

Master's Thesis Electrical Engineering at Energy Lab 2.0

Development of a Real-Time Electromagnetic Transients (EMT) Model of CERN Electrical Network

About Energy Lab:

In the search for new and advanced technologies for the energy transition, the Energy Lab 2.0 offers a Power Hardware-in-the-Loop environment, in which new developments can be tested under realistic conditions. These conditions need to be simulated by real-time digital simulator running sophisticated models of grids or power devices. You will be part of a team, developing and testing such models, especially concerning the investigation of power electronic devices in the modern power system. This job can pose challenges exploring uncharted waters, but also offer a great chance in gaining new insights into the world of electrical power systems and the research landscape in general.

Job Description:

The objective of this project is to enhance the existing real-time Electromagnetic Transients (EMT) model of the CERN electrical network developed in HYPERSIM. The work involves improving the accuracy, functionality, and computational performance of the existing model while ensuring its suitability for real-time simulation and advanced power system studies.

The responsibilities include reviewing and updating the existing network model, incorporating additional electrical components and parameters, and control systems where required, and validating the enhanced model against the reference DlgSILENT PowerFactory model under steady-state operating conditions, and the transient operating condition against the Phasor Measurement Unit (PMU) measured data. The project also involves performing fault analysis and dynamic simulations to evaluate the network response under various operating scenarios.

Furthermore, the work includes optimizing the EMT model for real-time execution, integrating measurement and monitoring functionalities such as PMU models were applicable, and documenting the modelling methodology, validation process, and simulation results. The enhanced model will provide a reliable platform for future studies involving power system operation, protection, control, and digital twin applications within the CERN electrical network.

Milestones:

- Analyzing the CERN electrical model developed in DlgSILENT PowerFactory
- Development of electromagnetic transients (EMT) model of CERN electrical network associated to LHC operation using a real-time HYPERSIM software
- Testing the developed EMT model for steady-state analysis against PowerFactory model as reference
- Testing the developed EMT model for Transient analysis against PMU measured data
- Converting the developed EMT model compatible to OPAL-RT real-time environment
- Analysis of real-time computational burden of the developed real-time EMT model

Your Profile:

- Basic knowledge of power systems, power-electronics, and control theory
- Basic experience with Matlab/Simulink
- Basic experience in EMT modelling
- Experience with DlgSILENT PowerFactory software, HYPERSIM Software and OPAL-RT real-time simulators are a plus
- Language: English or German

You will learn:

- Understanding about different EMT software
- Developing the EMT model for power system studies
- Conversion of EMT model compatible with the OPAL-RT real-time environment
- Simulating scenarios and analyzing data

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