MASTER THESIS @ ifa & NREL

NATIONAL RENEWABLE ENERGY LABORATORY

DECENTRALIZED SYNCHRONIZATION OF INVERTER BASED GRID

JOINT MASTER THESIS WITH THE NATIONAL RENEWABLE ENERGY LAB IN GOLDEN, CO, USA

DESCRIPTION:

All around the world we are witnessing an increasing penetration of renewable energy in the power grid. Traditional generators synchronize to the same frequency through the electromechanical coupling provided by the physics of the grid. Photovoltaic and wind generators are connected to the grid via power inverters that do not inherit these synchronizing properties.

Traditionally, power inverters are controlled to track the frequency of the grid and inject a predefined amount of power. This is only possible if there are enough synchronous generators that keep the grid running. The goal of this project is to study synchronization algorithms for a grid without synchronous generators. This is an ambitious task as the inverters must synchronize without communication and they can only rely on locally available information.

Using simplified inverter models, we have developed decentralized control algorithms that provably synchronize a power grid composed of 100% inverted connected generation. We are now seeking validation of our algorithms and we are in contact with the National Renewable Energy Lab (NREL) in Golden, CO, USA where they have extensive experimental facilities for inverted connected grids.

TASKS:

The Student will spend three months in Zurich under the supervision of Prof Florian Dörfler and three months in Golden, CO, USA under the supervision of Dr. Brian Johnson.

DURING THE FIRST THREE MONTHS IN ETH THE STUDENT WILL:

- Study and understand the control algorithms developed at IfA for synchronization of power inverters.
- Create realistic simulations using Matlab/Simulink to gain high-level understanding of the grid behavior under such control algorithms.
- Implement the control algorithms on the Simulink models provided by NREL.

DURING THE LAST THREE MONTHS AT NREL THE STUDENT WILL:

- Implement the controller in the laboratory facilities at NREL.
- Conduct experiments, collect and analyze experimental data.
- Write the master thesis.

WHO WE ARE LOOKING FOR

We are looking for a highly motivated student with good knowledge of linear algebra and control theory. Excellent Matlab/Simulink skills and good knowledge of power electronics are required.

ETH may contribute to the student travel expenses through a Travel Allowance.

CONTACTS

Marcello Colombino (mcolombi@control.ee.ethz.ch)
Dominic Gross (grodo@eeh.ee.ethz.ch)
Prof. Florian Dörfler (dorfler@control.ee.ethz.ch)
Brian Jonshon (brian.johnson@nrel.gov)