The University of Queensland
AUSTRALIA
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Updated 11 September 2025

2026 UQ Summer Research Project Description

Project Title:	**Design of new model mounting system for the X2 Expansion Tube**
Project Duration:	36 hours per week for 6 weeks on-site
Positions Available:	1
Description:	UQ's X2 expansion tube is a hypersonics impulse wind tunnel used for the simulation planetary entry and high-speed flight from 3 to 20 km/s. Like any machine, it is a mechanical system which is sometimes in need of upgrades to ensure it maintains peak performance. Test models need to be accurately mounted to allow high quality experiments to be performed in the facility. The current mounting system is clunky and not easy to work with and align accurately. This project aims to design an upgraded model mount which will hopefully be easier to use and allow for more accurate model placement.
Expected Outcomes and Deliverables:	This project will give students the chance to be a part of a large interconnected laboratory group focused on the study of the phenomena related to planetary entry and high-speed flight and contribute to improving experimentation in that laboratory. While this project is not a research project directly, it will give the student the ability to experience this type of research environment. The student will gain skills in the full engineering design process from scoping the design and then working with our staff, students and technicians to procure, manufacture and install experimental hardware. The project's outcome will be a report detailing the design of new system and hopefully manufactured components to be used on the facility.
Suitable for:	As engineering design experience is required for this project, it is open to Mechanical and Mechanical and Aerospace students in their 3rd and 4th years. Students with some actual engineering design experience outside of coursework would be preferred but is not essential.
Supervisor:	Dr Chris James c.james4@uq.edu.au
Further info:	It would be good to chat with students before they submit an application, so please do email if you are interested in a project.

Project Title:	**Dynamic rotor control for single-shaft wind turbines**
Project Duration:	36 hours per week for 6 weeks on-site
Positions Available:	1
Description:	This project aims to explore and develop a rotor dynamic control algorithm for small-scale vertical axis wind turbines (VAWTs) used in low-altitude wind energy harvesting. VAWTs are another type of wind generators different from conventional horizontal windmills. The biggest advantages is that these wind turbines can operate independently of wind direction and are thus more suitable for turbulent wind environments. Despite this type exists for decades, VAWTs have not achieved commercial viability. One of primary barriers is the lack of proper control method. VAWT control currently relies on maximum power point tracking (MPPT) algorithms which are ideal for less dynamic energy systems like solar PV. VAWT systems are highly dynamic, therefore they need a better control method. This Summer Research project involves a desktop R&D work to 1. Improve and simulate the rotor control algorithm using Simulink or Python. 2. Design a lab test setup and procedure using our existing Darrieus-type VAWT with a three-phase permanent magnet generator, enabling simultaneous electrical and mechanical measurements. The work will guide our following lab and outdoor tests on our VAWT prototypes.
Expected Outcomes and Deliverables:	This project will improve and verify our proposed VAWT dynamic control algorithm. This will help us to proceed to outdoor tests on several prototypes. Through this unique practise relevant to a real-world problem, the candidate gains valuable experiences in mechanical dynamics, control theories, and electromechanical systems. The work also fosters your ability in simulation of dynamic systems using either Matlab Simulink or Python.
Suitable for:	This project is open to applications from 3rd – 4th year students with a background in mechanical and/or mechatronic engineering or similar disciplines. Students with hand-on experience in making electronic systems are highly desired.
Supervisor:	Dr Yuanshen Lu
Further info:	Please contact Yuanshen Lu at y.lu7@uq.edu.au before you submit an application.

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Project Title:	**Understanding Electrode Morphology in CO_2 Electrolysers Using Volume Imaging**
Project Duration:	36 hours per week for 6 weeks. As this work will be based in the laboratory, this will be predominately on-site project. Data analysis can be completed remotely.
Positions Available:	1
Description:	Electrochemical CO_2 reduction (CO_2RR) is a promising pathway for converting CO_2 into valuable fuels and chemicals. However, the performance and durability of CO_2 electrolysers are strongly influenced by electrode morphology, which governs mass transport, local reaction environments, and catalyst stability. A key challenge in optimising these systems is the ability to visualize and understand electrode structure at different stages of operation. In this project, the student will develop advanced volume imaging methods to investigate electrode morphology in CO_2 electrolysers. The focus will be on designing and applying imaging techniques—such as electron tomography or X-ray computed tomography—to track structural evolution during operation. This project involves image data analysis. Experience and interest in research and interest in image processing and reconstruction is necessary.
Expected Outcomes and Deliverables:	The student will gain fundamental insights into how CO_2 electrolysers operate, providing a deeper understanding of electrochemical energy systems and their broader applications. Additionally, the student will develop data analysis skills to correlate electrode morphology with electrolyser performance. This includes expertise in advanced imaging techniques and data interpretation, which are valuable for careers in energy storage and conversion research.
Suitable for:	This project is open to applications from 3rd or 4th year students with a background or interest in materials science and engineering and image processing.
Supervisor:	A/Prof Ruth Knibbe ruth.knibbe@uq.edu.au
Further info:	If you would like more information about this summer research project, please email me.

Project Title:	**Printed batteries for health monitoring**
Project Duration:	36 hours per week for 6 weeks. As this work will be based in the laboratory, this will be predominately on-site project. Data analysis can be completed remotely.
Positions Available:	1
Description:	Printed batteries hold a great promise for health monitoring and RFID devices. However, scaling from coin cell battery to a larger scale system is a technical challenge. This includes, printed a larger area and also the associated packaging that is used in the final battery design. In this project, the student will explore scaling printed batteries for real work applications. This project will involve development and characterisation of deposition methods, so it would be best that the either student has laboratory experience or be interested in work in a laboratory.
Expected Outcomes and Deliverables:	The student will develop a fundamental insight into how batteries work, which would help understanding other electrochemical energy systems. In addition, the student will develop laboratory and data analysis skills to correlated battery performance with material characteristics.
Suitable for:	This project is open to applications from 3rd or 4th year students with a background or interest in materials science and engineering.
Supervisor:	A/Prof Ruth Knibbe ruth.knibbe@uq.edu.au
Further info:	If you would like more information about this summer research project, please email me.

Project Title:	**Design of Experiments for MHD Aerobraking at High Magnetic Reynolds Numbers**
Project Duration:	36 hours per week for 6 weeks on-site
Positions Available:	1
Description:	When a spacecraft enters a planet's atmosphere, it is travelling at hypersonic velocity. This results in the formation of a bow shock which envelopes the flight vehicle. As gas passes through the bow shock, the temperature rapidly increases to levels above the dissociation and ionisation temperature, and therefore charged particles are produced. It has been shown that a magnetic field can be used to manipulate the resulting ionised flow field in such a way that drag force increases, whilst heat transfer to the vehicle surface decreases. A magnetic field could also theoretically be used to apply off-axis forces to control the direction of the vehicle. These techniques are generally referred to as magnetohydrodynamic (MHD) aerobraking and flow control, and have the potential to enable optimised atmospheric entry trajectories with reduced heating and vehicle loading. Considering return to Earth of humans from Mars, this will involve atmospheric entry of large scale spacecraft at the highest ever Earth re-entry speeds. At these conditions a tendency develops for the applied magnetic field to undergo deformation as the effects of magnetic field advection overcome diffusion; these are referred to as "high magnetic Reynolds number" flows. The effect of the magnetic field being swept back on the resulting vehicle drag and surface heating is expected to be significant, but large uncertainty exists since there is little experience in the wider research field in simulating these effects, and there is a dearth of experimental data to develop and validate new high fidelity computational fluid dynamics (CFD) codes. In this thesis the student will use advanced CFD analysis to determine the feasibility of conducting experiments to examine the effect of high magnetic Reynolds number in UQ's large X3 ground test facility. This will require using finite rate reacting CFD, coupling with MHD effects, to determine if it is possible to run an experiment where 1) significant magnetic field advection takes place and 2) for those effects to provoke measurable and unambiguous changes to the flow field.
Expected Outcomes and Deliverables:	Technical report detailing rigorous analysis to identify optimal experimental configurations which provoke measurable magnetic field deflection.
Suitable for:	Student entering fourth year or later, very strong in fluid mechanics, numerical analysis techniques, and coding.
Supervisor:	Dr David Gildfind d.gildfind@uq.edu.au
Further info:	If you would like more information about this summer research project, please email me.

Project Title:	**Low temperature plasma modelling in eilmer.**
Project Duration:	36 hours per week for 6 weeks on-site preferred, but some hybrid possible.
Positions Available:	1
Description:	Low temperature, non-thermal air plasmas are important in a wide variety of problems. These include air-breathing plasma thrusters for high-speed propulsion and cold plasma jets for biomedical applications, both of which are under active investigation in the School of Mechanical and Mining Engineering. An accurate reaction rate mechanism is essential for accurately simulating such flows. At present, the air plasma model in eilmer is tuned for high temperature shock layers. A radically different model with non-Arrhenius rates, negative ions and electric field enhanced rates is known to be more accurate for low temperature plasmas. In this project, you will implement this mechanism as a bespoke, hard-coded gas model in eilmer. The model will then be validated against low temperature plasma reference cases from the literature. Finally, it will be used in 2D simulations of an air-breathing plasma thruster to evaluate its impact on modelled performance.
Expected Outcomes and Deliverables:	The expected outcome in a new, accurate modelling capability for low temperature air plasma flows in eilmer. The scholar will gain skills in research code development, nonequilibrium thermochemistry modelling, and compressible flow simulation. The scholar is expected to produce a report at the end of their project documenting the model that has been implemented and its validation.
Suitable for:	
Supervisor:	Professor Vincent Wheatley v.wheatley@uq.edu.au
Further info:	If you would like more information about this summer research project, please email me.