

Development of an analog power grid emulator

Graduate



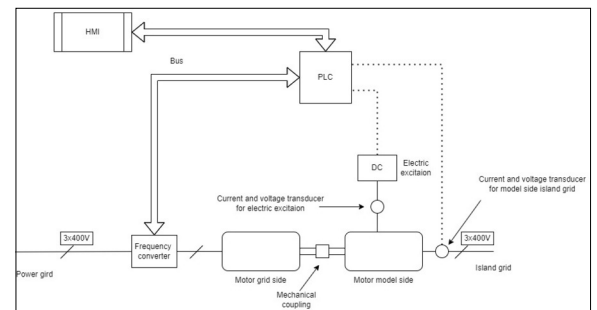
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Introduction: In the power grid of the future, renewable energy sources are a key player. Electrical power from sources as photovoltaic and wind turbines strongly depend on the weather conditions. They can cause fluctuations in the power grid that can lead in worst case to a black out of the grid. In this master thesis a physical emulator is built to emulate the power grid. The emulated 3-phase voltage is 400V and is therefore, 1000 times smaller then 400kV distribution grid. In a first step a concept is created for the emulator, where two electrical motors are mechanically coupled on their shafts. One of the two motors acts as a turbine and the second as a generator for the model grid in the emulator.

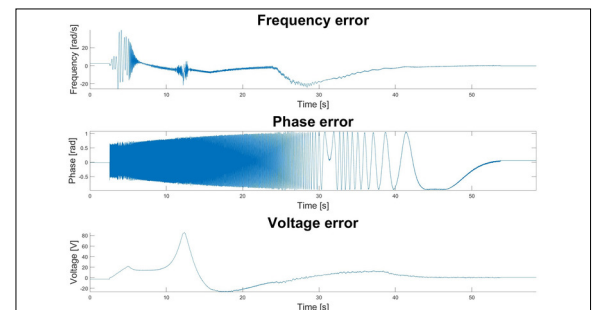
Approach / Technology: The control is designed and simulated in Matlab / Simulink. To govern the emulator, a PLC from B&R Automation is used. B&R Automation offers a compiler to generate program code from Simulink and run it on their PLCs. To control the equipment provided by B&R Automation, a variety of function blocks had to be implemented. Finally, the emulator is temporarily assembled and tested.

Result: The emulator works perfectly in speed control mode. Also automated synchronization of the generator to the external grid was achieved. Still some additional optimizations have to be done as when the emulator is synchronized and connected to an external grid, it starts to oscillate and trips after a short time. The exact root cause was identified but has to be fixed in further work. Since this application is not the typical use case of B&R Automation and the functionality of the different function blocks is not made for these cases, So the torque controller works against the external grid, causing the electrical current to oscillate.

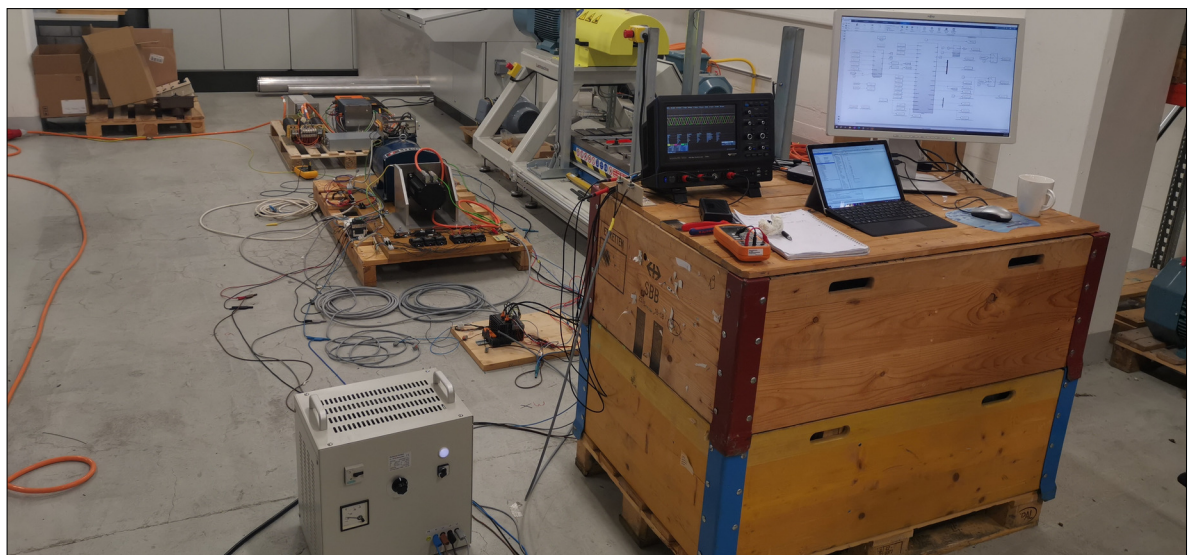
Overview diagram of the analog emulator
Own presentation



Error signals during synchronization
Own presentation



Temporary set up on wooden construction
Own presentation



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Subject Area

Electrical Engineering,
Energy and
Environment