2024-25 Adelaide Summer Research Scholarships.

Researchers listed in this document are interested in supervising students for Summer Research Scholarships in the Faculty of Sciences, Engineering and Technology.

Eligible students are encouraged to contact Researchers to discuss their research projects and potential supervision for a Summer Research Scholarship.

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SCHOOL OF AGRICULTURE, FOOD AND WINE:

Researcher:	Research Area:	Available Project(s):
Associate Professor Matthew Denton	Agriculture and Pasture Science	**Explore options to effectively deliver Bradyrhizobia in South Australian soils to enhance soil biological nitrogen fixation by French serradella during the pasture phase of crop rotations.** Project Description: French Serradella is an annual legume pasture with potential improve feedbase, soil productivity and enhance climate resilience of mixed farms in South Australia. The species has been found to effectively nodulate when grown on soils with prior lupin cultivation due to naturalized lupin or Bradyrhizobia populations in the soil. Effectively nodulated serradella pastures can fix about 70kg/ha of nitrogen on average which would substantially profit farmers by reducing their reliance on synthetic N fertilizers as well as reducing their farm's carbon footprint. However, most of the SA soils do not have lupin history or Bradyrhizobia population in the soils which limits productivity and nodulation especially when dry sown with pods. This project will use glass house experiments to investigate if wheat, sown in the previous season, can be used as a cheap alternative carrier to introduce Bradyrhizobia in soils before growing French serradella. The wheat seeds will be inoculated and sown before serradella in a similar manner of crop rotation in a farmer's paddock. The student will work with diverse pasture research team at University of Adelaide and get to learn about the agronomic production systems for dryland pastures and crops with the opportunity to grow plants and get a hands-on with seed sowing, seed inoculation and biophysical measurements of plant growth and performance both in the glasshouse and in the field trials. For further details contact A/Prof Matthew Denton for discussion.
Dr Bryan Coad	Chemistry; Chemical Engineering	I have three projects (please contact me for more detailed information: bryan.coad@adelaide.edu.au) **1. Biodegradable food packaging plastic films made from food waste** **2. Upcycling brewer's spent grain into high-value products** **3. Outsmarting fungal plant pathogens to find ways to improve food crops**
Dr Tina Bianco-Miotto	Food and Nutrition	Contact Dr Tina Bianco-Miotto for discussion
Dr Cristian Varela	Microbiology, fermentation	**Isolating Native Brewing Microorganisms** There are thousands of yeast species that have economically important roles in industrial processes, including in food and beverage production. This project aims to isolate microorganisms that inhabit the natural environment, and which could be used to produce native fermented beverages.

Dr Tatiana Soares da Costa	Biochemistry, Plant Science, Structural Biology, Molecular Biology.	**Turning failed antibiotics into herbicides to fight weeds** This project funded by the Australian Research Council will leverage our knowledge of antibiotic resistance in superbugs to tackle herbicide resistance in weeds. The student will re-purpose failed antibiotics as new herbicides that are less prone to resulting in resistance in weeds. The student will learn multi-disciplinary skills, work with a vibrant team led by Dr Tatiana Soares da Costa encompassing postdoctoral researchers, PhD and Honours students, and collaborate with national and international researchers in academia and industry. This work will likely lead to publications in international journals.
Dr Scott Boden	Agriculture/Plant genetics	**Identifying genes that control spike development in wheat** Our lab has identified mutant lines that form more grain-producing florets that wild-type plants, and we are investigating the underlying genes to develop strategies for increasing yield. This project will combine genetic and microscopy techniques help confirm the gene responsible for the modified spike architecture in these plants.

SCHOOL OF ANIMAL AND VETERINARY SCIENCES:

Researcher:	Research Area:	Available Project(s):
Dr Eduardo J. Fernandez	Animal Behaviour/Animal Welfare	**Assessing and Improving the Welfare of Zoo Animals:** The focus of the research will be two parts: (1) assessing the impact of various external events, such as visitor presence or staff interactions, and (2) examining strategies to manage and improve the existing conditions. There are multiple possible projects, mostly in collaboration with Adelaide Zoo and Monarto Wildlife Park. Contact researcher for more details, including potential species.
Dr Roy Kirkwood	Animal reproduction and veterinary sciences	The purpose of this project is to understand the long-term effects of colostral/milk bacterial metabolite on neurodevelopmental maturation in a pig model. This project will focus on developmental characteristics of sub-adult animals that were given a bacterial treatment during infancy, with tasks including handling and interaction with pigs.
Associate Professor Susan Hazel	Animal behaviour/ Animal welfare	**Evaluation of a medical pet shirt as a replacement for cones in dogs:** Cones are used in dogs post-surgery or following injury to prevent licking or damaging a wound. Many dogs do not tolerate what is nicknamed the 'cone of shame'. Medical pet shirts are an option to reduce stress in dogs and owners.
Dr Andrea McWhorter	Microbiology	**Using culturomics to identify bacterial species from insects.** Insects are being explored for their use as a protein source for animals. But what benefits could they potentially have on the gut microbiota and host health? This project will use culture methods to isolate and characterise potentially beneficial bacterial species from insects.
Dr Sita Withers	Canine immunology; Cancer immunology/immunotherap	Contact Dr Sita Withers for discussion

	eutics; Comparative oncology	
Dr Gustavo Ferlini Agne	Clinical Education	**Development of a smartphone application for clinical skills assessment and monitoring in the Doctor of Veterinary Medicine degree** The project aim is to develop a cross-platform smartphone and web app for veterinary students to log clinical experiences and competencies. The app will streamline the logging process, ensure accurate tracking of skills, and provide real-time feedback from supervisors. Experience in app generation and coding is required. Ideal for students interested in app development and veterinary education.
Dr Stephan Leu & A/Prof Will van Wettere	Animal Behaviour, Animal Reproduction	**How sheep cope with heat stress conditions** Our research groups investigate how sheep respond to heat stress conditions. We are interested in the behavioural response (shade use, grouping behaviour) as well as the consequences for thermoregulation and reproduction. In summer, we will track all individuals of a hair sheep flock using GPS collars and other sensors. The summer student would be integrated into the ongoing work. An interest in animal behaviour and/or reproduction are preferred. Please contact Stephan and Will for further information and discussion before applying.
Dr Kandarp Patel	Veterinary Public Health and Epidemiology	**A review of per- and polyfluoroalkyl substances (PFAS) prevalence in meat products worldwide.** PFAS persistence in humans, animals and the environment is an emerging public health concern. Currently, there is no data on the safe limit of PFAS in meat products in Australia. This review will help build a database of PFAS detection in global food surveys to inform the maximum limits. **Comparison and impact of CLSI and EUCAST guidelines for reporting antimicrobial susceptibility and AMR surveillance.** The methodologies and breakpoints of the two most commonly used systems worldwide, Clinical and Laboratory Standards Institute (CLSI) and European Committee for Antimicrobial Susceptibility Testing (EUCAST), are far from harmonized. Discrepancies in clinical breakpoints between CLSI and EUCAST significantly impact susceptibility interpretation of clinical isolates and generation of antibiograms. This study will compare the methods and the impacts of both guidelines using local antimicrobial susceptibility data. Contact Dr Kandarp Patel for discussion.

SCHOOL OF ARCHITECTURE AND CIVIL ENGINEERING:

Researcher:	Research Area:	Available Project(s):
Dr Larissa Arakawa Martins	Architecture and Built Environment	**Project Title - Exploring passive design strategies for buildings in South Australia through the use of building performance simulation**

		Project Description - This project aims to better understand the impact of passive design strategies and building materials (such as trombe walls, low-e glazing, external shading, air tightness) in the thermal and energy performance of buildings in South Australia, using building performance simulation tools. Real-case scenarios will be analyzed. A conference paper and attendance is proposed as the main outcome for the summer scholarship student undertaking this research.
Dr Aaron C. Zecchin	Water and Environmental Engineering	**Human-Environmental System Dynamics Modelling** System Dynamics is a commonly adopted qualitative and quantitative modelling framework used to conceptualise and simulate complex and dynamic systems. Originating within a Systems Theory/Systems Thinking background, System Dynamics aims to capture all the essential relationships and feedback processes within a system, providing a more holistic representation of a system. This project will explore the use of System Dynamics for integrated decision-making within an environmental management context.

SCHOOL OF BIOLOGICAL SCIENCES:

Researcher:	Research Area:	Available Project(s):
Associate Professor Danny Wilson	Malaria and Toxoplasma Biology	**Investigation of malaria protein function using gene-editing:** Malaria parasites cause >600,000 deaths every year. More than a third of their proteins have no known function. You will create vectors for malaria gene-editing, test for successful gene-editing using western blots and fluorescence microscopy, with these vectors used to investigate protein function.
Dr Erinn Fagan-Jeffries	Entomology/Wasp taxonomy	**DNA barcoding of parasitoid wasps:** Rapid DNA barcoding of insects has been developing in leaps and bounds over the last five years, and we've been working on getting a pipeline set up within the SARFMEE labs at the university. This project would involve working with the wasp biodiversity group within the Invertebrate Systematics and Biodiversity lab to identify wasp specimens using a microscope and learn to do rapid DNA extractions and sequencing using the Oxford Nanopore Minion sequencer. Some background in using keys to identify animals, microscopes and specimen handling, and genetics/wet-lab skills (e.g. using pipettes) would be advantageous.
Dr Jenna Crowe-Riddell	Evolutionary biology, sensory systems, herpetology, morphology, genetics	**Serpent sensory innovation and evolution:** This project aims to understand how senses have evolved in snakes that have adapted to different habitats. It will use high resolution microCT scans to identify morphological changes in the brain and sensory organs (eyes, ears, nose) across an ecologically-diverse range of species (e.g. taipans, sea snakes, cobras, vipers). This project will result in a better understanding of how animals interact with their environment (via senses and behaviour) and predict how adaptable snakes will be to future environmental change. The project may also involve gene expression and microscopy, please contact researcher for discussion.

Dr Nina Wootton and Dr Patrick Reis-Santos	Marine Ecology	**Microplastics in the marine environment:** Microplastics threaten ocean ecosystems globally. This project will involve sampling and analysing different species from the marine and freshwater environment for microplastic abundance and type. It will involve field and lab skills, as well as the opportunity to be involved in science communication and education.
Professor Ivan Nagelkerken	Marine Ecology / Climate Change Biology / Fish Ecology	We have lab-based and field-based projects available in the fields of: climate change, fish ecology, marine ecology, animal behaviour, and mangroves. This might include a field trip to NSW in summer to sample mangrove fish assemblages. Please contact researcher for further details.
Professor Phill Cassey	Environmental Science (specifically environmental crime, wildlife trade and invasion biology)	Contact Prof Phill Cassey for discussion Various environmental crime & wildlife trade research projects are available within our lab. Potential contexts include, but are not limited to: online surveillance of reptile & invertebrate trade; investigation of unlicensed fisheries, surveys of trading markets (pet stores & Expos), reviews of wildlife crime laws & policy.
Associate Professor Diego C. García-Bellido	Palaeontology and Evolutionary Biology	**"Morphology and mode of life of the Ediacaran organism Beltanelliformis from the Flinders Ranges"** This project aims to investigate and describe the morphology of the 555 million year old fossil Beltanelliformis, an enigmatic component of the Ediacara Biota present in the Flinders Ranges, as well as the White Sea and Namibia. We aim to clarify its mode of life, ecology and preservation pathway.
Dr Emma Sherratt	Ecology and Evolutionary Biology	Projects available in Evolutionary Biology: morphological adaptation to environmental change, in animals such as rabbits, cats, and snakes. Contact Dr Emma Sherratt for discussion.

SCHOOL OF CHEMICAL ENGINEERING:

Researcher:	Research Area:	Available Project(s):
Professor Pavel Bedrikovetski	Reservoir engineering & Mathematical Physics	Underground CO2 storage is an emerging industry worldwide, in Australia, and particularly in South Australia. Santos Ltd. is carrying out one of world's largest CO2 storage project Moomba. The summer project will derive an analytical model for well injectivity during CO2 injection under Moomba conditions.
Associate Professor Abel Santos	Materials Engineering	**Ternary sulphides of manganese and gallium as high–performance electrochemical supercapacitors:** To date, numerous materials have been explored to develop supercapacitors (SCs). Of all alternatives, the family of sulphide compounds has emerged as a promising platform material from the pseudocapacitor category since these offer superior electrochemical properties than their oxide counterparts and carbon-based materials. The main objective of this research is to study the structure and electrochemical properties of ternary sulphides of manganese and gallium “MnGaxSy”for high-performance SCs. The abundance, conductivity and electrochemical stability make gallium sulphides promising compounds in the field of energy storage. But these ternary sulphides have not reached the mature stage yet and their full potential as a material of choice for supercapacitors remains

		unexplored. The project will also study manganese gallium sulphides MnGaxSy, manganese is one element which has not been studied even under this configuration although it has showed appreciable performance on attractive properties electrochemical and flexibility through its binary oxides and sulphides.
Professor Yan Jiao	Clean energy; Materials engineering; Molecular modelling	**Project Title: Designing Catalysts for CO2 Conversion into Green Chemicals and Fuels** Project Description: Join this exciting summer project aimed at combating climate change by converting CO_2 into valuable green chemicals and fuels through a process called electrocatalysis. Utilizing molecular modeling techniques, you will design novel catalysts by constructing atom-by-atom models and evaluating their performance using high-performance computers. This approach allows us to explore the energetics of reaction pathways to identify efficient and selective catalysts. This hands-on experience in computational chemistry will equip you with valuable skills and knowledge in electrochemical processes as well as catalyst design. Additionally, your designs will provide essential guidance to experimental researchers. This project offers a unique opportunity for undergraduate students interested in clean energy and catalysis to engage in cutting-edge research. By participating, you will gain practical experience that might lead you to Australia's emerging clean energy industry, contribute to sustainable energy solutions, and have the chance to make a real impact on reducing CO_2 emissions. -- **Project Title: Simulation and Design of Electrocatalysts for Renewable Energy Conversion** Project Description: Join us in modelling advanced electrocatalysts for clean energy conversion reactions. This project uses molecular modeling to develop materials for efficient energy storage and conversion, including applications in hydrogen production and carbon dioxide reduction. Australia aims to boost manufacturing activity in clean energy, and this project will provide first-hand insight into the theories underpinning clean energy technologies. Ideal for students interested in computational chemistry and renewable energy technologies.
Dr Giuseppe Tettamanzi	Materials/Quantum Materials	Contact Dr Giuseppe Tettamanzi for discussion
Dr Luis Toronjo-Urquiza	Bioprocess engineering	**Optimization and Scale-Up of Extraction and Purification Processes for Plant-Based Anticancer Pharmaceuticals** Overview: The project focuses on the development, optimization, and scale-up of plant-based cancer drugs. At the core of this initiative is the enhancement of processes for extracting and purifying plant-derived molecules for cancer treatment. The aim is to optimize these processes to a level where the end products are of clinical-grade quality, suitable for preclinical trials in animals. Potential Outcomes: 1. Process Optimization Protocol: You will develop protocols for optimizing extraction and purification processes to achieve clinical-grade pharmaceuticals from plant biomass.

		2. Process Parameter Adjustment: Your work will involve fine-tuning critical process parameters to ensure the development of high-quality products ready for clinical trials. 3. Clinical-Grade Production: The project will culminate in the development of optimized processes for the production of clinical-grade pharmaceuticals, suitable for initial animal preclinical trials.
Xiaoyong Xu	Chemical engineering/solid oxide fuel cell and electrolysis	**Title: Development of Advanced Anode Materials for Proton-based Solid Oxide Fuel Cells** This aim of this project is to develop a next generation hydrogen production technology, proton-based solid oxide electrolysis cell, that can effectively support the rapid growth of intermittent renewable energy generated from solar and wind sources. In recent years, there has been a global focus on renewable and sustainable energy, highlighting the urgent need for reliable and affordable grid-scale energy storage. While batteries serve as suitable options for short-term stationary energy storage, they prove less viable for long-term energy storage and the transportation of renewable energy 1, 2. To address this challenge, researchers are turning to emerging technologies such as water electrolysis using solid oxide cells (SOCs). These SOCs are considered the most efficient and cost-effective solution for hydrogen production from renewable energy due to their favorable thermodynamics and kinetics. Moreover, they hold great potential in overcoming the issue of seasonal energy storage 3, 4 (Fig.1). Commercially available oxide-ion-conducting SOCs (O-SOCs), typically yttria-stabilized zirconia, which operate at temperatures exceeding 750 °C. These SOCs offer several advantages, including fuel flexibility, high efficiency, and the absence of expensive noble metal catalysts 5. However, the extreme operating conditions and high temperatures contribute to rapid degradation. To mitigate these challenges, researchers are exploring the use of proton-conducting solid oxide electrolysis cells (H-SOECs), which can lower the operating temperature to approximately 400-600 °C by virtue of their higher conductivity and lower activation energy. Nonetheless, even at 500 °C, the air electrode performance of H-SOECs lags behind that of O-SOECs due to significant polarization resistance associated with the air electrode6. In this project, the focus lies on developing an exceptionally efficient air electrode for the next generation of H-SOECs, capable of triple conduction (H+/O2-/e-). Success in this endeavor hinges upon the discovery of fundamentally novel materials designs, combined with state-of-the-art in situ instrumental techniques and advanced computational methods. As a result, substantial improvements in the activity and stability performance of the air electrode are anticipated. Based on my extensive experience working with industry partners in the field of SOC, I am well positioned to lead this project. The success of this project thus addresses a very important and practical air electrode issue for protonic solid oxide cells at low temperature (below 600 °C).
Dr Nam Nghiep Tran	Process control and optimisation	**Designing Practical Experiments and Scripts for Process Control and Instrumentation (CHEM ENG 3031)** In this project, students will apply their knowledge of process control to design practical experiments and scripts using various Armfield control systems. These experiments will demonstrate the concepts learned in CHEM ENG 3031: Process Control and Instrumentation. Students are expected to employ tuning techniques to optimise the

		control processes and develop a fit-for-purpose practical sessions for third-year Chemical Engineering students.
Dr Jodie Yuwono	Chemical Engineering, Materials Engineering	Contact Dr Jodie Yuwono for discussion on topics, including: **1. Techno-economic analysis of green energy implementation in Australia.** **2. Computational design of novel electrolyte for Li-ion batteries.**
Dr Alireza Salmachi	Energy	**Indirect Carbonation Processes for Iron-Based Minerals** Indirect carbonation, a multi-step process, starts with extracting the divalent metal using chemical processes (1, 2). This is usually achieved through leaching with an acid or an ammonium salt solution (3). These extracted ions react with carbon dioxide in a controlled environment to facilitate carbonation and form iron carbonate (4). This project investigates the use of indirect carbonation methods to convert iron oxides (hematite/magnetite) into stable carbonates for CO2 sequestration. The indirect carbonation process will involve two steps: 1.Leaching: Alkaline earth metal ions (Fe2+, Fe3+) are extracted from the iron oxides using a leaching agent. The project will experiment with different leaching agents such as acids, ammonium salts, molten salt, or sodium hydroxide, and assess their effectiveness. 2.Carbonate Precipitation: The leached solution, rich in metal ions, will be reacted with CO2 in the presence of base additives to precipitate carbonates. This project aims to determine the optimal conditions for indirect carbonation of hematite/magnetite in terms of: • Leaching agent type and concentration • pH • Temperature • Reaction time • CO2 pressure The efficiency of the process will be evaluated by measuring the carbonation efficiency, which is the amount of CO2 sequestered per unit mass of iron oxides. This project will provide valuable insights into the feasibility of using indirect carbonation for CO2 sequestration and waste management in the mining industry.

SCHOOL OF COMPUTER & MATHEMATICAL SCIENCES:

Researcher:	Research Area:	Available Project(s):
Associate Professor Hung Nguyen	Cybersecurity	**Active Directory Security with ADSynth and LLMs:** Most organisations use the Mircosoft Active Directory. Active Directory has been around for almost 25 years. Yet, it remains a weak point in many organisations' cybersecurity defences. Active Directory weaknesses are the most common exploits in recent attacks. We have developed an Active Directory data generation tool - ADSynth that allows cyber professionals to work with realistic AD data. See ADSynth GitHub page: https://adsynthesizer.github.io/ This project aims to further develop ADSynth by integrating advanced ML models and visualisation capabilities. Students need to be interested in security and machine learning. Background and experience with Python are required. **Understanding sophisticated cyber-enabled influence operations with LLMs** Cyber security is an asymmetric race between attackers and defenders. We seek to develop tools that use AI to help defenders in this project. Attackers typically combine sophisticated techniques and procedures to compromise a system. An emerging trend is to use combined cyber attacks with influence operations. These campaigns are highly sophisticated and very hard to detect and counter. Until recently, defenders track adversary behaviours individually, often focusing on only one specific action at a time. This mismatch between how attackers operate and how defenders try to track them has caused a significant gap in cyber defence. To address this problem, the MITRE Center for Threat-Informed Defense (Center) launched the Attack Flow project (https://medium.com/mitre-engenuity/attack-flow-beyond-atomic-behaviors-c646675cc793). The key idea is to model sophisticated attacks using models that capture the sequence of attack steps, the context within those sequences, as well as the relationships among them. Such a model enables additional defensive capabilities that make defenders much more effective. Building attack flows is mostly a manual and slow process. There are only 36 publicly available attack flows for cyber attacks, no flows are known for influence operations. In this project, we will use large language models to build a corpus of real-world attacks using the open source attack flow framework (https://github.com/center-for-threat-informed-defense/attack-flow). The output is a set of attack flow models that describe real world cyber-influence attacks. We will contribute these maps directly to the MITRE project. We will also develop algorithms that help defenders use the attack flow data to better defend their systems. **Hacking the CAN bus** Today's automobiles contain a number of different electronic components networked together that as a whole are responsible for monitoring and controlling the state of the vehicle. Electronic devices in a car typically communicate via a bus system called "Controller Area Network Bus", or CAN bus. As the automotive industry is increasingly using connected vehicle technologies. CAN bus will play a critical role in enabling communication between different connected vehicle systems, such as vehicle-to-everything (V2X), which includes vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communication systems.

		In this project, we will red-team (pen-testing) the existing CAN bus and protection mechanisms. We will investigate the weaknesses in the current CAN protocol using tools such as https://github.com/schutzwerk/CANalyzat0r or Metasploit for cars on a CAN simulator such as ICsim (https://github.com/zombieCraig/ICSim). We will then develop solutions to secure platforms running on CAN bus and other similar systems. Strong interest and background in cyber security, especially offensive cyber are required.
Dr Tim Chen	Computer science	**Real-Time Forensic Scene Visualization with 3D Gaussian Splatting:** *= Background =* Creating a 3D live view of forensic scenes can significantly enhance the accuracy and efficiency of crime scene analysis. By using 3D Gaussian Splatting, it is possible to stream real-time depth data and update 3D representations on the fly, allowing for detailed remote viewing and analysis. This cutting-edge approach combines advanced 3D visualization techniques with real-time data streaming to provide a comprehensive and interactive forensic tool. *= Aim =* The aim of this project is to develop a system that streams real-time depth data to generate and update a 3D Gaussian splatting representation of forensic scenes. This system will enable remote investigators to view and interact with the scene in real-time, improving situational awareness and decision-making. *What you will learn:* - Real-time data streaming and processing techniques - 3D Gaussian splatting and its applications in forensic analysis - Development and integration of 3D visualization tools - Potential to publish findings in top forensic and technology conferences/journals
Dr Kamal Mammadov https://researchers.adelaide.edu.au/profile/hung.nguyen	Computer Science	**Title: Enhancing grokking and circuit efficiency in neural networks with low-frequency low-parameter norm gradient descent.** Description: This project aims to enhance the understanding and efficiency of neural networks through the implementation of high momentum low-frequency gradient descent algorithms. The concept of "grokking" in neural networks will be explored, focusing on three key ingredients for achieving strong generalised test performance: 1. Generalising circuit: There are two families of circuits that achieve good training performance: a memorising family Cmem with poor test performance, and a generalising family Cgen with good test performance. 2. Efficiency: Cgen is more “efficient” than Cmem , that is, it can produce equivalent cross-entropy loss on the training set with a lower parameter norm. 3. Slow vs fast learning: The generalizing circuit is slower to learn than the memorizing circuit. As a result, early in training, the faster-learning memorizing circuit dominates but offers poor test performance.
Dr. Sangwon Hyun	Intelligent Testing and Analysis on Large-Language	**AIs generating AIs: Prompting Machine Learning Pipeline using Large-Language Models** This project aims to design a set of prompts for Large-Language Models (LLMs) to generate machine-learning model codes based on the

	Model Qualities on Text and Code Data	machine-learning pipeline process. The project will explore the implementation of several categories of AI models, followed by feasibility checking for the LLM-based code generation and quality evaluation. Please contact Dr Sangwon Hyun for further discussions or topics.
Professor Minh Hoai Nguyen	Computer Vison and Machine Learning	**Computer Vision and Machine Learning for Ego-Centric Video Analysis** This six-week summer research project introduces a scholarship recipient to computer vision and machine learning, focusing on the analysis of ego-centric videos. The participant will use Meta's Aria Glasses to capture first-person visual data and experiment with computer vision models for tasks like object detection and scene text recognition. The project provides hands-on experience with cutting-edge equipment and technology, and introduces the participant to all aspects of a research project, from data collection and curiosity-driven exploration to performance evaluation and reporting. The participant will be guided by an experienced academic and his PhD student, attending regular meetings to discuss progress and challenges. By the end of the project, the student will have gained practical knowledge in computer vision and machine learning and improved their project management and presentation skills. **Computer Vision and Machine Learning for fine-grained visual counting** This six-week summer research project introduces a scholarship recipient to computer vision and machine learning, focusing on the task of fine-grained visual counting. The participant will have the opportunity to experiment with state-of-the-art machine learning and computer vision algorithms for counting objects in images, analyze their performance, and identify their failure cases. The project will also require the participant to collect data to retrain the counting model to improve its performance. This project offers students the chance to gain valuable, hands-on experience in all facets of a computer vision and machine learning project. This includes understanding the core application that motivates the project, pinpointing the technical challenges, gathering data, training neural network models, and assessing their effectiveness. The participant will be guided by an experienced academic and his PhD student, attending regular meetings to discuss progress and challenges. By the end of the project, the student will have gained practical knowledge in computer vision and machine learning and improved their project management and presentation skills.
Dr Tim Chen	Computer Science, Human-AI interaction, Medical AI	**AI-assisted Endometriosis diagnosis** In this project, we will apply state-of-the-art detection and segmentation model to locate and identify features that are helpful for endometriosis diagnosis on ultrasound images. You will work with a team of AI researchers, sonographers, and sonologists for this very exciting project. See https://imagendo.org.au/
Angus Lewis	Applied probability and data science	**Simulating matrix-exponential random variables.** Matrix-exponential distributions generalise Phase-type distributions which are the time-until-absorption of a continuous-time Markov chain (CTMC). Recently, an interpretation of matrix-exponential distributions using CTMCs was constructed. This project aims determine if this can be used

		to simulate matrix-exponential random variables. Project suitable for maths students who are undertaking/completed Random Processes.
Dr Feras Dayoub	Machine Learning and Robotic Vision	**Teaching a Robot Dog to Fetch** You will develop an AI-powered fetch system for our robot dog (GO1 from Unitree). You will deploy an open-vocabulary object detection to enable the robot to recognise and locate user-specified objects. Create a command interface for users to request items. Design simple search algorithms to allow the robot to autonomously find the requested objects.
Dr Mike Chen	Applied Mathematics	**3D printing for biofabrication** Biofabrication uses 3D printing to create artificial biological tissues (bone, cartilage). This project will model a new printing technique where polymers are stretched into threads via application of an electric field. Other projects also available: Contact Dr Mike Chen for discussion.
Dr Luke Bennetts	Applied Mathematics	I offer projects in Mathematics of Climate Science, Offshore Renewable Energy, Acoustic Metamaterials, as well as other areas. Please contact Dr Luke Bennetts to discuss.
Dr Menasha Thilakaratne, Dr Thushari Atapattu	Natural Language Processing, Machine Learning, Deep Learning, Text Mining, Mental Health	**Enhancing Mental Health Emotion Annotation with LLMs for Scalable ML Model Training** In this project, we aim to leverage the capabilities of Large Language Models (LLMs) to enhance and expand an existing gold-standard mental health corpus, which is currently annotated with emotional labels. The gold standard corpus comprises meticulously verified data points, each annotated with precise emotional states pertinent to mental health studies. Our goal is to use LLMs to relabel these data points and examine their effectiveness in the annotation process. Upon validating the LLM annotations, the project will proceed to generate a larger, silver standard dataset. This dataset will incorporate the LLM-revised annotations, significantly expanding the number of data points available. This expansion is vital for building more robust and generalisable machine learning models, ultimately contributing to improved tools for mental health diagnostics and treatment planning.
Dr. Michael Albanese	Pure Mathematics (Differential Geometry)	Please contact Dr Michael Albanese for discussion
Dr Siu-Wai Ho	Navigation and Position Fixing, Machine Learning, Wireless Communications, Coding and Information Theory	This project aims to develop advanced algorithms for wireless communication and positioning systems. It is a camera-based positioning system that locates the square shaped tags. A camera takes a photo and from the photo the system locates the tag by finding its position in the photo. For other projects, please contact researcher for discussion. **Latent Structure Discovery by an Information Theoretic Inequality Prover** The project aims to develop new methods and algorithms for discovering structures in causal models. These models are important in areas such as healthcare, industry, and network security. The new methods can automate reasoning and generate human-verifiable proofs that are too large for humans to analyse.

Dr Edward Green	Applied Mathematics	**Mathematical Biology** Mathematics can be used to help answer a huge variety of questions in biology and medicine, from how do cells organise themselves into tissues, to what makes locusts swarm? If you're interested in applying mathematics in biology, contact me for a discussion.

SCHOOL OF ELECTRICAL AND MECHANICAL ENGINEERING:

Researcher:	Research Area:	Available Project(s):
Professor Withawat Withayachumnankul	Terahertz Technology	**Material parameter estimation for terahertz spectroscopy:** In our lab, we utilise state-of-the-art terahertz equipment operating around 300 GHz for a variety of applications, including sensing, imaging, and communications. A key challenge is estimating the complex dielectric properties of multilayer materials. This task directly supports our non-destructive evaluation projects with industry partners, where regular inspection of materials is crucial for their operation. We invite a student to join this project. The candidate should have solid coding skills (MATLAB or Python) and will gain expertise in signal processing and practical electromagnetic theory. Our group offers robust mentoring and comprehensive equipment support. We are developing purely dielectric filters for terahertz frequencies, specifically within the 252 to 325 GHz range recommended by the IEEE for point-to-point wireless communications. Some frequency components within this band could interfere with radioastronomy observations, and the International Telecommunication Union (ITU) has recommended protection measures in ITU-R RA.314-11. Our goal is to design stop-band filters to minimise such interference. We invite a student to work on this project, requiring a working knowledge of electromagnetics and coding. They will gain experience in filter design and terahertz experiments. Our group offers robust mentoring and comprehensive equipment support. **Transformation optics for terahertz waves** Our group has pioneered a substrateless integrated platform for terahertz applications in sensing and communications. The platform is made entirely of silicon, enabling efficient routing and processing of terahertz waves. A key aspect of this platform is the effective routing of waves in a 2D space. In this project, we will employ transformation optics for flexible 2D waveguiding. The project aims to develop a tool that will allow our group to create peripheral components based on the principles of transformation optics. We invite a student to work on this project. The ideal candidate should have a solid understanding of electromagnetics and coding, as well as a strong background in mathematics.
Dr Andy Boes	Electrical and Electronic Engineering - Photonic Integrated Circuits	The project aim is to design high efficient and high bandwidth optical modulators, which operate at visible wavelengths (blue). As part of the project, you will learn how to use standard simulations tools for the simulation of optical waveguides. This will enable you to carry out parameter sweeps for the optimisation of the waveguide and electrode dimensions with the aim of achieving high efficiency and broad operation bandwidth. This modulator design will form the basis for a fabrication run and experimental characterisation.
Dr Rey Chin	Fluid Mechanics, Turbulence, Computational	Please contact Dr Rey Chin for further discussion.

	Fluid Dynamics, Flow Control, Multiphase flow, Biofouling, Blood Flow, Coronary arterial flows, UAV, Rough wall flow, Aerospace applications, Renewable energy.	
Professor Andrei Kotousovhttps://researchers.adelaide.edu.au/profile/nghia.nguyentrong	Fracture and Solid Mechanics	We have multiple projects supported by the Australian Research Council, Defense Science and Technology (Melbourne and Adelaide Groups) as well as local companies (e.g. AML 3D). These projects are related to the evaluation of material properties, fatigue life, residual stress and fracture of additively manufacturing components to be used in space, defense and other applications. If interested, please contact Prof Andrei Kotousov for further discussion.
Dr Yujie Chen	Materials Science	**High-performance coatings for harsh environments:** This project aims to study the microstructure and mechanical properties of nanostructured high-entropy coatings. Both hardness and Young's modulus will be determined using nanoindentation. Assisted by advanced focused ion beam (FIB) microscopy, the microstructural features will be revealed using scanning electron microscopy (SEM).
Professor Zonghan Xie	Mechanical properties of engineering materials	**Design of strong, lightweight materials for a sustainable future** Strong, lightweight materials are needed for various applications from more efficient cars to higher-performance sports equipment. The focus will be on simulations with various topology designs and their combinations to achieve structural reinforcement. This will involve the integration of solid mechanics, finite element analysis, and 3D printing technologies.
A/Prof Claire Jones	Injury and Orthopaedic Biomechanics (musculoskeletal and neurotrauma)	**Biomechanics of spinal trauma and the healthy spine** In this research program we use physical models, post-mortem tissue and volunteer participants to understand the biomechanics of the healthy spine, and to gain insight into injury mechanisms. The summer project will involve elements of apparatus design, medical imaging analysis, laboratory experiments and data processing. The project will be defined in collaboration with the student. There is no required background knowledge, but a keen interest in biomechanics is essential. **Biomechanics of the wrist – can we predict surgical outcomes with computer models?** Aims to develop, validate and use subject-specific computational models of the wrist to predict the mechanical outcomes of surgical repair of wrist ligaments. It will involve elements of apparatus design, medical imaging analysis, laboratory experiments and data processing. There is no required background knowledge, but a keen interest in biomechanics is essential. **Biomechanics of traumatic brain injury (TBI)** Involves developing and using preclinical and physical models of traumatic brain injury to generate improved understanding of TBI. It may involve elements of apparatus design, medical imaging analysis, laboratory experiments and data processing. There is no required background knowledge, but a keen interest in biomechanics is essential.

Dr David Harvey	Robotics	**Arachnida Cave Exploration Robot** A hexapod robot prototype has been developed to allow robust operator-controlled movement and mapping of tough to access areas of cave environments to support the work of palaeontologists. This project will further develop the robot to allow autonomous operation in the difficult cave environment. This work has the scope to have genuine impact in a very interesting area of scientific research.
Prof Peng Shi & Dr Xin Yuan (Vernon)	Robotic, autonomous and control systems	**Human-robot Interactive Control for a Tracked Rover with a Robotic Arm:** This project will create an interactive control system, integrating human posture control for a tracked rover and robotic arm, enhancing operational efficiency and user engagement in fieldwork and agriculture applications.
Dr Hong Gunn Chew	machine learning, network device characterisation	**Development of Graph based Machine Learning Models for VPN Network Analysis** This project aims to characterise the behaviour of mobile apps and their devices through the analysis of their network communications traffic. Focus will be placed on developing techniques to classify apps via their network traffic by making use of an VPN connected mobile devices testbed for analytical and experimental purposes.
Dr Leok Lee	Electrical and Mechanical Engineering, renewable energy	1. **Renewable energy** 2. **Decarbonization for heavy industry** See my researcher profile for more details or email for discussion.
Dr Zhiwei Sun	Mechanical engineering, fluid mechanics, experiments in thermofluids, renewable energy	**Spray structure visulisation using an in-house imaging technique** You will design and conduct relatively simple experiments to assess the applicability of our micro-focusing shadowgraph technique in spary flows. Please contact researcher for more information and discussion.
Professor Nelson Tansu	Electrical and Electronic Engineering, Biomedical Engineering, and Mechanical Engineering	**Terahertz semiconductor lasers - intersubband quantum engineering** The lack of room-temperature semiconductor solution has been the limiting factor in the progress of terahertz systems. The project will focus on the pursuit of semiconductor materials innovations, nanoscale device design, quantum computational methods, and circuit-level implementations of the quantum-based structures to create room-temperature terahertz sources. Students with backgrounds in Electrical and Electronic Engineering, Physics, Materials Engineering, Mechanical Engineering, or Quantum Engineering will be highly appropriate for this project. **Machine learning and artificial intelligence engineering for semiconductor materials, devices, and systems accelerated designs** This project aims at inverse designing complex photonics, electronics, and nanoscale devices by using applied machine learning and artificial intelligence engineering. This project will marry physical electronics (semiconductor technologies) and artificial intelligence in addressing some of the most complex technologies for microdisplays, optical coherence tomography (biomedical engineering), space electronics, electric vehicles (power electronics), and defence (high-power lasers). Students with backgrounds in Electrical and Electronic Engineering, Physics, Materials Engineering, Mechanical Engineering, Computer/Mathematical Sciences, or Quantum Engineering will be highly appropriate for this project.
Dr Mergen Ghayesh	Mechanical Engineering	**Vibrations of Nanosystems** Explore the fascinating world of nanosystems by studying their vibrational properties. This project offers a unique opportunity to delve into

		nanotechnology, aiming to improve the stability and performance of nanoscale devices. **Advancing Heart Attack Detection and Treatment** Are you passionate about cutting-edge healthcare technology? Join our team to design advanced technology for gathering detailed information about arterial tissue, revolutionising early detection and personalised treatment for heart attack patients, and transforming cardiovascular disease prediction and treatment. **Vibrations of NEMS (Nano-Electro-Mechanical Systems)** Study the vibrational characteristics of Nano-Electro-Mechanical Systems (NEMS) to optimise their design and functionality. This project focuses on the enhancement of the performance of nanoscale devices. **Innovating Sustainable Power: From Vibration to Usable Energy** Are you passionate about sustainable technology? Join our research team to design and develop devices that convert mechanical vibrations into electrical energy, contributing to a greener future by transforming ambient vibrations into usable energy. **Vibrations of MEMS (Micro-Electro-Mechanical Systems)** Examine the vibrational properties of Micro-Electro-Mechanical Systems (MEMS) to improve their performance and reliability. This project aims to contribute to the development of advanced microscale devices. **Heart Attack Prevention Using FSI** Contribute to life-saving research by using fluid-structure interaction models to study heart attack prevention. This project offers a unique blend of biomechanics and biomedical engineering, aimed at improving cardiovascular health. **Stroke Prevention Using FSI** Join the fight against strokes by using fluid-structure interaction models to study cerebral blood flow. This interdisciplinary project combines biomechanics and biomedical engineering to develop effective stroke prevention methods. **Nature-Inspired: Harnessing Wind into Usable Energy** Are you passionate about taking inspiration from nature for sustainable technology? Join our research team to develop an energy tree, a structure that mimics nature to harvest wind energy into usable power, contributing to a greener future. **Advanced Hydrogen Storage Systems: Paving the Way for Clean Energy** Are you passionate about innovative solutions for clean energy? Join our research team to develop advanced hydrogen storage systems, crucial for the efficient and safe storage of hydrogen fuel.
A/Prof Said Al-Sarawi	Biomedical engineering and microelectronics	**Development of an automated bespoke bioreactor device and inoculation mechanisms for tissue engineering** A common practice in burns treatment that require intervention is the use of grafts from other areas of the body, however when the burn area is large, e.g. burns to majority of the body, large skin grafts is not possible. Tissue engineering is a common approach used to culture the needed autologous composite cultured skin from the burnt person cells. Our team has successfully developed an in-house prototype bioreactor that enables the production of large pieces of engineered tissue, skin size of 25cm x 25cm. Building on this success, the aim of this project is to further refinement the culturing process to enable a further scale-up and automate the process to enable a reduction in manual-handling and enable the production of a functional skin replacement at mass quantities and at low cost. As part of this project, there is a need to • develop a process model of the developed tissue culture process,

		• optimise the process model for streamlined and efficient cell culture, • fabricate a disposable perforated air-liquid interface device, • optimise the flow rate and volume output accuracy upon dispensing, • evaluate mechanisms to reduce the residual media retention post waste-tipping, • investigate a mixing mechanism for old/new media, • sterile automation of liquid dispensing, • measure lactate, pH and glucose levels of composite skin, • automated cell inoculation processes, and • automate cassettes manipulation within array. Supervisors: Associate Professor Marcus Wagstaff (Adelaide Medical School), Dr Bronwyn Dearman (Adelaide Medical School), Dr Said Al-Sarawi (School of Electrical and Mechanical Engineering). **Machine Based-Hip Migration Detection** This is a joint project betweenresearchers and clinicians in the Adelaide Medical School and School of Electrical and Electronic Engineering. The aim of this project is the development of a standalone automated measurement computer aided design tool using plain pelvic radiographs to enable detection of early hip implant migration. This exciting collaborative project has the potential to help patients who have already had a hip replacement along with preventing harm to future patients. The dataset for this project is provided by the Royal Adelaide Hospital in the form of Digital Imaging and Communications in Medicine (DICOM) image format This format is commonly used for image storage, management, and communications in Medicine. In simple terms, the DICOM file will have meta data with some personal information and X-ray images that have been taken at different times. The tool will be using these images for further processing. As part of this project there is a need to develop algorithms to identify unique landmarks, features, classes between successive X-ray images. AI and ML algorithms will be used to help automate the identification of these landmarks, features, and classes. This might be proceeded by image pre-processing for noise reduction and improved image processing.

SCHOOL OF PHYSICS, CHEMISTRY & EARTH SCIENCES:

Researcher:	Research Area:	Available Project(s):
Professor Greg Matha	Chemistry	The project will explore different aspects of researching photocatalytic water-splitting to produce green, sustainable hydrogen. This will include the synthesis, testing, and characterising of photocatalysts, as well as testing different reactors and techno-economic assessment of photocatalysis.
Dr Wenle Weng	Optics and photonics	**Simulation of nonlinear spectral expansion of laser pulses:** This project aims to use numerical simulation methods to investigate the spectral broadening of short laser pulses in nonlinear fibres. Based on the simulation results, follow-up experiments may be carried out to generate multi-carrier laser emission for telecommunication and sensing applications.
Associate Professor Tak Kee	Materials Chemistry, Physical Chemistry	**Photocatalytic Hydrogen Generation using Highly Efficient Materials:** The summer project will involve using highly efficient organic materials for light harvesting to generate hydrogen gas. Students will be working with a

		team of researchers. This project has significant implications on future materials for generation of renewable energy.
Stefan Loehr	Earth Science	Multiple projects available, ranging from Earth/Climate/Biospheric evolution to Critical Minerals related topics. Contact researcher for discussion
Dr Sabrina Einecke	High-Energy Astrophysics (incl. Data Analysis, Statistics, Machine Learning)	Contact Dr Sabrina Einecke for discussion.
Professor Anthony Thomas AC FAA	Theoretical physics	**Hypernuclei:** Hypernuclei are formed when a strange particle is bound to a normal nucleus. The aim of this project is to explore the role of three body forces in these systems. This is of great interest in connection with experimental programs at major international particle accelerators. Some computational expertise will be needed.
Dr Finn Stokes	Physics	**The muon magnetic moment mystery** A 20-year puzzle in high-energy physics. Work with the world-leading Budapest-Marseille-Wuppertal collaboration to investigate the consequences of their recent calculation that used supercomputers to upend our understanding of the long-standing discrepancy between theoretical predictions and experimental measurements of the muon magnetic moment.
Prof. Christopher Sumby	Chemistry, Materials Chemistry	**Hierarchically porous metal-organic framework composites** **porous solids are sponge like materials that can adsorb gasses, separate chemical mixtures and catalyse chemical reactions.** This project is part of a lab effort aiming to make monolithic porous materials and to examine their catalytic properties. Other projects are available too so contact me for a discussion.
Prof. Glenn Solomon	Physics	**Semiconductor and superconducting quantum photonics.** We make quantum confined structures in semiconductors and processes then into photonic devices. These devices varying for semiconductor lasers to quantum-dot single-photon sources. We also make superconducting single photon detectors. Like above, we make the superconducting material, process the structures, and test them.
Prof Heike Ebendorff-Heidepriem	chemistry and physics of optical glasses and fibres including design, fabrication and characterization	**1. 3D printing of glass** **2. development of diamond particles doped glass/fibre - fabrication and characterization** **3. new etching recipe for fluoride glass** **4. fabrication of polymer microstructured fibres for Terahertz guidance** **5. new solid phase extraction method for glass raw material purification** Please contact researcher for discussion
Prof Tara Pukala	Chemistry	**Developing Mass Spectrometry Approaches for Structural Biology** Research in my group primarily utilises mass spectrometry to obtain insight into the structure, function and interactions of biological macromolecules. We develop new techniques to study a range of systems primarily including protein misfolding disorders, snake venom proteins and unusual DNA structures involved in gene regulation. Please contact for further discussion.
Dr. Ori Henderson-Sapir and Prof David Ottaway	Physics - My research focuses mainly on mid-infrared fibre lasers	Various experimental and simulation projects related to the development and the applications of high-power mid-infrared fibre laser. Please contact researchers to discuss further

	and their applications	
Dr Daniel Brown	Experimental Physics	**R&D for next generation gravitational wave interferometers** Multiple projects on offer consisting of hands-on experimental laboratory work (optics, interferometry, control systems, electronics, mechanics) and theoretical (Scientific software development, next generation optical simulations) in the OzGrav group. Those with interests in physics, comp sci, electronics, and/or mechanical engineering should contact researcher for further discussions.
Dr Tao Li	advanced materials; materials chemistry; climate change; environmental remediation	**Design of advanced mixed matrix membranes for gas separation** **Industrial gas separation processes are highly energy intensive.** These include cryogenic distillation during olefin production, natural gas sweetening, post-combustion CO2 capture and so on. Developing new materials and technologies is a critical step towards lowering the carbon footprint of industrial gas separation processes. Mixed matrix membranes (MMMs) are advanced composite membranes that combine crystalline porous materials with polymers. These membranes show great potential to achieving efficient gas separation with low energy expenditure. However, the poor interfacial compatibility and nonoptimal membrane structure pose great challenges for the rational design of MMMs. This project aims to develop new chemistry tools to engineer MMMs' interfaces and structures. With the further understanding of the structure-property relationships of these MMMs, advanced membranes with superior gas separation performance will be rationally designed. **Imparting permanent porosity in liquids - the design of porous liquids** Conventional liquids do not contain permanent porosity. Their sorption behaviours of gas molecules are relatively simple. Porous liquids are a new class of engineered liquid emerged in recent years that combines the permanent porosity of a crystalline solid material with the fluidity of a liquid. These exciting new materials offer tremendous potential as new sorbents and catalysts for environmental remediation, molecular transformation, and chemical separation. This project aims to develop new strategies to synthesize functional porous liquids and explore their potential for various applications.
Dr Thomas Fallon	Chemistry/Organic Synthesis	**Synthesis of Shape-Shifting Liquid Crystals** Research in the Fallon lab focuses on the synthetic chemistry of shape-shifting molecules. These are rare molecules that spontaneously switch their structure and shape, leading to dynamic properties. This project will incorporate shape-shifting molecules in liquid crystals for the first time. The myriad uses of liquid crystals rely on phase transitions induced by eternal stimuli, including electric field, light, and temperature. The hope of this project is to couple the molecular shape-shifting with phase behaviour to expand the potential range of stimuli responsive. The work will primarily involve synthetic organic chemistry to make and evaluate a library of liquid crystal samples. Students will gain a broad experience in multi-step organic synthesis using a wide range of reactions, equipment, and analytical methods.