RWTH AACHEN UNIVERSITY

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

# Bachelor/Master Thesis Proposal:

## Interactions of Grid Forming Converters in Low-inertia Power Grids

**Context:**
The incessant increase of the number of converter-interfaced renewable generation jeopardizes the stability of future power systems and poses significant technical challenges in terms of synchronization, and voltage and frequency regulation. The so-called grid-forming control strategies for converters are needed to address these challenges and replicate synchronous generators functionalities. Different strategies are proposed in literature, namely: droop control, Virtual Synchronous Machine (VSM), and Virtual Oscillator Control (VOC).

The implementation of the VSM is based on the classical swing equation. By mimicking the synchronous generator, the VSM converter provides virtual inertia and participates in voltage and frequency control in addition to power sharing.

The VOC, on the other hand, is a new strategy based on emulating the dynamics of a nonlinear dead-zone oscillator. The VOC has appealing advantages on both the system-level and component-level. From the system-level perspective, the VOC, similar to the VSM, ensures synchronization of converters in an inter-connected electrical network without any communication. Hence, the voltage and frequency regulation objectives are achieved in a decentralized manner. At the component level, the VOC is able to rapidly stabilize arbitrary initial conditions and load transients to a stable limit cycle.

One of the open questions regarding the control and operation of future power systems, is how to properly coordinate the different converters including different control strategies to ensure the stability and reliability of the operation of the power system. Hence, interactions between different controllers need to be investigated.

**Your Tasks:**
- Literature review of different grid-forming converter control strategies.
- Implementation of the VOC and VSM control structures in Matlab/Simulink.
- Comparison of both control strategies in terms of performance and power system stability.
- Investigation of possible interactions between VOC and VSM converters.
- Propose/Implement remedial solutions in case of any resulting instabilities.

**Your Profile:**
- Student of Electrical Engineering at RWTH Aachen University
- Fundamental knowledge about power system dynamics and control.
- Matlab/Simulink is a prerequisite skill.

For further information, please contact:

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