

## Computation of Large-Scale Power System Transients with Renewable Energy Sources

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### **Abstract**

This presentation is on numerical methods for the computation and analysis of large-scale power system transients. A unified approach is presented for simulating both fast and slow transients from load-flow initialization. Various challenges for fast and accurate computations are discussed.

Fast circuit-based problem formulation allows to perform accurate computations for fast electromagnetic transients (EMTs) and slower electromechanical transients using a single computational kernel. Wind turbine and other renewable energy source models can be implemented for studying a wide range of power system phenomena. The accurate representation of inverter-based resource control systems allows searching for unstable operating conditions. It is possible to test detailed manufacturer models under different network contingencies.

There are several important challenges. The challenges include data management through advanced graphical user interfaces, fast initialization of inverter-based resources from unbalanced load-flow solution, integration and testing of renewable energy source models, parallelization of computational tasks, and visualization of results. Other aspects, such as frequency domain analysis techniques using time-domain solutions are discussed.