Waveform Tracking Monitor for Next Generation of Power System Operation

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Abstract

The advent of power markets makes the power system to operate close to its security boundary. The frequent occurrence of blackouts in power systems in North America and other countries draws the attention of the world to the vulnerability of power systems. Many major blackouts caused by power system instability have illustrated the importance of secure power system operation. Different forms of system instability have emerged as power systems have evolved through continuing growth in interconnections, use of new technologies and controls, and the increased operation in highly stressed conditions. For example, voltage stability, frequency stability and inter-area oscillations have become greater concerns than in the past. Preventing these instabilities by appropriate control methods becomes critical for secure power system operation.

Automatic post-contingency control has so far not been thoroughly studied in power systems, due to the slow responses of the existing steady-state monitoring and the complex and interacting causes which may drive power systems to cascading failures. Synchronized phase measurements by Phasor Measurement Units (PMU) provide a fast and accurate monitoring of faulted power systems. However, the errors which may be introduced by the communication channels and SCADA system keep us from directly using PMU measurements for the design of post-contingency control. A waveform tracking monitor, recently developed by the speaker, provides a robust, reliable and fast way to monitor power systems continuously even under disturbances.

This presentation will introduce the newly developed real-time monitor for power system operation. This monitor is designed to track the waveforms of signals of interest during power system operations, including the transients caused by load changes or faults. State estimation techniques are used to detect sampling errors in order to best track the trajectory of the original signal waveforms. Our previously proposed algorithms are then used to perform an observability analysis for a given set of measurements. A new measurement equation is introduced to detect bad data processing. Numerical results illustrate the effectiveness of the proposed tracking monitor.

Speaker's biography

Bei Gou worked as a senior analyst at the Independent System Operator – New England (ISO-NE) from 2002 to 2003. Dr. Gou was a power application engineer with ABB System Control at Santa Clara, CA from 2000 to 2002. From 1997 to 2000, Bei Gou was a research assistant at Texas A&M University, where he has developed new methodologies in state estimation observability analysis, harmonics state estimation, optimal capacitor placement and fault analysis by Prony method, and developed a tracking state estimator for power systems. Dr. Gou joined the faculty of the department of Electrical Engineering at UT Arlington in 2003. His current research areas include power system real time monitoring, nonlinear control and interface design of fuel cells, blackout and cascading failures, Phasor Measurements and state estimation, pricing theory for power markets, power system reliability, and globally optimal capacitor placement. Dr. Gou has published more than 50 journal and conference papers. Dr. Gou is Member of IEEE Power Engineering Society (PES), IEEE Power Electronics Society (PE), IEEE Circuits and Systems Society (CAS), Society of Industrial and Applied Mathematics (SIAM) and The U.S. National Committee of CIGRE.