ARCHITECTURE OF THE FUTURE LOW-CARBON, RESILIENT, ELECTRICAL POWER SYSTEM

Future Architecture of the Network (FAN) | Te Whatunga Hiko.

As part of the New Zealand government's Strategic Science Investment Fund (SSIF) on Advanced Energy Technology Platform (AETP), we are investigating what the future electrical power system might look like. Our main hypothesis is that high penetration of DC transmission and distribution (conveyance) into the AC grid will provide many benefits to transition to a low-carbon power system. The major research challenge is to determine the future architecture, topology, and a transition pathway.

Call for researchers:

Significant implementation of converter interfaced generation, storage and load make a highly integrated hybrid AC DC system an obvious but revolutionary step towards an efficient, reliable, and resilient power system.

The enabling research takes two forms:
- Creation of a simulation toolkit to conceptualise and design such a system at macroscopic and microscopic level
- Validation of the simulation tool kit in parts through practical implementation

The development of such a simulation tool kit that enables large scale true representation of the behaviour of a truly hybrid AC/DC system requires an investigation in a wide range of areas.

We are seeking researchers from Electrical Engineering, Mathematics, Physics, Computer Science, Computer engineering, Environmental science, and Engineering Mathematics to undertake the following research projects.

The projects are 3-6 months in duration, and we welcome domestic and international students to apply.

For more information, please email futurearchitecturenetwork@canterbury.ac.nz

Project 1: Mathematical techniques for modelling

Subject area:

Electrical Engineering, Mathematics, Physics

Topic:

Mathematical techniques or a combination of these that enable demonstration of study of time variant (slow small signal stability to very fast transients) and time invariant (steady state harmonic analysis, load flow etc.) phenomenon in a highly integrated hybrid electricity systems.

Project 2: Parallel processing

Subject area:

Mathematics, Computer Science, Computer engineering

Topic:

Techniques to speed up the complex simulations through parallel computing etc. Recognise the characteristics requirements of various subsystems and inter-dependencies to ensure that errors are not introduced in the results as the sub-systems will have mixed-time frame considerations.

Project 3: Finite Element modelling

Subject area:

Electrical Engineering, Physics, Mathematics

Topic:

Electric field, voltage distribution and partial discharge around transmission line insulators when exposed to alternating current (AC) and direct current (DC) fields
Preferable outcome – validation of the model against test results produced by final year students.

Project 4: Finite Element modelling

Subject area:

Electrical Engineering, Physics, Mathematics

Topic:

Behaviour of solid insulation (cables) in AC and DC applications. Effect of inherent impurities and air bubbles.
Preferable outcome – Validation of the model against test results produced by final year students.

Project 5: Life cycle analysis – inherent carbon footprint

Subject area:

Electrical Engineering, Environmental science

Topic:

Establish a database of carbon footprint (cradle to grave carbon emission) associated with key components associated with electricity system (generation, transmission, distribution and load) and assess the relative performance of AC and DC systems. Also establish the waste/saving of transition from AC to DC system. For this analysis select some template circuits within both the transmission and distribution network.