U.S. DEPARTMENT OF ENERGY
Office of Electricity

# Transmission Research Program: FOA 1861 - Big Data Analysis of Synchrophasor Data

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# Power System Sensing, Data Processing, Analysis, and Visualization

Program goals and activities

- Advancing control room software and visualizations
- Fully capturing new system dynamics through data analysis
- Guides and tools for the best use of different data sources
- Building partnerships for data sharing
- Developing research datasets using real world and synthetic data

Website for more information:

Power System Sensing, Data Processing, Analysis, and Visualization | Department of Energy

- **https://www.energy.gov/oe/power-system-sensing-data-processing-analysis-and-visualization**

# FOA 1861 and the National PMU Data set

FOA 1861: Big Data Analysis of Synchrophasor Data

- Derive additional value from the vast amounts of sensor data already being generated
- Provide actionable information on the use of Machine Learning and Artificial Intelligence methods on large PMU data sets
- Enable faster grid analytics and modeling and better grid asset management though new tools

First-of-its-kind PMU dataset that:

- Covers each of the three U.S. interconnections;
- Covers multiple years and includes event logs;
- Is real data including inconsistencies, varying quality levels, and flaws;
- Is anonymized to protect the data providers

Efforts are underway to further improve this dataset not only with additional data, but with more and higher quality labels as well.

# FOA 1861 Awards

| Performer | Team Members | |
|---|---|---|
| **Iowa State** | **Electric Power Group (EPG), Google Brain, IBM** | **Robust Learning of Dynamic Interactions for Enhancing Power System Resilience** |
| SEL | Oregon State University | Machine Learning Guided Operational Intelligence from Synchrophasors |
| **University of California Riverside** | **EPG, Michigan Technological University** | **Discovery of Signatures, Anomalies, and Precursors in Synchrophasor Data with Matrix Profile and Deep Recurrent Neural Networks** |
| University of Nevada, Reno | Arizona State University (ASU), IBM, Virginia Tech | Robust Event Diagnostics Platform: Integrating Tensor Analytics and Machine Learning Into Real-time Grid Monitoring |
| GE | GE Grid Solutions | PMU-Based Data Analytics using Digital Twin and PhasorAnalytics Software |
| Siemens | Southern Methodist University, Temple University | MindSynchro |
| Ping Things | NA | Combinatorial Evaluation of Physical Feature Engineering and Deep Temporal Modeling for Synchrophasor Data at Scale |
| **Texas A&M** | **Temple University, Quanta Technology** | **Big Data Synchrophasor Monitoring and Analytics for Resiliency Tracking (BDSMART)** |

**Bolded projects will be providing final presentations today**

# Big Data Analysis of Synchrophasor Data

Final reports from each project

- Summarize patters, insights, event signatures, data quality, analytical tools
- How electric industry can leverage results, and future research recommendations.

DOE Website for Reports and Information

https://www.energy.gov/oe/big-data-synchrophasor-analysis

- List of Awardees
- Final reports (as they are completed)
- Related Publications and Presentations

# Meta-Analysis and Event Log updates

## PNNL's summary of FOA 1861 awardee accomplishments

- Explain how analysis pipelines that incorporate new algorithms are ready to benefit industry
- Compile signatures for various grid disturbances
- Summarize challenges with the quality of measurements and event logs to help utilities prepare for AI/ML applications
- To be presented at the fall NASPI meeting and released as a public report

## Updating event logs for future use of the National PMU dataset

- Awardee accomplishments
  - Detected thousands of unlisted events
  - Determined more precise event timing
  - Identified erroneous entries
- Several awardees submitted their results to PNNL for incorporation into updated event logs
- These event logs will support additional research based on the FOA 1861 dataset

# Questions

Thank you.