Paihau—Robinson Research Institute
VICTORIA UNIVERSITY OF WELLINGTON TE HERENGA WAKA

Summer Research Projects 2025/2026

How to apply

Applications for Summer RA positions are submitted through the online form. Send copies of CV, transcript, and expression of interest letter with subject line "RE: Summer RA Programme 2025/2026" to rri-admin@vuw.ac.nz .

Projects

Other project opportunities may become available later. We will update this list if those opportunities arise. Keep an eye on the website.

Application deadline is Sunday 27th July.

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Thermo-mechanical Design and Build of a 1000A Superconducting Power Supply

Primary Supervisor: Dr Adam Francis

Co-supervisor: Dr Grant Lumsden

Project Description

Electrical design will be provided. You will complete the mechanical design and prototype build, including thermal systems to operate the power supply at cryogenic temperatures.

Required Skills

1. CAD - proficient with SolidWorks
2. Mechanical design and analysis
3. Thermal/hear transfer analysis
4. Some experience with thermal FEA would be an advantage

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Submersible Liquid Nitrogen Pump

Primary Supervisor: Nic Rogers Rehn

Co-Supervisor(s): Mike Davis, Dr Grant Lumsden

Project Description

Design, analysis and prototype testing of electric motor driven pumps for liquid nitrogen transfer.

Project Outcomes

- Pump(s) that can be used for LN2 transfer for lab experiments

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Magnetic Field Sensing Using FBGs Embedded in Magnetostrictive Materials

Primary Supervisor: Dr Shahna Haneef

Secondary Supervisor: Dr Bart Ludbrook

Project Description

Accurate and reliable magnetic field sensing is essential in a range of cutting-edge scientific and industrial applications, including superconducting magnet systems in fusion reactor, quantum computing, etc. These environments often have strong magnetic fields, very low temperatures, and limited space, which make traditional electronic sensors like Hall probes and magnetoresistive devices unreliable due to EM interference, heat, or poor durability.

This project explores the development of an optical magnetic field sensing technique using fibre Bragg gratings (FBGs) embedded in magnetostrictive materials. The strain induced in the magnetostrictive material due to external magnetic fields causes a shift in the Bragg wavelength of the FBG, effectively translating magnetic field changes into detectable optical signals. Importantly, this proposal includes the calibration and characterization of the sensor at cryogenic temperatures (down to 30 K), where both the magnetostrictive properties and FBG responses are significantly altered.

Project Outcomes

- A fully characterised FBG-based magnetic field sensor operational from 300 K down to 30 K

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Strain and Temperature Profiling in Current-Carrying Superconducting Tapes Using Optical Fiber Sensors

Primary Supervisor: Dr Shahna Haneef

Secondary Supervisor: Dr Bart Ludbrook

Project Description

Superconducting tapes are central to next-generation applications such as high-field magnets, fusion reactors, power transmission, and compact medical imaging systems. These tapes are highly sensitive to mechanical strain and temperature fluctuations, especially under operating conditions involving high transport currents and strong magnetic fields. Localized strain and heating can degrade performance or initiate quench events, posing safety risks and system failure. Optical fibre sensors offer high-resolution, multi-parameter sensing methods capable of simultaneously capturing strain and temperature distributions along the length of current-carrying superconducting tapes.

In this research we aim to explore the potential of

I) an ultralong FBG array with multiple sensing hotspots for distributed temperature profiling;

II) temperature-compensated strain gauges for accurate strain measurement with minimal thermal cross-sensitivity.

Project Outcomes

1. A dual parameter sensing system (strain & temperature) validated for superconducting tapes under current load.

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Real-time Signal Processing Techniques for Feature Extraction of High Impedance Faults in Electricity Distribution Networks

Supervisor: Dr Fiona Stevens McFadden

Project Description

Detection of electrical faults is of great importance to electricity distribution system operators. Undetected faults pose a risk to the electricity system and a safety risk to people. Faults have also been implicated in some bush fire occurrences. Conventional fault protection systems are not currently reliable for all fault types, particularly high-impedance faults. When a high impedance fault occurs, the characteristics of the fault current can be quite complex and varied; it is also buried within normal system behaviour, which is also quite complex and varying.

Project Outcomes

1) A set of key characteristics present in our fault dataset are identified.
2) Candidate signal processing techniques are identified from literature and evaluated on our dataset. Suitable techniques are those which can be implemented in a real-time system and have the potential to be used by unsupervised learning algorithms.

At Robinson Research we have been working on this industry problem. We established a physical network simulation and fault test facility at Robinson and generated and a substantive dataset of measurements during a variety of fault episodes along with normal system behaviour. We have built prototype sensing systems that we have installed in real electricity networks.

In this summer project we want to research and evaluate signal processing techniques that can highlight the key characteristic disturbances present in measured current and voltage signals during faults. Effective techniques could then be used for extracting features that can be used in an unsupervised learning-based detection algorithm, which is the goal of our wider work in this area.

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Exploring Magnetic and Electrical Transport in Superconductor/Ferromagnet Nano-thin Films

Supervisor: Yao Zhang

Project Description

In this project, the candidate will prepare superconductor/ferromagnet nano-thin films by using the state-of-the-art thin film deposition system. The crystalline structure will be characterised first. Then the magnetic and electrical transport behaviour will be explored at extremely low temperature. The candidate will experimentally investigate the quantum physics in condensed matter physics.

Project Outcomes

This project aims to understand the emerging physics in superconductor/ferromagnet nano-thin films. The candidate will obtain the knowledge of the quantum physics from experimental work.

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Designing and Building an Automated System for Tinning Long-Distance HTS Tape

Supervisor: Dr Xiyong Huang

Project Description

High-temperature superconducting (HTS) magnets are revolutionizing technologies across a wide range of industries—including energy, transportation, healthcare, and aerospace. Solder-impregnated and non-insulated HTS coils have shown great promise for their robustness under extreme thermal and electromagnetic stresses.

This project is best suited for a mechanical or mechatronics engineering student in their 3rd or 4th year. Experience with SolidWorks is preferred.

During this internship, you will design and build an automated system for tinning long length of delicate HTS tape using various solders. You will then conduct IC tests on the HTS tapes before and after the automated tinning process to investigate the reliability of the process. You will also be shown how to use the pre-tinned HTS tape to wind a non-insulated coil with a controlled turn to turn contact resistivity. Depending on the progress, you may also be shown how to test the HTS coil in liquid nitrogen at 77 K.

Project Outcomes

By the end of the summer trimester, you will have:

1. Built an automated system for tinning long distance of HTS tape,
2. Tinned 50 metres long of HTS tape with good surface finishing,
3. Gained an idea of how to use the tinned HTS tape to wind a solder impregnated coil with a controlled turn-to-turn resistivity;
4. Experience of testing HTS coil at 77 K.

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Analysing Data from Magnetoplasmadynamic Spacecraft Thruster Tests

Supervisor: Dr Ben Mallett

Project Description

The Robinson Research Institute has been routinely operating its superconducting magnetoplasmadynamic thruster in its test chamber GERALDINE, generating an extensive set of performance data in the process. This project involves developing and implementing analysis routines (coded in python) to extract further information from the data, relating, for example, to plasma and thermal processes.

Project Outcomes

- Python libraries for some analysis routines developed, implemented and published (e.g. github)
- Written report of analysis results

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Power Supplies for Electric Propulsion

Supervisor: Randy Pollock

Project Description

Develop techniques to precisely match two cameras video outputs in time and star fields - one of which will have a narrow band optical filter which will make it more difficult to index to the background stars. The goal is to characterise the altitude where specific metals are vapourised during space debris re-entry.

Project Outcomes

Python libraries to integrate the outputs, then tie the event to measurements made by other camera in the Fireballs Aotearoa's network to allow triangulation of altitude of the event.

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