Compositional Verification of Power Systems

Background

Due to the increased feed-in of renewable energy into the power grid and the liberalization of the energy market, it becomes more difficult to guarantee stability of power systems. For this reason, new formal methodshave to be developed that can prove the stability of energy systems.

Description

Today, the predominant analysis technique for power systems are simulations of dynamical models. This technique has the disadvantage that only a single scenario can be analyzed at a time. However, initial states, parameters, and disturbance trajectories are uncertain so that an infinite number of possible system simulations exist. The set of all possible solutions can be bounded by reachability analysis. If the set of reachable states remains within allowed voltage and frequency bounds, the power system is formally verified. A challenge in reachability analysis is the improvement of the scalability towards industrially relevant problem sizes.

In order to improve the scalability, compositional techniques should be investigated in this thesis by applying techniques from assume guarantee reasoning. This approach defines contracts between subsystems, such that the full system is verified when all subsystems are verified, which is much easier to compute.

Tasks

- Modeling of the power system under investigation
- Simulation of the power system
- Partitioning of the power system into subsystems
- Reachability analysis of subsystems
- Application of assume guarantee reasoning to verify the full system

References
