Architecture of the Future Low-Carbon, Resilient, Electrical Power System

Future Architecture of the Network (FAN) – Te Whatunga Hiko

Workstream 1 –Summer Project

Project title: Proof of Concept for Hybrid Electromagnetic Transient (EMT) Solver Using PSCAD/EMTDC Software

Relevant Workstream(s): WS 1

This project is offered to help in the ongoing research in the Future Architecture of Network (FAN) programme, where the benefit, design and analysis of DC electricity grids are explored. The FAN project is a 7-year, New Zealand wide research program led by the University of Canterbury. The project is broken into five workstream, where this summer student project is a part of Workstream 1, which is the development of fast and accurate numerical analysis tools to simulate large-scale hybrid AC/DC grids, such as for Power-Flow Analysis, Fault Analysis, Harmonic Analysis, Transient Stability, and Electromagnetic Transients. Also, WS1 proposes a future architecture of the hybrid AC/DC, which will be the focus of this project.

Project Description:

This project aims to develop a proof of concept for a hybrid electromagnetic transient (EMT) solver by combining the numerical integration substitution technique of PSCAD/EMTDC software with a user-defined model using the state variable technique. A dc-dc buck converter along with its simple open loop controller model will be developed for this purpose. The state variable approach will be implemented and integrated with PSCAD/EMTDC software for simulation. The expected outcome of this project is to achieve faster simulations while maintaining a high-fidelity model.

The successful candidate will gain experience in modelling power electronic converters and their controllers using PSCAD/EMTDC and MATLAB/Simulink software. They will also learn to create user-defined models in PSCAD/EMTDC using the state variable approach from MATLAB/Simulink. Developing high-fidelity power electronic converter models in PSCAD/EMTDC is a crucial skill needed in the modern power systems industry for effective system analysis.

Helpful Resources:

https://www.pscad.com/software/pscad/overview : PSCAD/EMTDC software documentation

https://au.mathworks.com/products/simulink.html : MATLAB/SIMULINK software documentation

Mohammad Zavahir, “Hybrid EMT solver” PhD thesis from University Canterbury.

https://resourcecenter.ieee-pes.org/education/webinars/pes_web_eremt_092023_sld : Event replication EMT simulation of high-fidelity power grid-PV plant models.

A. M. Gole and V. K. Sood, "A static compensator model for use with electromagnetic transients simulation programs," in *IEEE Transactions on Power Delivery*, vol. 5, no. 3, pp. 1398-1407, July 1990, doi: 10.1109/61.57982.

Specific requirements:

- BE(Hons) - Electrical and Electronic Engineering (EEE) student- Third (second Pro) or Fourth (Third Pro) year.
- Good knowledge of power system grids and power electronics.
- Some knowledge of voltage source converter control methods would be beneficial, but it is not required.
- Some familiarity with power system simulation tools like PSCAD/EMTDC and MATLAB/SIMULINK will very helpful.
- 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.

Potential Supervisor(s): Veerabrahmam Bathini, Josh Schipper, Neville Watson

Based in: University of Canterbury, EPECentre