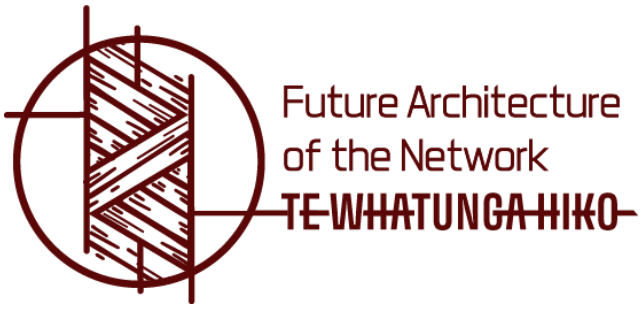

2021

Future Architecture of the Network

Summer Projects

Title: Demonstration of characteristics of DC and AC systems

Relevant Workstreams:

The focus for WS1 – Network Architecture is to develop a large-scale digital model encompassing DC grids and their interface to AC grids. They will enable operational steady-state, dynamic and transient studies associated with distributed power electronic converter interfaced technologies.

In WS4 - Transition from AC to DC, we will assess the implications of high level of infiltration of DC in AC systems and develop mitigation measures where needed. Furthermore, to enable progressive transition we will evaluate the potential of repurposing AC infrastructure for DC applications.

The outputs of this project would also contribute towards VM Work Stream (WS5).

Project Description:

Your task is to produce a practical demonstration which highlights the characteristics of AC and DC systems.

The objective of the project is to produce an educational demonstrator that could be used for education and outreach.

Main Host University and Department:

University of Canterbury, Electrical and Computer Engineering

Main Supervisor: Prof. Neville Watson (University of Canterbury)

Co-supervisors: Dr. Andrew Lapthorn (University of Canterbury), Dr. Hamish Avery (University of Canterbury).

Application Details:

Please send you application (CV and a short cover letter/email) by 31 October to futurearchitecturenetwork@canterbury.ac.nz

Specific student requirements:

BE(Hons) - Electrical and Electronic Engineering (EEE) student- Second, Third or Fourth year.

Summer scholarship: $6k

Dates: 16 November - early Feb

Title: Understanding and programming homolytic power flow analysis or dynamic phasors

Relevant Workstream:

The focus for WS1 – Network Architecture is to develop a large-scale digital model encompassing DC grids and their interface to AC grids. They will enable operational steady-state, dynamic and transient studies associated with distributed power electronic converter interfaced technologies.

Project Description:

Your task is to document the principles of homomorphic power flow analysis and dynamic phasors, an understanding of their benefits and limitations and programme simple systems to demonstrate the principles. The programme outcomes will require validation.

Depending on the quality of your exploration there is a potential that your contributions make their way to a research publication.

Main Host University and Department:

University of Canterbury, Electrical and Computer Engineering

Main Supervisor: Professor Neville Watson (University of Canterbury)

Co-supervisor: Dr. Radnya Mukhedkar (University of Canterbury)

Application Details:

Please send you application (CV and a short cover letter/email) by 31 October to futurearchitecturenetwork@canterbury.ac.nz

Specific student requirements:

BE(Hons) - Electrical and Electronic Engineering (EEE) student- Third (second Pro) or Fourth (Third Pro) year.

Programming skills: MATLab, Python, C++

Summer scholarship: $6k

Dates: 16 November - early Feb

Title: Large scale AC/DC hybrid system simulation

Relevant Workstream:

The focus for WS1 – Network Architecture is to develop a large-scale digital model encompassing DC grids and their interface to AC grids. They will enable operational steady-state, dynamic and transient studies associated with distributed power electronic converter interfaced technologies.

Project Description:

Your task is to perform a literature review of the existing analysis tools for simulating hybrid AC/DC systems. Questions this review would attempt to answer include: What tools are available? What are their capabilities and limitations? What gaps are present?

You will work with the research team and depending on the quality of your exploration there is a potential that your contributions make their way to a research publication.

Main Host University and Department:

University of Canterbury, Electrical and Computer Engineering

Main Supervisor: Professor Neville Watson (University of Canterbury)

Co-supervisor: Dr. Radnya Mukhedkar (University of Canterbury)

Application Details:

Please send you application (CV and a short cover letter/email) by 31 October to futurearchitecturenetwork@canterbury.ac.nz

Specific student requirements:

BE(Hons) - Electrical and Electronic Engineering (EEE) student- Third (second Pro) or Fourth (Third Pro) year.

Summer scholarship: $6k

Dates: 16 November - early Feb

Title: Practical demonstration of breaking DC currents in residential setting

Relevant Workstream:

In WS4 - Transition from AC to DC, we will assess the implications of high level of infiltration of DC in AC systems and develop mitigation measures where needed. Furthermore, to enable progressive transition we will evaluate the potential of repurposing AC infrastructure for DC applications.

The outputs of this project would also contribute towards VM Work Stream (WS5).

Project Description

We believe DC in the home is a likely pathway. At present, electrical appliances are designed to run off 230V ac but a significant number then convert to DC through some form of rectifier circuit.

Your task is to produce a practical demonstration for breaking DC currents for application in residential setting. The proposed solution could use power electronics, electrical, mechanical, magnetic principles or a combination there off.

The objective of the project is not only to have a working solution that could be applied in residential settings, but also to produce an educational demonstrator that could be used for education and outreach.

Main Host University and Department:

University of Canterbury, EPECentre

Main Supervisor: Dr. Hamish Avery (University of Canterbury)

Co-supervisor: Dr. Andrew Lapthorn (University of Canterbury)

Application Details:

Please send you application (CV and a short cover letter/email) by 31 October to futurearchitecturenetwork@canterbury.ac.nz

Specific student requirements:

BE(Hons) - Electrical and Electronic Engineering (EEE) student- Third (second Pro) or Fourth (Third Pro) year.

Summer scholarship: $6k

Dates: 16 November - early Feb

Title: Narrative of DC and AC systems

Relevant Workstreams:

The focus of WS5 is Vision Mātauranga which contributes to distinctive needs and opportunities for Māori-led businesses and communities. The plan is to partner with different Māori communities to explore and trial some of the concepts developed as part of the Future Architecture Network (FAN) project.

The focus for WS1 – Network Architecture is to develop a large-scale digital model encompassing direct-current (DC) grids and their interface to alternating-current (AC) grids. They will enable operational steady-state, dynamic and transient studies associated with distributed power electronic converter interfaced technologies.

In WS4 - Transition from AC to DC, we will assess the implications of high level of infiltration of DC in AC systems and develop mitigation measures where needed. Furthermore, to enable progressive transition we will evaluate the potential of repurposing AC infrastructure for DC applications.

Project Description:

The project focuses on dissemination and outreach to empower more Māori students in Science-Technology-Engineering-Math related fields, and especially working in the electricity industry.

A narrative around AC and DC systems through the application of storytelling and art will be developed to produce an output (presentation or demonstration) that can be used for education and outreach.

Main Host University and Department:

University of Canterbury, Electric Power Engineering Centre (EPECentre)

Main Supervisor: Dr. Hamish Avery (University of Canterbury)

Co-supervisors: Dr. Radnya Mukhedkar (University of Canterbury), Assoc. Prof. Ramesh Rayadu (Victoria University Wellington).

Application Details:

Please send you application (CV and a short cover letter/email) by 31 October to futurearchitecturenetwork@canterbury.ac.nz

Specific student requirements:

Graduate students of Art, Communication, Product design

Summer scholarship: $6k

Dates: 16 November - early Feb

Title: A survey on Low and Medium Voltage DC Circuit Breakers and Preliminary Tests on Supercapacitors in DC Current Diversion

Relevant Workstream:

This project is focussed on Workstream 3.

To enable proliferation of DC grids within AC grids by addressing technologies and control mechanisms for DC circuit breakers.

Project Description:

The main objective of this summer research project is to investigate the existing techniques for DC circuit breakers, and future research directions. Study will begin with a survey on existing circuit breaking techniques for low voltage DC circuits, and comparing them with mature techniques for AC circuit breakers up to several hundred amperes.

Student is expected to detail the physical mechanisms, and physics of the arc extinguishing process and then extending it to the potential investigation towards the utilisation of commercial supercapacitors as a new and potential device family to be used in DC circuit breakers useful for commercial and domestic renewable energy systems, useful for Future Low Carbon, Resilient, Electrical Power System.

Specific requirements:

A good background knowledge on electrical physics, and circuit theory together with strong mathematical capability to analyse the DC transient circuits and techniques

Based in:

University of Waikato

Application Details:

Please send you application (CV and a short cover letter/email) by 31 October to futurearchitecturenetwork@canterbury.ac.nz

Qualifications

- Final year Bachelor Honours students in Electrical Engineering or a closely related field
- Good knowledge of power system grids and power electronics
- Experience with programming languages, e.g. MATLAB
- Excellent academic track record
- High proficiency in written and spoken English
- Enthusiastic applicants (any nationality) that want to make a positive impact in the world and can work in a collaborative environment

Title: An Investigation on Supercapacitor Based Energy Storage for Future DC appliances and DC-DC converters.

Relevant Workstream:

This project is focussed on Workstream 3.

To enable proliferation of DC grids within AC grids by addressing energy storage.

Project Description:

The main objective of this summer research project is to investigate the recent developments of supercapacitor families and their application in energy storage requirements of future DC grids, dominated by renewable energy sources.

Student is first expected to carry out a comprehensive survey on commercial supercapacitor families and their specifications in an engineering viewpoint as applicable to both short and medium term energy storage in DC appliances and DC grids. The work should be extended to study the on-going research on new supercapacitor materials and devices, and their potential to become commercially viable technologies, and their potential impact on Future Low Carbon, Resilient, Electrical Power System.

Specific requirements:

A good background knowledge on electrical physics, and circuit theory together with strong mathematical capability to analyse the energy storage techniques.

Based in:

University of Waikato

Application Details:

Please send you application (CV and a short cover letter/email) by 31 October to futurearchitecturenetwork@canterbury.ac.nz

Qualifications

- Final year Bachelor Honours students in Electrical Engineering or a closely related field
- Good knowledge of power system grids and power electronics
- Experience with programming languages, e.g. MATLAB
- Excellent academic track record
- High proficiency in written and spoken English
- Enthusiastic applicants (any nationality) that want to make a positive impact in the world and can work in a collaborative environment

Title: An Investigation on Future Directions of Supercapacitors to Replace Rechargeable Batteries

Relevant Workstream:

This project is focussed on Workstream 3.

To enable proliferation of DC grids within AC grids by addressing energy storage technologies for short and medium term.

Project Description:

The main objective of this summer research project is to investigate the recent developments of supercapacitor families and their application in energy storage requirements of future DC grids, comparing them with currently used rechargeable battery chemistries, including flow batteries. .

Student is first expected to carry out a comprehensive survey on supercapacitor devices, materials and technologies with their specifications in an engineering viewpoint as applicable to both short and medium term energy storage and if and how they could compete with existing rechargeable battery chemistries. The work should be extended to study the on-going research on new energy storage devices and materials, and their potential impact on Future Low Carbon, Resilient, Electrical Power System.

Specific requirements:

A good background knowledge on electrical physics, and circuit theory together with strong mathematical capability to analyse the energy storage techniques.

Based in:

University of Waikato

Application Details:

Please send you application (CV and a short cover letter/email) by 31 October to futurearchitecturenetwork@canterbury.ac.nz

Qualifications

- Final year Bachelor Honours students in Electrical Engineering or a closely related field
- Good knowledge of power system grids and power electronics
- Experience with programming languages, e.g. MATLAB
- Excellent academic track record
- High proficiency in written and spoken English
- Enthusiastic applicants (any nationality) that want to make a positive impact in the world and can work in a collaborative environment

Title: Setting boundaries and technology identification between distributed generation residential area and distribution network export based on local usage

Relevant Workstreams:

This project is focussed on Workstreams VM and 2.

Project Description:

The main objective of this summer research project is to investigate the possibility of finding ways and processes where maximum amount of distributed energy-based generation is used locally than being exported to the distribution network. Study will begin with a survey on existing entities around the world that perform similar activities and identifying the unique topological parameters.

The test case for this project involves a remote Maori Iwi installing 100 kW Solar and 120 kW battery in a rural setting. Hence a major part of the study would involve input from local distribution company (Powerco), a community power sharing company (Our Energy) and the Maori Iwi (Tuwharetoa).

Student is expected to analyse the generation and usage scenarios of the Iwi through modelling, identify different topologies for generation and 'local' distribution to maximise local usage, and write a report.

Specific requirements:

A good background knowledge on electrical physics, and circuit theory together with strong communication skills.

Based in:

Victoria University of Wellington with some travel required to Halcombe and Taranaki region.

Application Details:

Please send you application (CV and a short cover letter/email) by 31 October to futurearchitecturenetwork@canterbury.ac.nz

Qualifications

- Final year Bachelor Honours students in Electrical Engineering or a closely related field
- Good knowledge of power system grids and power electronics
- Experience with programming languages, e.g. MATLAB
- Excellent academic track record
- High proficiency in written and spoken English
- Enthusiastic applicants (any nationality) that want to make a positive impact in the world and can work in a collaborative environment

Title: Optimisation of battery storage placement in a weak rural network based on system constraints.

Relevant Workstream:

This project is focussed on Vision Workstream.

Project Description

The main objective of this summer research project is to investigate the best possible methodologies to install a battery storage system in a weak rural distribution network environment.

Student is first expected to carry out a comprehensive survey of the present network and perform weak network studies in collaboration with the local distribution network. The candidate is further expected to model and analyse the network for battery storage connection optimisation based on the network constraints. The student is also expected to investigate into fault studies and protection. The outcome would be a report outlining the recommendations.

The student will be interacting with local distribution company, Powerco and the Iwi (Tuwharetoa).

Specific requirements:

A good background knowledge on electrical and power systems engineering and circuit theory, together with strong mathematical capability to analyse the energy storage techniques. Good communication skills are necessary.

Based in:

Victoria University of Wellington with some travel to Halcombe and Taranaki region

Application Details:

Please send you application (CV and a short cover letter/email) by 31 October to futurearchitecturenetwork@canterbury.ac.nz

Qualifications

- Final year Bachelor Honours students in Electrical Engineering or a closely related field
- Good knowledge of power system grids and power electronics
- Experience with programming languages, e.g. MATLAB
- Excellent academic track record
- High proficiency in written and spoken English
- Enthusiastic applicants (any nationality) that want to make a positive impact in the world and can work in a collaborative environment

Title: A self-tuning DC-DC converter

Relevant Workstream:

This project is focussed on Workstream 3.

Project Description

In this summer research project, a student will design a control system for a buck converter, that can vary a PWM frequency and duty cycle, in response to a user's voltage/current requirements and inductor current and output voltage sensors.

Student is first expected to carry out a comprehensive survey on DC-DC converter operation and design with focus on both continuous and discontinuous modes. A high-resolution model will be developed using a power electronics software before final implementation of the hardware for analysis. The outcome will a report discussing the detailed design with analysis.

Specific requirements:

A good background knowledge on electrical physics, circuit theory and power electronics.

Based in:

Victoria University of Wellington

Application Details:

Please send you application (CV and a short cover letter/email) by 31 October to futurearchitecturenetwork@canterbury.ac.nz

Qualifications

- Final year Bachelor Honours students in Electrical Engineering or a closely related field
- Good knowledge of power system grids and power electronics
- Experience with programming languages, e.g. MATLAB
- Excellent academic track record
- High proficiency in written and spoken English
- Enthusiastic applicants (any nationality) that want to make a positive impact in the world and can work in a collaborative environment

Title: A DC Housing Community – An outreach project

Relevant Workstream:

This project is focussed on Workstream 4.

Project Description

In this summer project, the student is required to build a scaled down physical model of a DC residential house. It should have electronic devices that mimic household devices that can be programmed to switch on/off by a user to simulate a scaled down version of a household power system over a 24-hour period. The household/community should operate with a lower voltage power supply that is easily transportable and safer for the kids to operate.

Student is first expected to develop a design based on agreed specifications at the start of the project. The student will then develop electronics that mimic different appliances and develop a model house with the developed loads. The load curve must be programmable. The outcome will a report discussing the detailed design with analysis.

Specific requirements:

A good background knowledge on electrical physics, circuit theory and power electronics.

Based in:

Victoria University of Wellington

Application Details:

Please send you application (CV and a short cover letter/email) by 31 October to futurearchitecturenetwork@canterbury.ac.nz

Qualifications

- Final year Bachelor Honours students in Electrical Engineering or a closely related field
- Good knowledge of power system grids and power electronics
- Experience with programming languages, e.g. MATLAB
- Excellent academic track record
- High proficiency in written and spoken English
- Enthusiastic applicants (any nationality) that want to make a positive impact in the world and can work in a collaborative environment

Title: Adaptation of existing smart meter technology for dc measurement

Relevant Workstream:

This project is focussed on Workstream 4.

Project Description

In this summer project, the student will investigate the adaptation required for the existing smart metering technology to enable DC measurements.

Student is first expected to survey the present smart metering technologies used in the DC measurements. The student is further required to source the smart meters that are currently installed in New Zealand residential environment, understand the associated circuity and address the changes that will be necessary for DC metering. The candidate is expected to interact with smart meter manufacturers to elicit the relevant knowledge. The outcome will a report discussing the DC sensing technology suitable for smart metering design updates, testing where possible, and analysis.

Specific requirements:

A good background knowledge on electrical physics, circuit theory and power measurement techniques.

Based in:

Victoria University of Wellington and/or University of Canterbury

Application Details:

Please send you application (CV and a short cover letter/email) by 31 October to futurearchitecturenetwork@canterbury.ac.nz

Qualifications:

- Final year Bachelor Honours students in Electrical Engineering or a closely related field
- Good knowledge of power system grids and power electronics
- Experience with programming languages, e.g. MATLAB, Python
- Excellent academic track record
- High proficiency in written and spoken English
- Enthusiastic applicants (any nationality) that want to make a positive impact in the world and can work in a collaborative environment