Comparison between Lyapunov direct method and reachability analysis for transient stability analysis of power systems

Description

Numerical simulations and Lyapunov direct method are the dominant techniques for the analysis of power systems. In the recent years, reachability analysis has emerged as an alternative technique, making it possible to compute the set of all possible trajectories (infinitely many) of a dynamical system, when the uncertainty of initial states and time-varying inputs are unknown but bounded by sets. In contrast to numerical simulations and the direct method, reachability analysis can formally verify whether the systems constraints are met, such as e.g. line frequency and bus voltage remain within permitted ranges.

Tasks

In this thesis, the student is expected to

- Present a comparison between Lyapunov direct method and reachability analysis.
- Highlight the benefits of each technique considering transient stability analysis.
- Consider power systems modelled as a set of time-invariant, semi-explicit, nonlinear, index-1 differential algebraic equations (DAEs) without any modelling simplifications.
- Compute reachable sets of differential and algebraic variables using the Continuous Reachability Analyser (CORA) toolbox.
- Obtain the largest estimate of the Region of Attraction (ROA) by exploiting the Sum of Square (SOS) programming.

References


