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Real-Time Stability Monitoring Using Synchrophasors

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Abstract

Synchrophasor measurements are being implemented in power systems all over the world in great numbers, and there is an urgent need for algorithms that can process a large number of these signals towards extracting useful system information. Our research at WSU is focused on developing fast algorithms for real-time stability monitoring of the power grid using a large number of PMU signals. Three classes of algorithms have been developed for monitoring of 1) oscillatory stability, 2) voltage stability, and 3) angle stability, respectively. As an example, Fast Frequency Domain Decomposition (FFDD) [1] has been developed for oscillation monitoring using PMUs by the WSU team in recent years. FFDD carries out real-time ambient modal analysis of large-scale power system. Specifically FDD detects the presence of any poorly damped modes and/or oscillations by estimating their mode frequencies, damping levels, and mode shapes simultaneously. FFDD has been implemented in several utilities in North America and has proved successful in detecting and analyzing problematic oscillations in the grid. FFDD can analyze 1000+ PMU signals simultaneously in real-time moving window analysis of one minute analysis window with 10 second refresh rate. For voltage stability, WSU team has developed a measurement based approach for estimating line Q-V sensitivities directly from ambient PMU data. For angle stability, we have implemented fast algorithms for real-time detection of islanding and angle instability events.

[1] H. Khalilinia, L. Zhang, and V. Venkatasubramanian, "Fast frequency domain decomposition for ambient oscillation monitoring", IEEE PES Letters, to appear.