PMU Enhanced Power System Operations

Overview and Problem Statement

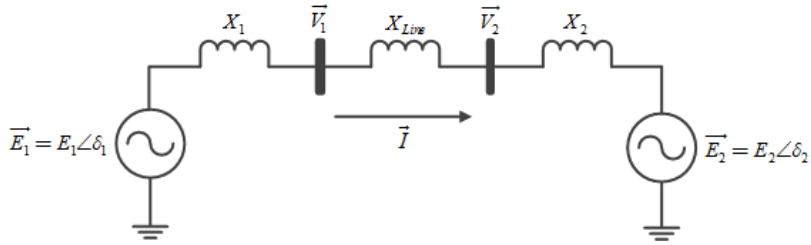
This project is exploring the direct application of Phasor Measurement Unit (PMU) data to improve situational awareness. PMUs are beginning to be widely deployed in electric power systems, and this trend is expected to continue. However, even with that increase in the number of installations, PMUs are still deployed at only a small percentage of system buses. That presents a challenge: how to get useful information from a small number of data points. The motivation for this application arises from the fact that the time-synchronized PMU data allow the creation of dynamic snapshots of the system, and those can be used to update system models and provide online decision support to the system operator. In other words, the transmission line and simple machine parameters can be estimated from the PMU data with high time resolution, and system event identification can then be presented from the estimated parameters. In addition, this project is developing a new reduced model approach to decrease computational complexity in power system transient simulation. The project is investigating conditions that make fast modes active or inactive.

Research Objectives

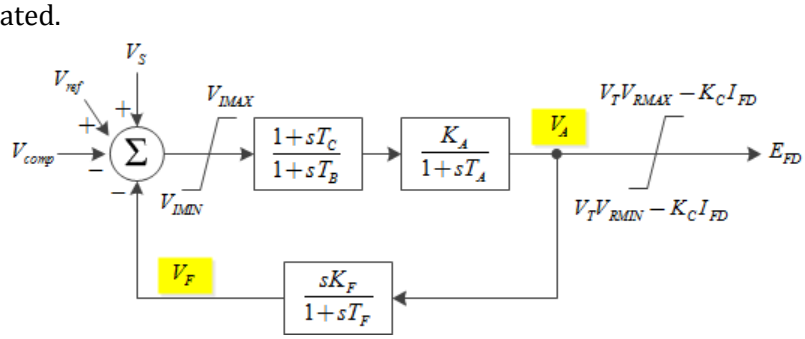
- Develop a framework to allow PMU measurements to create the equivalent system model.
- Develop an algorithm and systematic way to derive system parameters from PMU data.
- Develop online event detection method with PMU data.
- Achieve faster power system analysis.

Technical Description and Solution Approach

- In the first step of this project, we are creating an equivalent system model and deriving the system parameters using PMU data. The Thevenin-equivalent circuit with a classical machine model makes an analysis of a complicated power system simple. A sudden change of the derived system parameters can be interpreted as the system event.



- Regarding the fast transient simulation work, modes in the original system in which fast dynamics do not appear can be neglected, allowing simulation steps to be increased without numerical stability issues. During a transient simulation, the proposed method switches dynamically between the original system model and the reduced model, depending on the switching criterion. For this work, exciter model reduction has been investigated.



Results and Benefits

- Matlab code to derive the equivalent system using PMU data has been implemented.
- A key benefit will be an algorithm that can accommodate PMU values for improved situational awareness. The use of an equivalent system allows system operators to detect a system event. That will have positive benefits in operations, since the algorithms could be used in real-time without any system model information.
- Exciter model complexity reduction is being completed for faster transient simulation, and case studies are validating the proposed reduction work. This is an advanced dynamic simulation approach that provides a fast solution without sacrificing simulation accuracy. It will enable operators to quickly assess a system's dynamic security.
- **Technology Readiness Level:** The faster simulation method can be directly applied to commercial power system simulation tools.

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