TIP 352: Development and Demonstration of a Phasor-Driven Tool for Adaptive Stability Model Calibration using GE PSLF

Context

Many mathematical models developed to simulate power plant models have been found to be problematic when their results are compared against measured data from phasor measurement units (PMU) and digital fault recorders (DFR). The Bonneville Power Administration (BPA) is concerned when information from these models is used to make planning and operational decisions. Similar concerns are observed elsewhere.

WECC has dedicated significant efforts to model validation through its Modeling and Validation Working Group (MVWG). While these efforts have greatly advanced the model validation and calibration practices, several obstacles still exist, including 1) identification of problematic parameter(s); and 2) baseline testing for generators requiring a disruption of their service.

Model validation and calibration has been identified as one of the most wanted phasor applications in several recent meetings of the North American SynchroPhasor Initiative (NASPI) working group.

Description

This project aims to develop a prototype tool for generator model validation using Alstom Grid's E-terra Phasor Analytics platform and parameter calibration using GE's Positive Sequence Load Flow software. (GE PSLF)

The tool will have the following features and advantages over existing techniques:

1) Identification of system event information from PMU data in an automated way

2) Calibration of model parameters through an on-demand process

3) Validation of models in an automated/periodic way

4) Leveraging the suite of standard dynamic models library in GE PSLF to eliminate the need for developing hundreds of models from scratch

5) Optimally calibrating model parameters while considering measurement noises and

model uncertainties

6) Possesses the flexibility of extending to system-level, simultaneous model validation and calibration for multiple generators

7) Report generation to quantify model quality and summarize calibration results.

Four major tasks will be undertaken to design and develop the prototype tool:

Task 1–Development of E-terra Phasor Analytics platform for event and phasor data retrieval, and creating equivalent systems for model validation: An innovative phasor data analytics platform will be developed on top of Alstom's commercial tool, which can read in historical PMU data stream, import system model and parameter files, and export the full topology model representing the operating condition before the detected event.

Task 2–Improvement of Kalman Filter-based algorithms for stability model calibration under different test scenarios: Enhance the Kalman filter-based methodology developed at PNNL for generator model calibration once model deficiencies are identified.

Task 3–Integration of the model validation and parameter calibration tool in Phasor Analytics and GE PSLF: Integrate the main pieces developed in Task 1 and Task 2 into the e- terraphasoranalytics platform, and focus on developing the remaining features for automatic model validation and on-demand parameter calibration.

Task 4–Demonstration and Evaluation

Why It Matters

This tool can complement or even eliminate power plant baseline tests saving significant costs associated with generator staged testing.

It will enhance the quality of BPA's power system models for planning and operational studies.

Better models can yield more realistic study results. As a consequence, it can help obtain realistic transmission line limits, when using real-time cases for studies.

Goals and Objectives

The objective is to develop an improved phasor platform that implements innovative methodologies and the corresponding tools for stability model validation and on-demand parameter calibration. The methodology will enhance the previously proposed Kalman filter method for scenarios like wind farm model calibration or remote installation of PMU devices and significantly speed up the process of model validation.

Deliverables

During the course of the project deliverables will include:

A detailed project progress report including: a) the design of the prototype tool; b) performance of model validation module; c) functionality of APIs developed

A presentation to demonstrate the performance of parameter calibration algorithms.

A demonstration of the parameter calibration method linking to the stability model library in GE PSLF software.

A demo of the integrated software prototype that connects all pieces together for model validation and parameter calibration.

Final Deliverables:

1) A project report on the overall project outcomes
2) A prototype of the model validation tool

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Project Start Date: October 1, 2015

Project End Date: September 30, 2017

Funding

Total Project Cost:	$2,000,000
BPA Share:	$1,000,000
BPA FY2015 Budget:	$ 500,000

Reports & References

Links

Participating Organizations

Pacific Northwest National Laboratory (PNNL)
Alstom Grid
General Electric Energy Consulting
Peak Reliability Coordinator (PEAK RC)

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