RWTH AACHEN UNIVERSITY

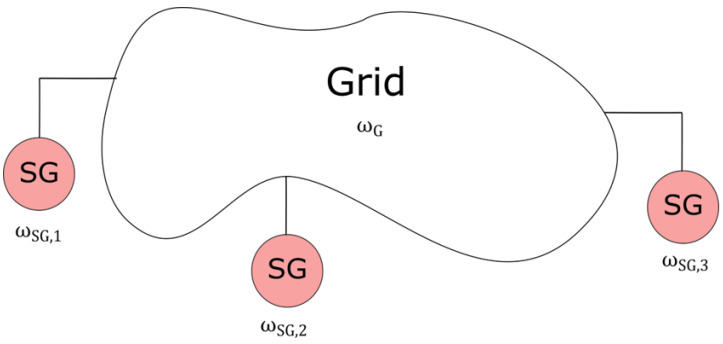
E.ON Energy Research Center
ACS | Institute for Automation of Complex Power Systems

Bachelor/Master Thesis:

Transient Stability Analysis of Modern Power Systems using Dynamic Phasors

Context:
The simulation of modern power systems requires the accurate representation of grid dynamics emerging due to additionally installed components such as distributed energy resources with low-inertia characteristics. Besides, large-scale simulations of scenarios with a high number of grid nodes allow to understand specific dynamic phenomena and to include as well lower voltage levels, but they are computationally more expensive.
To enable large-scale simulations with highest possible accuracy, the *Institute for Automation of Complex Power Systems* develops a power system simulator named *DPsim*. The power system simulator allows for conventional phasor simulations as well as for the application of a new simulation approach based on dynamic phasor models.

The analysis of the transient stability of power systems sets its focus on the simulation of electromechanical oscillations. For this, standard simulation tools perform a conventional phasor simulation using an estimated value for the grid frequency. However, this can be inappropriate for simulations of larger grids with local frequency variations as well as for low-inertia grids with higher frequency deviations.
This thesis targets an accuracy improvement of transient stability analysis for modern power systems using an alternative modeling approach. The application of dynamic phasor models shall enable a more accurate representation of grid dynamics with respect to conventional phasor models. A comparative assessment of the modeling approaches shall be outlined within the scope of this thesis considering suitable scenarios in modern power systems.



$$V_L = j\omega_G L I_L$$

vs.

$$V_L(t) = L\frac{dI_L(t)}{dt} + j\omega_G L I_L(t)$$

Task:
The scope of the thesis can be adapted to be suitable for bachelor or master thesis. The key elements of the work will be:

- Integration of a common frequency estimation technique into an existing simulator
- Adaption of grid component models for transient stability simulations
- Performing simulations in the presence of large disturbances
- Comparison of simulation results obtained with conventional phasor and dynamic phasor models

Basic knowledge of C++ is mandatory. Experience in power system modeling and simulation is desired.

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