Karlsruher Institut für Technologie

Master

Feb. 20, 2023

Stability Analysis of a multi-port Power Hardware in the Loop setup with Impedance-based modeling approach

Description:

The ever-increasing energy shift towards renewable-based power sources and new power technologies, along with their penetration into the grid, will require a comprehensive understanding of their behavior before implementing it into the main grid.

The Power-Hardware-In-Loop (PHIL) evaluation has gained more attention in the last years to validate new technologies in a low-risk and reliable environment. The PHIL testing allows the performance evaluation of the latest technology, known as Hardware under Test (HuT), while connected to a realistic simulated network in a Digital Real-Time Simulator (DRTS). To make this possible, a power interface, usually a power electronics-based amplifier, has to reproduce in hardware the simulated grid conditions of a particular grid point. In the experiment, the digital/analog nature of the actual PHIL setup introduces conversion delays on top of other non-idealities, such as limited amplifier bandwidth, noise injection, and measurement delays known as the cause of stability issues. For this reason, more efforts must be made in the stability evaluation of the PHIL setup while employing state-of-the-art power technologies such as grid converters in the HuT part. To provide a better insight into the expected content of the Master thesis project, requirements and expectations are listed in the following:

- Read the literature and summarize the state-of-art approaches, particularly for impedance-based modeling of P-HIL.
- Implement the multi-port PHIL model in a non-real-time simulation environment using MATLAB and MATLAB/Simulink.
- Implement the same model in a real-time simulation environment such as RT-LAB or RTDS.
- Validate the model with experimental results using data provided by an operation of the real converters.
- Make a clear and comprehensive presentation and evaluation of the results. All results should be documented adequately.

Qualification:

- A background in electrical/control engineering is required for this project.
- Experience in programming using MATLAB or simulations using MATLAB/Simulink.
- Knowledge about power electronics and linear control theory is a plus.
- Language: German/ English
- Due to the experimental nature of this work, attendance at our institute is required.

Starting date and duration of the contract:

Immediately after the agreement, short-term, six months

Contact person:

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