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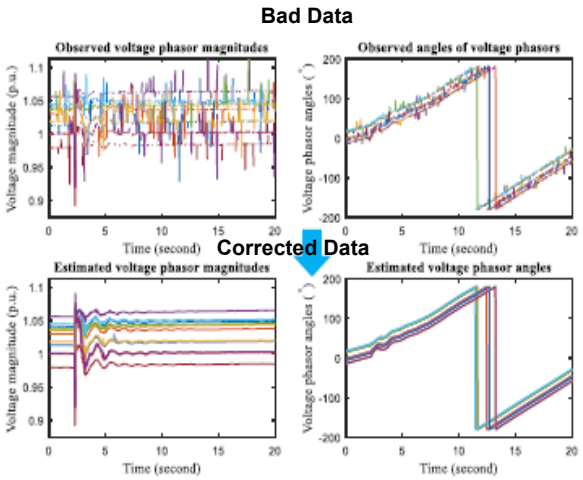
Streaming Synchrophasor Data Quality Conditioning



Project Highlights

- Improve streaming synchrophasor data quality with:
  - Accurate estimation and replacement of missing synchrophasor data; and
  - Detection, removal, and substitution of incorrect/bad synchrophasor data.
- Conditioning of synchrophasor data in near real-time for performance and accuracy improvement of real-time synchrophasor applications.

Background, Objectives, and New Learnings

Power system measurement data are used to monitor, operate, and analyze the power system, and should be accurate and reliably available. With the increasing deployment of Phasor Measurement Units (PMUs), that provide high-resolution synchronized measurements, synchrophasor data quality issues are common and pose considerable challenges to effective use. Issues may arise from missing or lost data, due to occasional communication delays, or data received may be erroneous due to time inaccuracies from intermittent loss of GPS signal or PMU hardware errors. In some cases, data quality flags are available for bad data, but not always. In either case, the data would be problematic for the end use applications. High data quality is essential for robust and accurate synchrophasor applications.

To address data quality issues within PMU data, EPRI has developed a method, and associated software tools, called Streaming Synchrophasor Data Quality (SSDQ), for detecting missing and/or bad data in synchrophasor data streams and replacing those with very accurate estimated values. The developed method does not require power system models (topology, impedances etc.) or full system observability. The algorithm creates spatial-temporal blocks of streaming data from electrically close areas and uses low-rank properties of the constructed data to detect inaccurate and missing data and estimate correct values. The software reliably identifies bad measurements, effectively corrects them, and fills in missing data entries with high accuracy estimates. The approach also reliably distinguishes disturbance events within the data streams and does not misidentify event data as bad data.

There are two software implementations of the SSDQ algorithms. One version is designed for off-line analysis using archived synchrophasor data. The other version is targeted for on-line application using streaming synchrophasor data and has been implemented on OpenPDC and OpenECA[1] software platforms.

The objective of this project is to apply EPRI's SSDQ software tools on the project participant's synchrophasor data streams and evaluate the effectiveness and accuracy of data conditioning and data quality improvement for both off-line and on-line applications.

Benefits

EPRI expects that this supplemental project will provide the foundation for operational use of real-time applications using synchrophasor data. It is expected to improve robustness and accuracy of synchrophasor applications and improve confidence of system operations personnel.

[1] Grid Protection Alliance (GPA)

In addition, many data mining methods use large amounts of archived synchrophasor data. Such data processed with SSDQ to remove bad data and fill in missing data, will improve accuracy of the inferences derived from data mining analysis.

Project Approach

The project scope consists of two tasks.

Task 1: SSDQ Off-Line Implementation

Under this task, the off-line version of the SSDQ tool will be applied using recorded synchrophasor datasets provided by the project participants. Depending on the number and location of the PMUs and the corresponding measurement channels, the measurement datasets may be separated into groups for execution of the tool. Analysis will be performed to optimize the grouping for the system. The performance of the method/tool for identifying and correcting missing and bad data will then be evaluated.

Task 2: SSDQ On-line Implementation and Demonstration

Under this task, the on-line version of the SSDQ tool will be applied using streaming synchrophasor data from the project participant's PMU system. First, the EPRI project team will provide remote assistance to the participating member to install the tool and link it with the participant's phasor data concentrator (PDC) to input PMU streaming data. Once installed, EPRI will provide remote assistance for tool configuration, based on the analysis performed in Task 1. Once operational, SSDQ will be set up to run for a prolonged period of time to record the streaming inputs/outputs for off-line analysis and performance evaluation. The tool may be updated during the project to resolve any issues. Customized output analytics, reports, and graphical user interface updates may also be designed, depending on feedback from the participating member.

Deliverables

- Technical report summarizing results of the analysis performed to demonstrate SSDQ effectiveness using archived data provided by the participating member.
- Workshop/demonstration meeting presenting SSDQ implemented in on-line test environment.

The non-proprietary results of this work will be incorporated into EPRI's Transmission Operations R&D program and made available to the public for purchase or otherwise.

Price of the Project

The cost of participation is $65,000.

This project qualifies for tailored collaboration (TC) or self-directed funding (SDF). There is no minimum number of funders required to start the project.

Project Status and Schedule

The project duration is six months from the start date.

Who Should Join

Utilities and/or system operators using or planning to use synchrophasor applications and experiencing or expecting to experience synchrophasor data quality issues.

Contact Information

For more information, contact the EPRI Customer Assistance Center at 800.313.3774 (askepri@epri.com).

Technical Contact

Evangelos Farantatos at 650.855.2214 (efarantatos@epri.com)

Member Support Contacts

Todd Myers at 972-556-6515 (tmyers@epri.com)
Brian Long at 704.595.2875 (blong@epri.com)
Richard Menar at 650.855.8707 (rmenar@epri.com)

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Electric Power Research Institute
3420 Hillview Avenue, Palo Alto, California 94304-1338 • PO Box 10412, Palo Alto, California 94303-0813 USA
800.313.3774 • 650.855.2121 • askepri@epri.com • www.epri.com