD Scholarship Opportunities May 2024

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 Projects

Drone Systems Testing and Failure Mode Recognition using AI and ML

Supervisor:

Associate Professor Nicholas Williamson – **nicholas.williamson@sydney.edu.au**
Project Description:

Drones of all sizes have significantly changed the way we can monitor things, transport things and do research. Their applications continue to grow at a phenomenal rate and we are also now looking at new passenger transport systems, based on advanced air mobility (AAM). With any drone design, there are many systems ranging from propulsion, to navigation and power systems. Their reliability is one area of concern and data on failure modes of some systems is critical to drone future deployment. Within the School of Aerospace, Mechanical and Mechatronic engineering, we have constructed a preliminary test bed that allows us to test and monitor drone power and propulsion systems. In a recent pilot project the basic test bed was commissioned and we now have funding for a PhD scholarship to extend this work. Using and modifying the current rig, we would like to record data from generic drone electric power and propulsion systems, and use the data to predict system failures, using artificial intelligence (AI) and machine learning (ML) algorithms. We are looking for a highly motivated aerospace, mechanical or mechanics student, who is interested in running and modifying our rig and looking at failure recognition methods, in a 3.5 year fully funding PhD program.

Offering:

A full PhD stipend or $5,500 top up stipend for 3.5 years for an Australian citizen or permanent resident only.

Successful candidates must:

- Have a Bachelor degree (1st class honours or equivalent) or a Master degree
- Be a domestic student

How to Apply:

To apply, please email nicholas.williamson@sydney.edu.au the following:

- CV
- Transcripts (can be unofficial)

Dissolved Oxygen Transfer by convective cooling in lakes and rivers

Supervisor:

Associate Professor Nicholas Williamson – **nicholas.williamson@sydney.edu.au**
Project Description:

Gaseous Oxygen is dissolved into the surface waters of rivers, lakes oceans and then mixed by turbulence within the water column. The turbulent mixing which controls this transfer rate is poorly understood in conditions of low wind and strong thermal stratification where convective cooling and other mechanisms are important. This project will investigate these effects through both experimental and numerical approaches.

Large scale fish kill events are an increasingly common occurrence in inland Australian rivers as a result of low dissolved oxygen (DO) levels. Rivers have significant DO demand for fish respiration and biological activity in the sediments and water column. Under normal conditions this DO demand is met by the continual transfer of gaseous oxygen from the atmosphere into the water surface, where it is then mixed through the water column by turbulence. When river flow is low however the water column can become thermally stratified and buoyancy effects damp out turbulent mixing thereby reducing DO transport from the surface. These conditions lead to DO depletion and fish kills. The gas transport process is very complex. Studies across a wide range of flows (lakes, oceans, rivers) have shown that

gas transfer from the surface is usually controlled by small scale mixing at the surface driven by larger scale turbulence within the water column. However, the dynamics of the turbulence, including how the turbulence is generated have a strong influence on the process and require separate parameterisations. The strongly stratified flow regimes seen leading up to fish kill events in Australian rivers are very different from conditions examined in most early investigations, so we are unable to predict DO supply into a water body before, during or after a fish kill event.

This project comprised of two main lines of investigation:

- Numerical research program which will use highly resolved direct numerical simulations to investigate the near surface mixing in strongly stratified river/lake flow under light wind forcing. The dynamics of convective cooling on gas transfer and the dynamics of non-breaking surface waves will investigated.
- A field program which will involve deploying high accuracy eddy covariance instruments to capture the turbulent oxygen and heat flux near the surface. Our well equipment fluid mechanics laboratory will be used for testing and development of instrumentation.

Successful candidates must:

Have a strong background in fundamental fluid mechanics, heat and mass transfer and numerical or experimental methods for fluid mechanics.

How to Apply:

To apply, please email nicholas.williamson@sydney.edu.au the following:

- CV
- Transcripts (can be unofficial)

Turbulent mixing in urban environments – towards trusted simulations under strongly stable and unstable conditions

Supervisor:

Associate Professor Nicholas Williamson – **nicholas.williamson@sydney.edu.au**

Project Description:

Using high resolution numerical simulations this project will advance our understanding of the effects of buoyant convection on turbulent mixing in urban environments (i.e. within city streets) and will develop new modelling approaches for large eddy simulations of these flows.

The modelling and simulation of urban environments is undergoing an extraordinary revolution. The increase in computational power currently available means that computational fluid dynamics simulations of an urban city block can be performed at ∼ 5m resolution in near real time using Large Eddy Simulation (LES). This advancement has the capacity to revolutionise local weather prediction, decision making in urban planning and responses to natural and anthropogenic disasters, as well as address critical challenges such as urbanisation, urban heat islands and climate change. There are key deficiencies in current urban flow models that must be addressed however.

This project focuses on understanding the effect of buoyancy on street level mixing process. These process include convective boundary layers formed on streets and buildings and thermal plumes that discharge into the urban roughness layer. These processes are poorly represented in course resolution models. This project will use high resolution direct numerical simulation and high resolution large eddy simulations to understand the flow physics and develop new modelling strategies for them.

Successful candidates must:

- Have a strong interest in fundamental fluid mechanics, heat and numerical methods.
- Have a background in Engineering or Science/Mathematics is preferred.

How to Apply:

To apply, please email nicholas.williamson@sydney.edu.au the following:

- CV
- Transcripts (can be unofficial)

The fluid mechanics of particulate inhalation under various types of breathing

Supervisor:

Associate Professor Agisilaos Kourmatzis – **agisilaos.kourtmatzis@sydney.edu.au**
Project Description:

Our aim is to undertake a large-scale study to improve our understanding of the impact of particulate inhalation during exercise and/or extreme environmental conditions.

A range of potential directions for this project are possible, from developing an instrumented system that "models" particulate generation from a bushfire-like system, to computational modelling of inspiratory and expiratory flow and airway deposition, to implementation of laser-based diagnostics to improve our understanding of particulate flow processes during intense breathing. We have a degree of flexibility and can tune projects to leverage on your skill and interest. This is a highly multidisciplinary project that will be running across sites. There will be up to 3-4 PhD students working on this program over the next few years and you would be one of those students.

Offering:

This scholarship is offered to both international and domestic PhD applicants for 3.5 year (fulltime) at the RTP stipend rate of $40,109 p.a. (2024 rate) and includes tuition fees for international students.

Successful candidates must:

- Have a Bachelor degree (Honours or Honours Class 1 equivalent) or a Master degree,
- Have a strong background in fluid mechanics, optical diagnostics, instrumentation, experimental methods and/or computational fluid dynamics

How to Apply:

To apply, please email agisilaos.kourtmatzis@sydney.edu.au the following:

- CV
- Transcripts (can be unofficial)

RTCMA PhD Top-Up Scholarship: Machine Learning-based 3D Object Detection for Navigation in Unstructured Environments

Supervisor:

Dr. Andrew Hill – **andrew.hill@sydney.edu.au**
Dr. Mehala Balamurali – **mehala.balamurali@sydney.edu.au**

Project Description:

The Australian Centre for Field Robotics (ACFR) at The University of Sydney, in collaboration with Rio Tinto, a global mining company, established the Rio Tinto Centre for Mine Automation (RTCMA) with an aim to develop and implement the vision of a fully autonomous, remotely operated mine.

Our research programs at RTCMA are dedicated to addressing critical challenges in the mining industry. For more detailed information about our research initiatives, please visit our website at https://www.sydney.edu.au/cma.

We are seeking a highly motivated and talented PhD student to join our research team in the field of machine learning for autonomous navigation, with a specific focus on 3D object detection in challenging, unstructured environments. This project aims to investigate the application of deep neural networks to enhance the detection and tracking of objects in specialized domains, such as open-pit mines, where conventional approaches face unique challenges.

The primary objectives of this research project are as follows:

- Data Acquisition - Explore and evaluate two distinct methods for acquiring data suitable for training and evaluating deep neural networks. This includes semi-automated annotation of recorded LIDAR data and synthetic data generation.
- Object Detection - Develop and test various deep neural network architectures for the task of 3D object detection in unstructured environments, focusing on large, dynamic objects such as wheel loaders and excavators.
- Integration with Autonomous Platforms - Propose and implement a seamless integration of a ROS2 detector module into an autonomous driving platform, allowing real-time deployment and evaluation of the trained models in a practical setting.
- 3D Multi-Object Tracking - Extend the object detection work into 3D multi-object tracking to estimate the location, orientation, and scale of objects in the environment over time, considering temporal information to improve robustness against partial or full occlusions.
- Motion Pattern Analysis - Utilize the resulting object trajectories to infer motion patterns and excavation/driving/reversing behaviours, enabling enhanced forecasting and operational training for autonomous decision-making.

This research is expected to make the following contributions to the field of autonomous navigation:

- Novel methods for data acquisition and annotation in specialized domains.

- Proposed 3D object detection models for unstructured environments and for objects with dynamic shapes.
- Practical integration of deep learning models into ROS/ROS2 for real-world deployment.
- Advancements in 3D multi-object tracking techniques.
- Insights into motion patterns and behaviour analysis for autonomous decision-making.

At RTCMA, we are committed to advancing science and engineering in the field of mining through our specialised PhD Top-Up Scholarship. These scholarships are designed to provide exceptional graduates with unique opportunities to excel in their doctoral studies at University of Sydney.

Benefits of the RTCMA PhD Top-Up Scholarship:

- Access to our world-class team of scientists, engineers, and mentors in academia and industry.
- The opportunity to elevate your research to new heights using our state-of-the-art facilities.
- First-hand experience in an environment where groundbreaking research is actively contributing to positive changes in the mining industry.

Further information:

The RTCMA PhD Top-Up Scholarship is an additional award that complements the support received from a primary scholarship, such as an RTP scholarship.

Successful candidates must:

- Have a Bachelor degree (Honours or Honours Class 1 equivalent) or a Master degree,
- Have a strong background in computer vision, machine learning, or related fields, along with a passion for solving complex problems in autonomous navigation.

How to Apply:

To apply, please email andrew.hill@sydney.edu.au or mehala.balamurali@sydney.edu.au, with the subject line “RTCMA PhD Top-Up Opportunity” and your name. Include the following:

- CV and letters of recommendation,
- Transcripts (can be unofficial) and statement of purpose.

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:

Professor Julie Cairney – julie.cairney@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:

- https://research.csiro.au/hyresearch/embrittlement-tolerant-alloys-for-safe-hydrogen-transmission-and-storage
- https://research.csiro.au/hyresearch/mitigating-hydrogen-embrittlement-in-high-strength-steels
- https://research.csiro.au/hyresearch/characterise-high-performance-green-steels-for-the-hydrogen-economy

Offering:

This scholarship is offered to both international and domestic PhD applicants for 3.5 year (fulltime) at the RTP stipend rate of $40,109 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,

How to Apply:

To apply, please email **julie.cairney@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:

Professor Julie Cairney – **julie.cairney@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 $40,109 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 julie.cairney@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 RTP stipend rate $40,109 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)

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/

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-word 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 and 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.

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.

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 nicholas.lawson@sydney.edu.au.

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

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 metallugical 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 Projects

Bioengineering Patient-Specific Osteochondral Grafts

Supervisor:

Professor Hala Zreiqat – hala.zreiqat@sydney.edu.au

Project Description:

Throughout life, human diarthrodial joints must bear the loads associated with physical activity, a process enabled by the cartilage-bone interface, or osteochondral (OC) unit. Diseases such as osteoarthritis (OA) cause pathological changes to the OC unit, leading to cartilage destruction, sclerotic bone, and pain, often necessitating total joint arthroplasty (TJA). TJA patients face a high lifetime risk of revision surgeries, highlighting the need for alternative tissue-engineered solutions.

This project aims to use natural materials to bioengineer patient-specific OC grafts that closely mimic the architecture, zonal organization, and functional properties of native OC tissue. We will utilize 3D computer models based on native subchondral bone architecture to print high-resolution models from a bioceramic known for its toughness, strength, and osseointegrative properties. Cellular layers of hyaline and calcified cartilage will be bonded to the bioceramic base and matured in a bioreactor until they match the native tissue.

Offering:

A PhD scholarship for 3.5 years at the RTP stipend rate (currently $40,109 in 2024). International applicants will have their tuition fees covered.

The project is funded by the Swiss National Foundation in Collaboration with ETH-Zurich, Switzerland.

Successful candidates must:

- Have a Bachelors degree (1st class honours or equivalent) or a Masters degree
- Have a background in either: biomedical sciences, biomedical engineering or stem cell biology

How to Apply:

To apply, please email **hala.zreiqat@sydney.edu.au** the following:

- CV
- transcripts

The position will be available in early 2025.

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.

Collaborator: Peter Tually and Chris Cowcher, TeleMedVet, Perth, Western Australia.

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.a**

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 cont**act** 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 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 **c**ontact 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 – **wei.chenbme@sydney.edu.au**

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 degre**e** 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 **wei.chenbme@sydney.edu.au** 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 – **wei.chenbme@sydney.edu.au**

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 **wei.chenbme@sydney.edu.au** with the subject line "PhD Application:" to discuss your suitability for this project.

Real-time Low-power Neural Accelerator

Supervisor:

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

About the project:

This project aims at developing an Application-Specific Integrated Circuit (ASIC) for a low-power learning system processing real-time time-series data.

For over a decade, the semiconductor industry, that propelled us all into the digital age, has been struggling with a chip power-density crisis. The birth of multi-cores microprocessors has its root in this very challenging issue of fundamental physics. The known thermal-voltage (kT/q) parameter, which identifies the scalability of basic transistor parameters, is a non-scalable factor. Additionally, the minimum feature size of the transistors has continuously shrunk from 10µm in 1970 to just 14nm in 2015 (iPhone 6S was shipped with 14nm transistors) making it extremely difficult and costly to engineer energy barriers in transistor channels (where electrons move) to avoid excessive electron tunnelling through the barrier when the transistor is supposed to be OFF. Success of the industry has traditionally been measured by how effectively they avoid quantum mechanical effects, such as the tunnelling. Unfortunately, with a few tens of atoms across a sub-10nm transistor switch, such effectiveness is vanishing into the shadow of ever increasing quantum tunnelling. This project aims to develop a neuro-inspired computing platform for cognitive task that current supercomputers fail to do in real-time like human brain [1-3]. The system architecture is inspired by how the brain function and solely dedicated to tasks dealing with big-data, including data mining, data analytics, pattern recognition and feature extraction. We use our state-of-the-art GPU cluster to develop the software and integrated circuit design tools to explore hardware implementation.

How to Apply:

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

Low-power Intelligent Bio-Signal Processing

Supervisor:

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

About the project:

This project aims at developing a responsive implant that is making decisions based on smart bio-signal processing.

While artificial intelligence (AI) has paved its way to some bionic applications mostly through software post-processing, close to none of today's electronic implants can be named "Intelligent"! We believe with the large amount of data that is available in any medical field and remarkable advances in AI and the expertise that we have in that as well as electronic technology shrinkage to a remarkable scale, there is a real chance that we may ultimately be able to let an implant to "learn and understand" streams of neural data and make decision with high accuracy. There are software and hardware expertise exist in our side that requires to be matched with medical knowledge, expertise and data. With that in mind please find the following proposal for collaboration [1-4].

This project aims to (A) introduce a deep learning platform for prediction of anomalies before it causes alteration of consciousness or other damages, (B) implement an ultra-low power fully digital and fully customized chipset to parallel achieved software performance, (C) mitigate problems of 'false alarms' and 'delay in action' confirmed using a set of clinical trials.

This project uses our state-of-the-art GPU cluster to develop the software and integrated circuit design tools to explore hardware implementation. We also study packaging and high-level integration and surgery issues for full animal clinical trial.

How to Apply:

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

Data-intensive solutions for medical technologies

Supervisor:

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

About the project:

This project aims at developing advanced solutions in software for processing medical data, addressing the issue of less or no labelled data.

Using today's advances in machine intelligence and pattern recognition, and our incredibly massive amount of structured and unstructured data on central nervous systems and the Brain, making sense of massive datasets with high amount of data-noise and incoherency is now a possibility [1-3]. We will develop, test and implement cognitive computing technologies in data-driven medical contexts. This project aims to develop data-driven machine learning medical technologies to make medical practices more personalized and precision in both domains of medical devices and services. While expanding knowledge in the information and computing sciences, this project aims to massively reduce costs in health and support services as well as providing low-cost bed-side or wearable technologies for constant monitoring and notification systems. This project uses our state-of-the-art GPU cluster to develop these technologies.

How to Apply:

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

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

Artificial intelligence (AI) assisted single-cell biomechanical nanotools for cardiovascular mechanobiology

Supervisor:

Associate Professor Arnold Lining Ju, Snow Fellow GAICD FHEA – **arnold.ju@sydney.edu.au**

Research Area:

Mechanobiology, Cardiovascular Engineering, Single molecule, Artificial intelligence, Piezo

Project Description:

The dynamism and intricacy of protein complexes performing critical physiological functions present a significant challenge. Traditional biochemical and biophysical techniques often falter in visualizing and characterizing their kinetic and signalling processes on singular living cells. The pressing need is for advanced bioimaging and single-molecule manipulation technologies capable of observing life activities in native cellular environments at the nanoscale.

Over the past half-decade, Dr. Ju has been at the forefront of this evolution, pioneering the pico-force (10^-12 Newton) BFP technique in Australia, the first of its kind. With this revolutionary nanotool, groundbreaking insights have been attained into the mechanosensory proteins' inner mechanics, as evidenced by a myriad of esteemed publications.

This ambitious project envisions the fusion of BFP with artificial intelligence to give birth to an unparalleled BFP manipulation platform. An ambitious vision for the future aims to marry the platform with patch clamp technology, enabling a trifecta of single-molecule electrophysiology, imaging, and manipulation within one system.

This initiative's pinnacle will be its application to the groundbreaking 2021 Nobel Prize discovery — Piezo mechanosensitive ion channels. The goal? To illuminate their role in cardiovascular diseases, especially in blood clotting phenomena, and pioneer new anti-thrombotic therapeutic strategies. Furthermore, this research stands poised to usher in a new era in biosensing device design, optimizing the human-machine interface.

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.

To learn more about the Snow-Ju Lab: Mechanobiology and Biomechanics Laboratory (MBL) and our research, please visit our official website (https://snowmedical.org.au/fellow/lining-arnold-ju/). For more information on A/Prof Ju's Snow Fellowship and groundbreaking research, check out these public release news articles:

A father had a heart attack at 54. His son's technology could have predicted it (https://www.smh.com.au/national/nsw/a-father-had-a-heart-attack-at-56-his-son-s-technology-could-ve-predicted-it-20230327-p5cvkj.html)

How to Apply:

If you are interested in this opportunity, you can complete your Expression of Interest via https://sydney.au1.qualtrics.com/jfe/form/SV_5vSA2po0sooUt0i, additional enquires can be emailed to arnold.ju@sydney.edu.au with the subject line "PhD Application" and the project title in the body of the email.

Harnessing Ancient Chinese Movable Type 3D Printing for Point-of-Care Microfluidic Diagnostics in Cardiovascular and Cerebrovascular Diseases

Supervisor:

Associate Professor Arnold Lining Ju, Snow Fellow GAICD FHEA – **arnold.ju@sydney.edu.au**

Research Areas:

Microfluidics, Point of care, Vessel on chip, Mechanobiology, Thrombosis

Project Description:

Thrombosis, resulting in devastating cardiovascular diseases such as heart attacks and strokes, stands as the predominant global killer. A particularly challenging variant, Cerebral venous sinus thrombosis (CVST), has been thrust into the spotlight due to its links with stroke and the observed complications from certain COVID-19 vaccines.

It's long-established that platelets play a central role in thrombosis. However, our latest research has unveiled a biomechanical prothrombotic mechanism that underscores platelets' sheer sensitivity to blood flow disturbance gradients. Alarmingly, prevalent anti-thrombotic drugs such as Aspirin, Plavix®, or Brilinta®, present limited efficacy against this mechanism.

Our team, based at the state-of-the-art Biomedical Engineering School and the Charles Perkins Centre, seeks to address this critical gap. Integrating principles from the ancient "Chinese Movable Type" printing with modern microfluidic biochip design, we've conceptualized the Vein-Chip platform. This innovative tool can simulate patient-specific CVST vascular anatomy using magnetic resonance imaging (MRI), coupled with the associated haemodynamic flow profile. This cost-effective, rapid, and scalable chip paves the way for personalized thrombotic assessment and monitoring, holding significant promise for a clinical breakthrough.

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:

- Minimum one-year expertise in clean room micro/nano processing and soft lithography.
- Experience with theoretical simulation using Matlab, Comsol, or Labview programming for equipment and device control.
- Proficiency in creating processing models, CNC programming, mechanical part manufacturing, and 3D printing.
- Pre-doctoral accomplishments such as publications, conference papers, and evidences of independent research.
- Outstanding oral and written communication skills.

To learn more about the Snow-Ju Lab: Mechanobiology and Biomechanics Laboratory (MBL) and our research, please visit our official website (https://snowmedical.org.au/fellow/lining-arnold-ju/). For more information on A/Prof Ju's Snow Fellowship and groundbreaking research, check out these public release news articles:

A father had a heart attack at 54. His son's technology could have predicted it (https://www.smh.com.au/national/nsw/a-father-had-a-heart-attack-at-56-his-son-s-technology-could-ve-predicted-it-20230327-p5cvkj.html)

How to Apply:

If you are interested in this opportunity, you can complete your Expression of Interest via https://sydney.au1.qualtrics.com/jfe/form/SV_5vSA2po0sooUt0i, additional enquires can be emailed to arnold.ju@sydney.edu.au with the subject line "PhD Application" and the project title in the body of the email.

Artificial intelligence (AI) assisted novel design and molecular dynamics simulation of anti-thrombotic peptides and experimental validation by nanomedicine delivery

Supervisor:

Associate Professor Arnold Lining Ju, Snow Fellow GAICD FHEA – **arnold.ju@sydney.edu.au**

Research Areas:

Molecular dynamics simulation, AlphaFold, Molecular docking, Computational biology, Peptide, nanoparticle

Project Description:

Heart and vascular diseases remain a significant concern in modern medicine, with a shocking 5.6% of Australian adults over 18 facing these challenges in 2017-18. While the interplay of shear in blood flow and its effect on proteins like von Willebrand factor (VWF) and FVIII is evident, a comprehensive understanding of their structures remains elusive.

Enter the revolutionary AlphaFold, a DeepMind-developed AI software, which demonstrated unparalleled accuracy in predicting protein structures, particularly with its AlphaFold 2 version. This project aims to harness the profound capabilities of AlphaFold to dive deep into the intricate mechanisms of these proteins.

Once we decode and design our anti-thrombotic peptides, the journey doesn't stop. We will step into the exhilarating world of nanotechnology. Using cutting-edge techniques, we plan to design nanocarriers tailored for optimal drug delivery, ensuring that our drugs not only impede thrombosis but are also delivered efficiently to their intended targets without interfering with hemostasis. This integration of computational design with experimental nanotechnology offers students a chance to be at the forefront of interdisciplinary 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 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.

To learn more about the Snow-Ju Lab: Mechanobiology and Biomechanics Laboratory (MBL) and our research, please visit our official website (https://snowmedical.org.au/fellow/lining-arnold-ju/). For more information on A/Prof Ju's Snow Fellowship and groundbreaking research, check out these public release news articles:

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How to Apply:

If you are interested in this opportunity, you can complete your Expression of Interest via https://sydney.au1.qualtrics.com/jfe/form/SV_5vSA2po0sooUt0i**,** additional enquires can be emailed to arnold.ju@sydney.edu.au with the subject line "PhD Application" and the project title in the body of the email.

Exploring Tumor-Endothelium Mechanobiology: Development of Advanced Imaging Technologies for 3D Cancer-Induced Thrombosis

Supervisor:

Associate Professor Arnold Lining Ju, Snow Fellow GAICD FHEA – **arnold.ju@sydney.edu.au**

Research Areas:

Tumour spheroids, Microfluidics, Volumetric imaging, Super resolution microscopy, Thrombosis

Project Description:

The intricate dance between tumors and their surrounding microvasculature holds keys to many pathological mysteries. Utilizing the foundation laid by the paper, "3D spheroid-microvasculature-on-a-chip for tumor-endothelium mechanobiology interplay," this project seeks to delve deeper into these interactions by pioneering advanced imaging technologies.

Our mission is dual-faceted:

1. Develop and refine single-molecule tracking and super-resolution imaging technologies such as TIRF, HiLo, PALM, STORM, and Lattice Light-Sheet Microscopy.
2. Implement these imaging methodologies to study the dynamic processes of thrombosis and platelet activation. This includes the analysis of molecular conformational changes in entities

like integrin receptors, cytoskeletons, and mechano-sensitive ion channels, as well as protein assembly, relocation, and interactions.

One of our overarching goals is to render a comprehensive "molecular interactome" detailing the nuanced interactions between platelets in both healthy individuals and cardiovascular patients grappling with conditions such as diabetes, obesity, and metabolic syndromes.

Lastly, using the high-volume 2D-3D image data generated, we'll venture into the realm of anti-platelet drug screenings, aiming to find potential therapeutics that can alter these tumor-endothelium interactions beneficially.

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, and the principles of fluorescent materials.
- Use of spatial light modulators, deformable mirror devices, and acoustic optical deflectors.

To learn more about the Snow-Ju Lab: Mechanobiology and Biomechanics Laboratory (MBL) and our research, please visit our official website (https://snowmedical.org.au/fellow/lining-arnold-ju/). For more information on A/Prof Ju's Snow Fellowship and groundbreaking research, check out these public release news articles:

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How to Apply:

If you are interested in this opportunity, you can complete your Expression of Interest via https://sydney.au1.qualtrics.com/jfe/form/SV_5vSA2po0sooUt0i**,** additional enquires can be emailed to arnold.ju@sydney.edu.au with the subject line "PhD Application" and the project title in the body of the email.

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 5B. The project aims to improve the feasibility, efficiency, and performance of gigascale solar photovoltaics. To achieve this, we will collaborate directly with 5B 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.

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 Projects

Techno-economic and environmental assessment of sustainable and fit-for-purpose concrete materials for civil infrastructure

Supervisor:

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

Research Areas:

Life Cycle Assessment, Waste, Concrete

About the opportunity:

The SmartCrete Cooperative Research Centre (SmartCrete CRC) is a government-funded initiative designed to support industry-led research aimed at improving the cost efficiency, productivity, and sustainability of Australian concrete infrastructure.

In collaboration with the SmartCrete CRC and various stakeholders, the University of Sydney is conducting research on the techno-economic modelling of durable, high-performance specialty concrete, as well as recycled waste-blended specialty concrete for use in construction and rehabilitation of civil infrastructure.

This project aims to provide a comprehensive techno-economic and environmental assessment throughout the life cycle of civil assets built with specialty and recycled waste-blended specialty concrete.

The concrete industry is currently grappling with several challenges, including the conflict between growing demands and rising costs, as well as stringent requirements to reduce embodied carbon, wastewater generation, and other harmful emissions.

Proposals to use more durable, high-performance specialty concrete and incorporate recycled wastes into concrete mixtures offer potential solutions. These approaches could reduce the lifecycle economic and environmental impacts of concrete infrastructure. However, the market adoption of these materials is limited by a lack of streamlined standards and evidence-based performance data.

In Australia, there is a notable lack of comprehensive studies on the economic and environmental implications of using specialty concrete and recycled waste-blended specialty concrete (CEM-X) as construction materials. Such information is crucial for decision-makers in the cement, water, transport, mining, and recycling industries.

To address this research gap, mathematical programming and computational tools will be employed to model the economic and environmental costs of using specialty concrete and CEM-X in Australian civil infrastructure. The modelling framework will integrate techniques from techno-economic modelling, life cycle costing, and life cycle assessment to quantify the true costs and environmental emissions of constructing assets with specialty concrete and CEM-X.

The role and the research will involve the following:

- Contribute to the development of a comprehensive modelling framework to assess the economic and environmental costs of specialty concrete and CEM-X for civil infrastructure construction.
- Conduct life cycle assessment (LCA) and life cycle costing (LCC) analyses to quantify the real costs and environmental impacts of using specialty concrete and CEM-X.
- Assist in building and maintaining a database for economic and environmental data inputs relevant to specialty concrete and CEM-X.
- Develop a decision-making tool to suggest optimal rehabilitation patterns based on cost analysis.
- Contribute to the communication of research findings through papers, seminars, and conference presentations.
- Collaborate with colleagues and stakeholders in organisations linked to SmartCrete CRC.

Offering:

This scholarship is offered to both international and domestic PhD applicants for 3.5 year (fulltime) at the RTP stipend rate of $40,109 p.a.

Successful candidates must:

- Have a Bachelors degree (1st class honours or equivalent) or a Masters degree in chemical, environmental, or civil engineering
- Demonstrate strong computational skills
- Demonstrate ability in process/project design and modelling
- Have familiarity with techno-economic modelling, life cycle costing/assessment
- Have the ability to work well with others in a team
- Have industry experience in civil construction for the water and/or transportation industries (desirable)
- Have industry experience working for cement and/or recycling companies (desirable)

How to Apply:

To apply, please email **marjorie.valix@sydney.edu.au** the following:

- CV
- Transcripts

A Risk-Based Consequence Matrix Tool for Asset Failure Assessment

Supervisor:

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

Research Areas:

Asset Management, Concrete, Infrastructure

About the opportunity:

The SmartCrete Cooperative Research Centre (SmartCrete CRC) is a government-funded initiative aimed at promoting industry-led research to improve the cost efficiency, productivity, and sustainability of Australian concrete infrastructure.

Through the SmartCrete CRC, the University of Sydney and various stakeholders are developing a decision support tool designed to predict the likelihood of asset failure and critically evaluate its consequences.

This project contributes by offering a comprehensive tool to assess the potential impacts of water infrastructure asset failure, facilitating better-informed decision-making and proactive risk management within the water sector.

SmartCrete CRC is undertaking a crucial mission in the water sector. Our collective goal is to ensure that the water services of our industry collaborators remain accessible, reliable, and trustworthy, despite the challenges posed by aging infrastructure and financial constraints.

While other roles within the project focus on developing advanced deterministic models to predict potential asset failures, this role is dedicated to examining the consequences of such failures. This involves investigating the wide-ranging impacts, including financial losses, environmental damage, community disruptions, and risks to human health. A practical tool (a consequence matrix) will be developed from deterministic models to simplify these complex scenarios.

This matrix will help Australia's water utilities to assess the severity of potential outcomes, considering factors such as the number of people affected, traffic congestion, and economic losses. Through close collaboration, we aim to not only improve the functionality of water systems but also protect communities and the environment.

The role and the research will involve the following:

- Contribute to the development of the consequence matrix for the water infrastructures.
- Develop Critical Infrastructure Rating (CIR) by analysing the various factors for asset failures such as economic and environmental
- Contribute to the communication of research results through papers, seminars, and conference presentations.
- Collaborate with colleagues in organisations linked to SmartCrete CRC.

Offering:

This scholarship is offered to both international and domestic PhD applicants for 3.5 year (fulltime) at the RTP stipend rate of $40,109 p.a.

Successful candidates must:

- Have a Bachelors degree (1st class honours or equivalent) or a Masters degree in chemical, environmental, or civil engineering
- Demonstrate strong computational skills
- Demonstrate ability in process/project design and modelling
- Have familiarity with techno-economic modelling, critical infrastructure rating, life cycle costing/assessment
- Have excellent oral and written communication skills
- Have the ability to work well with others in a team
- Have industry experience in civil construction for the water and/or transportation industries (desirable)
- Have industry experience working for cement and/or recycling companies (desirable)

How to Apply:

To apply, please email marjorie.valix@sydney.edu.au the following:

- CV
- Transcripts

Utilization of carbon materials from methane pyrolysis for water treatment applications

Supervisor:

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

Research Areas:

Carbon materials, Water treatment

About the opportunity:

CH_4 pyrolysis (CH_4 ® $2H_2 + C$), in which CH_4 is split into H_2 and solid carbon without generating CO_2, is a potential bridge technology from fossil fuels to a renewable and sustainable H_2 economy. Diverse types of carbon materials, such as carbon black, graphite, carbon nanotubes, carbon fibers, and hybrids of different carbon materials, can be produced from CH_4 pyrolysis, often with limited control over their structures and purity. A substantial technical gap exists in controlling carbon materials and realizing their practical applications. The resulting carbon materials contain sustainable iron residues when iron catalysts are used in CH4 pyrolysis. The project will explore unpurified carbon/iron composite materials for water treatment applications. In particular, we are interested in their roles as tri-functional adsorbents and catalysts for organic contaminant degradation. The adsorption capacity in removing different types of organic contaminants will be studied. Their roles in catalyzing hydrogen peroxide synthesis and serving as electro-Fenton catalysts to enable advanced oxidation will also be examined.

Offering:

This scholarship is offered to both international and domestic PhD applicants for 3.5 year (fulltime) at the RTP stipend rate of $40,109 p.a.

Successful candidates must:

- Have a Bachelors degree (1st class honours or equivalent) or a Masters degree
- Have previous research experience in carbon materials and water treatment
- Have journal publications (preferred)

How to Apply:

To apply, please email **yuan.chen@sydney.edu.au** the following:

- CV
- Transcripts (can be unofficial)

Utilization of carbon materials from methane pyrolysis for battery applications

Supervisor:

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

Research Areas:

Carbon materials, Battery

About the opportunity:

CH4 pyrolysis (CH4 ® 2H2 + C), in which CH4 is split into H2 and solid carbon without generating CO2, is a potential bridge technology from fossil fuels to a renewable and sustainable H2 economy. Diverse types of carbon materials, such as carbon black, graphite, carbon nanotubes, carbon fibers, and hybrids of different carbon materials, can be produced from CH4 pyrolysis, often with limited control over their structures and purity. A substantial technical gap exists in controlling carbon materials and realizing their practical applications. The project will explore novel synthesis methods to maintain the structure of carbon materials and new cost-effective purification methods to obtain high-purity carbon materials required for battery applications. Their applications in lithium-ion, sodium-ion, and carbon-carbon batteries will be comprehensively studied to enable further industrial scale-up and commercial adoption.

Offering:

This scholarship is offered to both international and domestic PhD applicants for 3.5 year (fulltime) at the RTP stipend rate of $40,109 p.a.

Successful candidates must:

- Have a Bachelors degree (1st class honours or equivalent) or a Masters degree
- Have previous research experience in carbon materials/batteries
- Have journal publications (preferred)

How to Apply:

To apply, please email yuan.chen@sydney.edu.au the following:

- CV
- Transcripts

Tandem processes for carbon dioxide utilization

Supervisor:

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

Research Areas:

Catalyst, Carbon Dioxide Reduction

About the opportunity:

Excessive carbon dioxide emission is a crucial challenge for humanity in this century. One potential solution is converting carbon dioxide into valuable chemicals. Professor Yuan Chen's team is developing novel catalytic processes for carbon dioxide utilization as a part of the ARC Centre of Excellence for Green Electrochemical Transformation of Carbon Dioxide (GETCO2) (https://www.getco2.org/). GETCO2 is a new research Center funded by the Australian Research Council and seven leading Australian universities with multiple international university partners. The students in this project will be based at the University of Sydney and work closely with a team of researchers in GETCO2 to gain an improved fundamental understanding of electrocatalysts and develop innovative processes to convert carbon dioxide into valuable chemicals. In particular, tandem processes that integrate electrochemical and thermal catalytic processes will be explored.

Offering:

This scholarship is offered to both international and domestic PhD applicants for 3.5 year (fulltime) at the RTP stipend rate of $40,109 p.a.

Successful candidates must:

- Have a Bachelors degree (1st class honours or equivalent) or a Masters degree
- Have previous research experience in catalysts and carbon dioxide reduction
- Have journal publications (preferred)

How to Apply:

To apply, please email yuan.chen@sydney.edu.au the following:

- CV
- Transcripts (can be unofficial)

Responsive Metal-Organic Framework Glass Composite Materials

Supervisor:

Professor Deanna D'Alessandro – **deanna.dalessandro@sydney.edu.au**

Research Areas:

Metal-Organic Frameworks, Composite Materials, Glasses, Spectroscopy, and Electrochemistry.

About the opportunity:

This PhD Scholarship aims to support a student undertaking a PhD within the School of Chemical and Biomolecular Engineering, Faculty of Engineering.

The focus of research is the design, synthesis and characterisation of new MOF glass materials. The successful recipient will use spectroscopic and electrochemical techniques to characterise MOF glasses. They will also determine the suitability of MOF glasses in composite materials for gas storage and energy applications.

Offering:

This scholarship is offered to both international and domestic PhD applicants for 3.5 year (fulltime) at the RTP stipend rate of $40,109 p.a.

Successful candidates must:

- Have an honours degree (first class) or masters in Inorganic Chemistry or Chemical Engineering**.**
- Good proficiency in programming languages and computational skill.
- Be willing to undertake research in spectroscopy and electrochemistry, and demonstrate a willingness to undertake occasional experiments at the institutes of collaborators.
- Applicants with experience in spectroscopy or electrochemistry are highly favoured.

How to Apply:

To apply, please email deanna.dalessandro@sydney.edu.au , with the subject line "PhD Application:" and your name. Include the following:

- CV
- Transcripts (can be unofficial)
- A personal statement which demonstrates how they reach the eligibility criteria.

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 $40,109 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 2024

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 wastes 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 though 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 – 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.

Civil Engineering Projects

AI-based Quality Control in Structural Steel Fabrication

Supervisor:

Dr Mike Bambach – mike.bambach@sydney.edu.au

About the opportunity:

This project will establish a system for AI-based monitoring of the quality of fabricated steelwork, optimising inspection requirements and managing compliance risks, based on big data analysis. This also includes collection and analysis of productivity data, and in-service health monitoring data, from a large number of steel fabrication companies.

Offering:

A scholarship is offered to both international and domestic PhD applicants for 3.5 years (fulltime) at the RTP rate of $40,109 (2024 rate) and includes tuition fees for international students.

Successful candidates must have:

- Have a Bachelor degree (1st class honours equivalent) or Masters degree
- Preference will be given to candidates with a background in steel structures and some experience using programming languages such as python.

How to apply:

To apply, please email please email **mike.bambach@sydney.edu.au** the following:

- CV
- academic transcripts

Applications close on the **31 July 2024**

Simulations of Thermal Performance of Solar Photovoltaics at Module and Sub-Array Level

Supervisor:

Professor Chengwang Lei – **chengwang.lei@sydney.edu.au**

About the opportunity:

We are looking for a PhD candidate to work on simulations of thermal performance of solar photovoltaics at module and sub-array level. The candidate will develop a numerical model to simulate the thermal behaviour of a photovoltaic array. The candidate will validate these models against experimental data. The model must consider the effects of free convection, forced convection, radiation, and moisture transport on the array under various conditions and orientations. This model will then be used to explore optimisation strategies of the panel and array design, with the goal being to develop a new thermally efficient photovoltaic array.

The project will employ the commercial Computational Fluid Dynamics (CFD) software COMSOL Multiphysics or other commercial CFD package if appropriate. 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.

Offering:

A scholarship is offered to both international and domestic PhD applicants for 3.5 years (fulltime) at the RTP rate of $40,109 (2024 rate) and includes tuition fees for international students.

Successful candidates must have:

- Have a Bachelor degree (1st class honours equivalent) or Masters degree in Engineering or Science

- Have evidence of a completion of a major research project, e.g. an Honours degree (First Class), a Master's degree, a research assistant job, or equivalent industry experience.
- Have a strong interest in computational fluid dynamics and experience in physical sciences (physics, maths, computer science).
- Demonstrated proficiency in fluid mechanics, numerical methods for partial differential equations and the finite element/volume method is highly desired but not essential.
- Applicants must be able to demonstrate strong written and oral communication skills (including the University requirements for English language proficiency) and the capacity to work independently and as part of a team.

How to apply:

To apply, please email please email chengwang.lei@sydney.edu.au the following:

- CV
- academic transcripts

Reliability Analysis of Fibre Reinforced Concrete Structures

Supervisor:

Dr Ali Amin – ali.amin@sydney.edu.au

Research Areas:

Fibre Reinforced Concrete, Concrete Structures

About the opportunity:

This study is intended to investigate estimate the reliability indices β, resistance factors ϕ and partial safety factors used in the design of fibre reinforced concrete structures.

Fibre reinforced concrete is characterised by its post cracking strength. Determining these properties can be subject to a high degree of scatter which may otherwise lead to low characteristic values which may be adopted in design. Reliability analyses together with sensitivity analyses (through the use of Monte Carlo simulations) on key parameters such as variability of the material's direct tensile strength and model errors from published analytical, are required to determine reliability indices β, resistance factors ϕ and partial safety factors used in the design of fibre reinforced concrete structures.

Offering:

This scholarship is offered to both international and domestic PhD applicants for 3.5 year (fulltime) at the RTP stipend rate of $40,109 p.a. The cost of tuition will also be provided to international students as part of the scholarship.

Successful candidates must have:

- Bachelor degree (Honours or Honours Class 1 equivalent) or a Master degree.

How to Apply:

To apply, please email ali.amin@sydney.edu.au the following:

- CV
- Transcripts (can be unofficial)

AI-based Quality Control in Structural Steel Fabrication

Supervisor:

Dr Mike Bambach – **mike.bambach@sydney.edu.au**

Research Areas:

Steel Fabrication, Welding and Artificial Intelligence (AI).

About the opportunity:

This project will establish a system for AI-based monitoring of the quality of fabricated steelwork, optimising inspection requirements and managing compliance risks, based on big data analysis. This also includes collection and analysis of productivity data, and in-service health monitoring data, from a large number of steel fabrication companies.

Offering:

This scholarship is offered to both international and domestic PhD applicants for 3.5 year (fulltime) at the RTP stipend rate of $40,109 p.a. The cost of tuition will also be provided to international students as part of the scholarship.

Successful candidates must:

- Have a Bachelor degree (Honours or Honours Class 1 equivalent) or a Master degree.
- Preference will be given to candidates with a background in steel structures and some experience using programming languages such as python.

How to Apply:

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

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

Applications close on the 31 March 2024.

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 $40,109 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 and transcripts (can be unofficial)

Closing date:

30 June 2023.

Environmental pollution caused by tire and brake wear

Supervisor:

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

Professor David Levinson – david.levinson@sydney.edu.au

Research Areas:

Environmental Engineering, Transport Engineering, Mechanics, Urban and Infrastructure Planning, Soil Physics and Biogeochemistry

About the opportunity:

The project covers the environmental pollution caused by automobile tire and brake wear and emphasizes the generation and environmental fate of micro and nano particulate originated from wearing across typical tire and brake life cycles. Tire- and brake-generated particulates are a very underrepresented source of pollution but at the same time the problem is highly diffused worldwide with radically unknown consequences. Tire and break wear contamination in the environment is not yet fully unraveled but it is potentially as pervasive and detrimental to the environment and biodiversity as the one related to microplastics. The project may cover various cross-disciplinary topics, including mechanics, environmental engineering, hydrological processes, and land and soil processes. The project can have wide applications including in environmental quality assessment, urban and infrastructure planning, soil physics and biogeochemistry and others.

Offering:

This scholarship is offered to both international and domestic PhD applicants for 3.5 year (fulltime) at the RTP stipend rate of $40,109 p.a.

Successful candidates must have:

- Bachelor degree (Honours or Honours Class 1 equivalent) or a Master degree.
- Good proficiency in programming languages and computation.

Candidates with the following skills will be considered favourably:

- background in theoretical or computational reaction-advection-diffusion processes, eco/hydrology or soil physics, data science (statistics or econometrics or machine learning) and supply chains,
- be willing to learn mathematical concepts needed to develop advanced computational tools including mechanics, chemistry, and chemical kinetics.
- 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 "PhD Application:" and your name by December 2023. You will need to provide the following:

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

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.

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.

Computer Science Projects

Characterising Information Flow Networks Across Brain Regions in Rest and Task

Supervisor:

Associate Professor Joseph Lizier – **joseph.lizier@sydney.edu.au**

Research Areas:

Complex Systems and Complex Networks, Information Theory and Computational Neuroscience.

About the opportunity:

Billions of years of evolution have shaped brain structure and function to solve complex problems, likely by shaping information-flow around the trillions of connections that comprise the human brain. We now have access to neural recordings of unprecedented quality and resolution, but we still do not know how distributed whole-brain neural activity patterns give rise to human cognition. Network neuroscience frames cognitive functions as emergent properties of the distributed and dynamic interactions between regions across the brain, seeking to create brain network models from high quality data. Yet the measurements used to model brain networks from time-series recordings have thus far mostly focussed on symmetric correlation-based functional networks.

This project will measure directed, multivariate and nonlinear information flows across the brain to establish network models that more wholistically map cognitive information processing directly from functional neuroimaging data. The project will utilise our JIDT (https://github.com/jlizier/jidt) and IDTxl (https://github.com/pwollstadt/IDTxl) open-source toolkits, implementing the information-theoretic measure transfer entropy and its variants to characterise information flow between time-series. (Further reading is available regarding the algorithms we use for directed functional and effective network inference in doi:10.1162/netn_a_00092 and doi:10.1162/netn_a_00178). We will analyse various open data sets, including neural time-series recordings such as fMRI, potentially including both resting state and various task recordings.

The research will involve computational analysis in complex systems, complex networks, information theory, dynamical systems, and computational neuroscience. The student will be exploring applications of, and/or updates to algorithms for, inferring brain network models to represent information flow relationships between brain regions, based on time-series neural recordings (such as fMRI, EEG, MEG, etc). The PhD will be supervised by A/Prof. Joseph Lizier. The applicant will join A/Prof. Lizier's Information Dynamics team in the Modelling and Simulation group, which studies complex systems and networks at The School of Computer Science. The student will collaborate with A/Prof. Mac Shine (Brain and Mind Centre) and Dr. Ben Fulcher (Physics) and their teams as part of their Systems Neuroscience and Complexity collaboration, within the University's Centre for Complex Systems.

More information:

This scholarship covers both tuition fees and a stipend at the RTP rate and is offered to both international and domestic PhD applicants for 3.5 years (fulltime).

The successful applicant is expected to start in 2024. The position will be open until filled.

Eligibility criteria:

- A Bachelor's degree with honours or Master's degree in a relevant quantitative field. First-class honours equivalent results are essential.
- Excellent skills in computational numerical analysis and mathematics
- Preference will be given to candidates with previous experience in a research project (e.g. thesis) in computational neuroscience / complex networks / complex systems etc.

How to Apply:

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

- CV
- Transcripts (can be unofficial)
- Thesis from your previous studies
- Cover letter or paragraphs in the email) explaining your interest in, and suitability of skills/background/experience for, this project. Please highlight your academic results, any published papers and research/industry experience.

Synchronisation in complex networks

Supervisor:

Associate Professor Joseph Lizier – **joseph.lizier@sydney.edu.au**

Research Areas:

Complex Systems and Complex Networks, Information Theory and Computational Neuroscience.

About the opportunity:

Studies of the structure of complex networks have been one of the great successes of complex systems in the past several decades, establishing well-known small-world and scale-free networks for example and revealing how widely they occur in the world around us. The field has been very successful in characterising the structure of complex networks, but we remain less well informed about the function of complex networks. That is, one of the most significant open questions in complex systems research is that of *structure-function*: how does the structure of a complex network relate to its dynamics?

A canonical problem of structure-function has been that of characterising *synchronisation*, a phenomenon of interest observed across fireflies, heart cells, the human brain in epilepsy, and in power grids. How does the structure of connections between the entities in these systems help or hinder them from synchronising their activity, and can we control this?

We have recently published the first method to fully relate the structure of a complex network to how well it can synchronise (Lizier et al, PNAS, 2023; doi:10.1073/pnas.2303332120), and to interpret that in terms of walks on networks. This presents the opportunity to build on this method for further insights (such as for networks with delayed coupling), and to utilise it to explore further scenarios.

The research will involve computational and mathematical analysis in dynamical systems and complex networks. The student will be developing mathematics for and computational analysis of dynamics on complex networks; this will involve computational experiments including simulations and numerical analysis. The PhD will be supervised by A/Prof. Joseph Lizier. The applicant will join A/Prof. Lizier’s Information Dynamics team in the Modelling and Simulation group, which studies complex systems and networks at The School of Computer Science, and potentially involve collaborations within the University's Centre for Complex Systems

Eligibility criteria:

- A Bachelor's degree with honours or Master's degree in a relevant quantitative field. First-class honours equivalent results are essential.
- Excellent skills in computational numerical analysis and mathematics
- Preference will be given to candidates with previous experience in a research project (e.g. thesis) in complex networks, complex systems and/or dynamical systems

How to Apply:

Applications should be sent by email to joseph.lizier@sydney.edu.au and include the following:

- CV
- Academic transcripts
- Thesis from your previous studies
- Cover letter or paragraphs in the email) explaining your interest in, and suitability of skills/background/experience for, this project. Please highlight your academic results, any published papers and research/industry experience.

Dynamic snapshots of multivariate network effects in collective animal flocking/schooling

Supervisor:

Associate Professor Joseph Lizier – **joseph.lizier@sydney.edu.au**

Research Areas:

Complex Systems and Complex Networks, Information Theory and Computational Neuroscience.

About the opportunity:

Collective behaviour such as flocking or schooling in animals such as birds and fish provides important evolutionary advantages, such as predator avoidance. Understanding the dynamics of these group behaviours are critical to inform our management of a changing environment. Fully characterising the connections between individuals in these groups remains difficult though, since flocking or schooling interactions induce fluid structures whereby individuals who are close-by and genuinely interacting may shift over extremely short periods of time. This presents substantial challenges for standard time-series analysis, yet if we could wholistically model such interactions there is major interest in the utility of such a method.

As a first step, we have adapted the information-theoretic measure transfer entropy (TE) to provide the gold-standard approach for measuring pairwise information flows in flocks/schools. This method identifies source-target pairs which are pairwise interacting at any snapshot in time In collaboration with Prof. Ashley Ward (USyd Life Sciences) we have used this method to relate pairwise TE to hunger and predation in fish schools, and relative location of source fish [24]. This project will extend that research beyond pairwise information flows to measure higher-order interactions in flocks/schools (e.g. to detect when an effect on a target results from a synergistic combination of two source individual's actions). This will allow us to infer for the first time the set of causal parents for a target individual at any given snapshot in time. The project will utilise our JIDT (**https://github.com/jlizier/jidt**) open-source toolkit, extending the methodology for studying information flows in Flocking within it. There is potential for many applications to real data sets of schooling fish.

The research will involve computational analysis in complex systems, complex networks, information theory and collective animal behaviour. The student will be exploring new algorithms for measuring multivariate information flow relationships between animals in flocks/schools, based on time-series recordings of their positions and speed. The PhD will be supervised by A/Prof. Joseph Lizier. The applicant will join A/Prof. Lizier's Information Dynamics team in the Modelling and Simulation group, which studies complex systems and networks at The School of Computer Science. The student will collaborate with Prof. Ashley Ward (Life Sciences), within the University's Centre for Complex Systems.

Eligibility criteria:

- A Bachelor's degree with honours or Master's degree in a relevant quantitative field. First-class honours equivalent results are essential.
- Excellent skills in computational numerical analysis and mathematics
- Preference will be given to candidates with previous experience in a research project (e.g. thesis) in complex networks, complex systems and/or dynamical systems

How to Apply:

Applications should be sent by email to joseph.lizier@sydney.edu.au and include the following:

- CV
- Academic transcripts
- Thesis from your previous studies
- Cover letter or paragraphs in the email) explaining your interest in, and suitability of skills/background/experience for, this project. Please highlight your academic results, any published papers and research/industry experience.

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.

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.

Resilient and Secure Federated Learning

Supervisor:

Dr Kanchana Thilakarathna – **kanchana.thilakarathna@sydney.edu.au**

Research Areas:

Computer Science, Cybersecurity, Distributed Systems.

Project Description:

Billons 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 and cover letter
- Transcripts (can be unofficial)

Electrical and Computer Engineering Projects

AI in Intelligent Building Systems

Supervisor:

Dr Huaming Chen – huaming.chen@sydney.edu.au

Research Areas:

Smart Buildings, Artificial Intelligence, Explainable AI

Project Description:

Smart buildings embody the transformation of contemporary infrastructure as they integrate automated control systems, data processing, and artificial intelligence (AI), in which Past AI research in smart buildings has primarily concentrated on energy conservation. In this project, we seek to enhance the building performance, such as building design, more effective use of space and environments within buildings, and improving occupant safety, with the use of the cutting-edge AI techniques. This is an industry project in collaboration with Adelaide Holdings.

This project will integrate cutting-edge AI techniques to both fortify and demystify AI operations for smart buildings, covering the topics of reasoning and planning of AI-based operations, and integrity of AI decisions in different scenarios.

Offering:

Two scholarships will be available for 3.5 years at the RTP stipend rate (currently $40,109 in 2024). International applicants will have their tuition fees covered.

Successful candidates must:

- Have a Bachelor degree (1st class or equivalent) or Master degree in artificial intelligence, or a related field.
- Have deep understanding of machine learning and smart building
- Have proficiency in Python and familiarity with machine learning frameworks such as PyTorch and TensorFlow are required
- Have experience with XAI techniques and their application in real-world settings is highly desirable
- Exhibit strong analytical skills and ability to communicate complex technical content clearly

How to apply:

To apply, please email huaming.chen@sydney.edu.au the following:

- CV
- Transcripts

Scan control for EUV nanometrology systems

Supervisor:

Associate Professor Feng Shu – feng.shu@sydney.edu.au

Research Areas:

Metrology, Coherent Diffraction Imaging, Ptychography, Nanophotonics, Precision Engineering

Project Description:

The last few years has witnessed the successful commercialization of the extreme ultra-violet (EUV) photolithography technology, enabling mass-production of smaller and more powerful microchips with intricate structures and features. Meanwhile, EUV-based metrology has recently emerged as one of the most promising technologies to tackle the metrology challenges imposed by the next generation nano- and quantum devices, as well as the ever-increasing characterization needs in areas of material science, biological analysis, medicine and so on. Recent progresses have shown that EUV nanometrology exhibits unique advantages and can fill many current nanometrology gaps. This project aims to set up a table-top EUV nanometrology research system using a femtosecond laser and a high harmonic generator (HHG) - based EUV source module and an imaging chamber with increased scan efficiency and throughput.

Requirements:

- Major in optoelectronics, applied physics, photonics, electrical and electronic engineering, mechatronics, computer engineering and related disciplines;
- Excellent hands-on skills in optoelectronic experiments
- Excellent programming skills e.g., MATLAB, Python, or C++
- Good English communication skills;
- Good at teamwork and collaboration.

Contact:

If you are interested, please email **feng.shu@sydney.edu.au** with your resume attached, to discuss your suitability for this project.

Efficient algorithm design for phase retrieval in ptychographic nanometrology

Supervisor:

Associate Professor Feng Shu – **feng.shu@sydney.edu.au**

Research Areas:

Phase Retrieval Algorithms, Coherent Diffraction Imaging, Machine Learning

Project Description:

Phase retrieval is the process of algorithmically finding solutions to the phase problem and is a key component of extreme ultra-violet (EUV) ptychographic systems which is an important type of coherent diffraction imaging (CDI). In such systems, the intensity of the diffraction pattern scattered from a target is measured. The phase of the diffraction pattern is then obtained using phase retrieval algorithms and an image of the sample is constructed. This project aims to boost the efficiency of existing phase retrieval algorithms by using various techniques including machine learning, to pave the way for EUV ptychography to become a mainstream nanometrology approach.

Requirements:

- Major in applied physics or mathematics, computer engineering, electrical and electronic engineering, optoelectronics, and related disciplines
- Excellent at mathematical and analytical skills
- Excellent programming skills e.g., C++/CUDA, Verilog or Python
- Good English communication skills
- Good at teamwork and collaboration.

Contact:

If you are interested, please email feng.shu@sydney.edu.au with your resume attached, to discuss your suitability for this project.

Nanostructured Textiles for a Sustainable Warming World

Supervisor:

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

Research Areas:

Sustainable energy, Nanomaterials, Nanophotonics

Project Description:

Did you know even the lightest clothing can create a personal greenhouse effect, keeping you warmer than you'd like? Researchers from the schools of Engineering, Physics, Chemistry, Architecture, and Health are investigating nano-structured fabric and textile fibres which can reduce this greenhouse effect. By controlling solar and thermal radiation, our aim is to develop innovative clothing that can keep you cooler indoors and in full sun.

In our modern society, the demand for energy efficiency, recycling, and harvesting is pressing. Nano control of radiation provides unique opportunities for sustainable energy, with a wide range of applications including human-body cooling, building cooling, and heat recycling. If you are passionate about photonics, thermal physics, materials, or nanoscience, we invite you to explore and contribute to this captivating research area.

Further Information:

One to two scholarships. Starting date: 2024 June (earlier also possible). For domestic or international students.

Interested students please email their CV, transcript, and any other relevant info to alex.song@sydney.edu.au and boris.kuhlmey@sydney.edu.au

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.

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 Computer 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.

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 Computer 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.

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**

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/

Frontiers of Nanophotonics

Supervisor:

Dr Alex Song – **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.

For more information, please visit our website: https://alexsong.group/

Project Management Projects

Productivity in Project Delivery

Supervisor:

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

Project Description:

The PhD candidate will be based in the School of Project Management at the University of Sydney under the supervision of **Professor Jennifer Whyte**. The scholarship is being funded by the **John Grill Institute for Project Leadership**.

This doctoral research project will develop new insights into what 'productivity' is in the construction sector, beyond the productivity of workers on site to consider the overall ability for efficient delivery of services across all stages of project delivery. It builds on and extends recent reports by the Australian Constructors Association (ACA, 2023) and the John Grill Institute for Project Leadership (JGIPL) (Crawford and Pollack, 2021) on productivity, a survey of the academic literature (Hasan, et al. 2018), and discussion at the Major Project Leadership Forum that was hosted by JGIPL. It will inform ongoing policy work through basic research on a policy relevant topic.

The doctoral candidate will first review the statistical evidence used to compare productivity in construction with that in other sectors of the economy, unpacking the standard industry classification codes used in the sector and the statistical analysis of productivity in construction over time. The doctoral project involves empirical work using either interview or survey-based methods to understand how work in the Australian sector is attributed to different Australian and New Zealand Standard Industrial Classification (ANZIC) codes; and will compare and contrast the inclusions and exclusions in comparable industries, and the impact of changes in construction such as the increasing use of modular offsite production that may take activities into different codes.

A second set would be for the PhD student to map the processes of construction in ore exemplar projects to analyse productivity across the life-cycle of these projects, and to compare and contrast productivity under different conditions (such as different methods of construction, governance structures or procurement routes). This work could indicate how different activities are attributed to different ANZIC codes, and as productivity is often calculated by dividing a measure of output by a measure of inputs, could also consider how the outputs and outcomes of the project are measured. If there is historical data then it might consider how the measurement of the outputs have changes as the industry has worked to increase safety and sustainability.

A lot of existing work has used European statistics to compare productivity across EU countries (e.g. Bellocchi & Travaglini 2023). As a potential extension to the PhD work, if the data is available then the PhD candidate may also be able to connect the sub-codes used in the sector to measures of innovation in Australia to develop insight about productivity and innovation in the sector. Such work has been done in the EU, through the academic studies built on the European Innovation Survey (e.g. Barata & Fontainha 2017, Reichstein et al. 2008).

Offering:

A scholarship is offered to both international and domestic PhD applicants for 3.5 years (fulltime) at the RTP rate of $40,109 and includes tuition fees for international students.

Successful candidates must have:

- Have a Bachelor degree or a Master degree (preferred) in a related field (e.g. project management, economics, policy, organisation studies, innovation studies, management).
- Eagerness to work in a multidisciplinary, multi-cultural team
- Strong understanding of business dynamics and the use of statistics in business
- Exceptional written and oral communication skills.
- Familiarity with mixed methods, with previous experience applying quantitative and qualititative methods (preferred)

Fieldwork and International Commitment:

The position will require extended periods of international fieldwork. Candidates must be able and willing to travel and live overseas outside Australia (up to a maximum 12 months over the PhD).

The preferred start date is 1 October 2024 (Research Period 4). This is negotiable.

How to apply:

To apply, please email jennifer.whyte@sydney.edu.au by the **15 July 2024** the following:

- A concise cover letter detailing your motivation for pursuing a PhD and alignment with the research topic.
- A comprehensive CV highlighting relevant academic achievements, research experiences, and skills.
- Transcripts
- Detailed research proposal (1 page) elaborating on the methods and data sources you intend to utilise to address the research topic.

AI Techniques for Emergency Management and Critical Infrastructure

Supervisor:

Associate Professor Nader Naderpajouh – nader.naderpajouh@sydney.edu.au

Research Areas:

Climate Change

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, in addition to $5,000 p.a for training and, $5,000 for travel, a thesis allowance and it also covers tuition fees. The recipients will also have the opportunity 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, including Engineering, Social Sciences, Science, Economics, etc.
- 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)