RWTH AACHEN UNIVERSITY

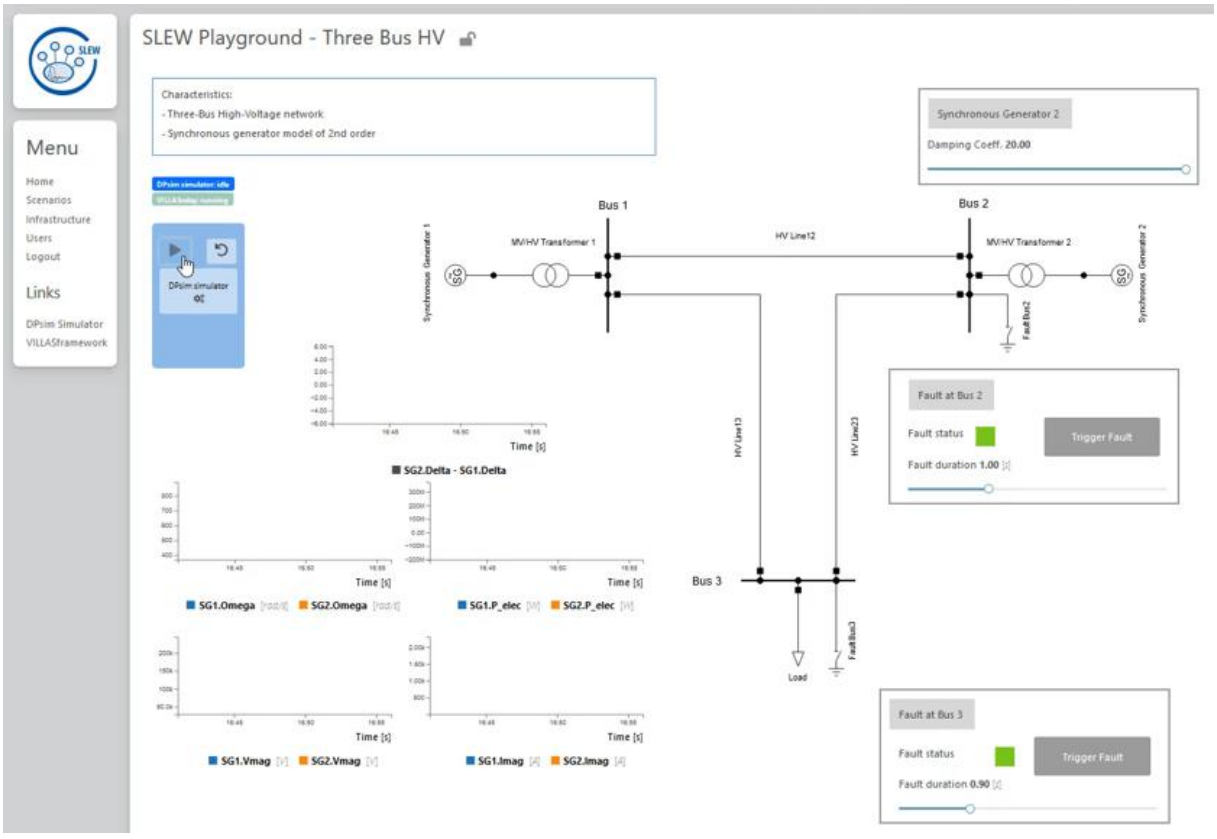
E.ON Energy Research Center
ACS | Institute for Automation of Complex Power Systems

HiWi Position:

Virtual Laboratory-as-a-service Based in Open-source Tools for the course "Measurement Techniques and Distributed Intelligence for Power Systems (MTDI)"

Context:

The preparation of course materials as virtual laboratories based on numerical simulators often require the user to configure and install a suitable environment and software packages that many times are not available without licensing issues, which in some cases represents a time-consuming task, resulting in a suboptimal approach for validating and demonstrating key concepts of the course. Furthermore, the process can decrease the motivation of students and make the assistants invest extra hours in documentation and support activities. For this reason, many educational resources are being increasingly offered as a service. In this case, the research institute hosts the infrastructure and students can access the resources directly via a web browser. This results in an almost instant interaction of the students with the relevant concepts and contents of the course, and a reduced time of the assistants for support activities



The main objective of this effort is to implement a virtual laboratory-as-a-service based in open source tools for the MTDI course, to illustrate and demonstrate the main concepts of the MTDI course such as measurement techniques and uncertainty, computation of PMU, state estimation of Power Systems and the IEC 61850 standard. This laboratory consists on a web platform featuring the real-time simulator of Power Systems DPsim, and the associated measurement emulation software modules. The platform comes with a predefined set of Jupyter Notebooks that could be integrated to the RWTH Jupyter Platform, with which the student can perform the numerical validation of measurement techniques in Power Systems. Furthermore, the student will be able to easily modify and configure the scenarios or implement his/her own test cases. Finally, the student will be able to use standard tools for data analysis and visualization in Python, such as Pandas and Matplotlib, or environments like JupyterLab

Tasks:
The scope of the thesis makes it suitable for a master thesis. The key aspects of this project are summarized into the following tasks:

- Choosing a benchmark scenario from the literature, which is relevant for illustrating aspects of the course regarding PMU estimation, measurement error, etc; and implement it in the DPsim simulator, if not already available, in a containerized manner
- Choosing a PMU emulator which implements the IEC 61850 protocol, and interconnecting it to the DPsim simulation, either as an additional software module, or as a software-in-the-loop component (interfaced via VILLASnode). In the second case, implement it in a containerized manner as well
- Implementing a set of Jupyter notebooks on top of this scenario, to demonstrate key concepts of the course such as: PMU estimation, measurement error, Least Squares state-estimation, the IEC 61850 protocol and packet loss in communication (using VILLASnode's network emulation)
- Implementing this virtual lab in Kubernetes, deploy it and make it available for the community

Your profile:

- Good knowledge of C++ and Python
- Experience in power system modeling is not necessary, but preferable
- Good knowledge of container orchestration tools, specifically Kubernetes, and REST API technologies
- A good level of English is required

If you are interested in the advertised position, please send your CV and current grades

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