



TIP 299: Synchrophasor Linear State Estimator and PMU Data Validation & Calibration

Context

One of the major challenges for real-time operations is having a comprehensive, trustworthy snapshot of the power system. Many utilities deploy SCADA state estimators to capture an unsynchronized, validated view of the system state (complex voltage magnitude and phase angle) and rely heavily on these tools.

In 2003, failures of the Midwest ISO (MISO) state estimator and their lack of situational awareness was one of the major drivers contributing to the blackout of the Northeast US and Canada. US DOE published an estimated cost of this blackout to be about \$6 billion.

Any improvement to conventional measurement and monitoring of the system state reduces the probability and risk of low-probability, high-consequence events.

Currently, BPA does not use its state estimator for real-time situational intelligence because of data quality challenges. Instead, BPA uses pre-studied operating boundaries and abides by these in real-time. This leaves the operators fairly blind to changing conditions, especially immediately following contingencies on the system.

Description

This project will research and develop approaches for data mining and data validation using synchrophasors through two methods: PMU-based Linear State Estimator (LSE) and formal data mining tools. The LSE is an advanced PMU application that builds off traditional state estimation techniques to estimate system state but also validate incoming measurements, calibrate the measurements, and predict the next measurement through filtering. Using the LSE as a front-end application will enhance the robustness of the synchrophasor network as BPA moves towards utilizing high-resolution, synchronized measurements in control and operation of the power grid.

The PMU LSE will be developed in the Synchrophasor Labs for this project, with progression plans developed for real-time implementation for operator applications.

In addition, this project will develop a panel to assess BPA needs for data mining. The broad range of data mining applications makes this a necessary step. Based on data mining requirements, BPA will develop data mining applications for implementation in the Synchrophasor lab.

Why It Matters

The existing synchrophasor network currently does not use the wide-area, time-synchronized perspective of PMUs to detect bad data. Therefore, “bad” data may enter the real-time synchrophasor applications as “good”.

The methods that will be explored, implemented, and deployed through this project mitigate the risk of this data entering both online and offline tools. The need for this project is driven by the lack of data quality monitoring tools applied to both real-time and historical data. Advancements of synchrophasor technology at BPA makes it possible to address this problem at this time.

State estimators are effective and proven tools used for accumulating large quantities of data and providing an indication of system conditions. This project moves BPA towards a more accurate, more robust, and more trustworthy state estimate from the PMU architecture.

Goals and Objectives

The goal of this project is to explore, develop, and implement PMU data quality applications via two integrated yet independent focuses to provide a breadth of advancement as well as parallel tracks for development and analysis.

The objective is to 1) provide a more robust PMU measurement set to the applications utilizing the information downstream, and 2) develop tools that can help inform decision makers on phenomena causing specific operating conditions to occur.

Deliverables

Progress report on preliminary development and implementation of the PMU Linear State Estimator.

Scoping Document for BPA requirements for data mining applications for either conventional SCADA or PMU measurements.

Detailed progress report on development and implementation of data mining applications in both pseudo-real time and online versions.

Detailed progress report for BPA Event Detection Algorithm updates, improvements, modifications, validation, and tuning. Implemented data mining applications, including all source code and logic.

TIP 299: Synchrophasor Linear State Estimator and PMU Data Validation & Calibration

Project Start Date: October 1, 2013

Project End Date: September 30, 2016

Funding

Total Project Cost: \$440,000

BPA FY2015 Budget: \$70,000

Reports & References (Optional)

Links (Optional)

For More Information Contact:

BPA Project Manager:

Tony Faris, ajfaris@bpa.gov

Participating Organizations

Virginia Tech

Dominion Virginia Power

Grid Protection Alliance: openPDC

