RWTH AACHEN UNIVERSITY

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

Master Thesis Proposal

Voltage unbalance and harmonics compensation for virtual oscillator based converters in islanded microgrids

Context:

A microgrid is a controllable network that can effectively integrate any kind of distributed generations (DGs) as a utility-friendly customer. A typical microgrid usually consists of DGs like photovoltaic (PV) generation, wind generation, energy storage systems (ESS) like batteries, supercapacitors, fly wheel, and distributed (local) loads. Optimal utilization of microgrid will reduce the need of building new transmission and distribution systems, reduce power losses in transmission and distribution networks, increase power quality, and create new approaches for using renewable energy resources.

However, the incessant development and deployment of microgrids poses significant technical challenges in terms of system stability and synchronization, voltage and frequency regulation, and load power sharing. Moreover, there might be a large number of unbalanced and nonlinear loads in the microgrid which will decrease power quality and cause severe problems on system equipment. Existing control methods relying on communication links between converter controllers, such as Master-Slave and Centralized control, achieve good performance at the cost of intercommunication lines, but limiting system reliability, modularity and expandability.

Virtual Oscillator Control (VOC), on the other hand, is a new technique which provides a method to synchronize and control a system of parallel converters without communication, by emulating dynamics of a nonlinear dead-zone oscillator. VOC offers both system-level and component-level advantages. From system-level perspective, VOC ensures synchronization in connected electrical networks of inverters without any communication, voltage and frequency regulation objectives are verified in a decentralized fashion. At the component level, each converter with VOC is able to rapidly stabilize arbitrary initial conditions and load transients to a stable limit cycle.

Task:

In this context, the required task for a thesis will be:

- Implementation of VOC in Matlab/Simulink.
- Optimal design of additional controllers to support VOC in order to mitigate voltage unbalance and harmonics.
- Stability analysis of a system with multiple VOC-based converters.

The student will receive an introduction to VOC and related materials (including references, basic VOC model and proposed additional control methods) in order to quickly start with the required tasks. The details of the tasks and time plan will be discussed in the first meeting.

During the work, the student will be supervised and supported by research associates of the institute.

Your Profile:

- Good knowledge in power system dynamic and control
- Matlab/Simulink is prerequisite skill.

If you have any question or concern, please do not hesitate to contact me via email or in person.

Contact:

Tran, Trung
Tel. +49 241 80 49617
TTrung@eonerc.rwth-aachen.de

ACS | Institute for Automation of Complex Power Systems
ERC | E.ON Energy Research Center
RWTH Aachen University
Mathieustr. 30, 52074 Aachen, Germany

Raisz, David
Tel. +49 241 80 49730
draisz@eonerc.rwth-aachen.de

ACS | Institute for Automation of Complex Power Systems
ERC | E.ON Energy Research Center
RWTH Aachen University
Mathieustr. 30, 52074 Aachen, Germany