Master Thesis

Modal identification in electrical power systems

Siemens Energy Grid Consulting

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Scenario

Interconnected power systems increase the reliability of power system significantly. In case of failure of any generating station, the grid will share the load of that generating plant. Despite this advantage, interconnections between systems still have some drawbacks. The fact that several generation and transmission devices with different dynamic characteristics are integrated into the same electrical system makes the modelling and operation of the system more complex, which directly affects the capacity to maintain the stability of the electrical system.

Thesis goal

The linearization of the full model of electrical power systems is a key limitation of developing a practical and a software-agnostic damping controller design and tuning. The goal of the Thesis is therefore to investigate and compare different Modal Identification techniques for the computation of equivalent linear power system models directly from time domain simulations, which are suitable for system modal analysis and control design.

More specifically, the goal is to identify the most adequate Modal Identification technique that can be applied on the simulation results obtained from the non-linear models of the power system, to derive the transfer functions and state space representations (linear models) of the power system, which retains the most relevant modes associated with inter area oscillations as well as the higher frequency torsional modes. In addition, the Thesis should identify which signals from the non-linear power system model is most suitable for obtaining the most accurate linear models from the time domain simulation, and which type of events is best to simulate for this purpose.

A Python based script/tool will be developed to calculate equivalent linear models from simulations performed with standard stability programs (e.g., PSSE, PowerFactory). The identification techniques to compare will be based on various algorithms (e.g., Prony's method, transfer function fitting, etc.). The equivalent system should retain the modal characteristics of the original system. The calculation of system modes, transfer functions, and state space representation to later enable studying modal interaction and designing Damping Controllers, like Power System Stabilizer (PSS) and Power Oscillation Damper (POD). The design and tuning of such controllers are not part of this Thesis.

Practical Info

1 or 2 Master students are researched.
The Master Thesis activity has a duration of 6 months, refunded by the company.
The students will work within the Grid Consulting team of Siemens Energy in Erlangen, Germany.
Ability in programming and process control, and interest in system identification and power systems are appreciated.
For further info, please contact Prof. Gabriele Pannocchia: gabriele.pannocchia@unipi.it