EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Summary of EPRI Synchrophasor Related Activities

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San Diego, CA
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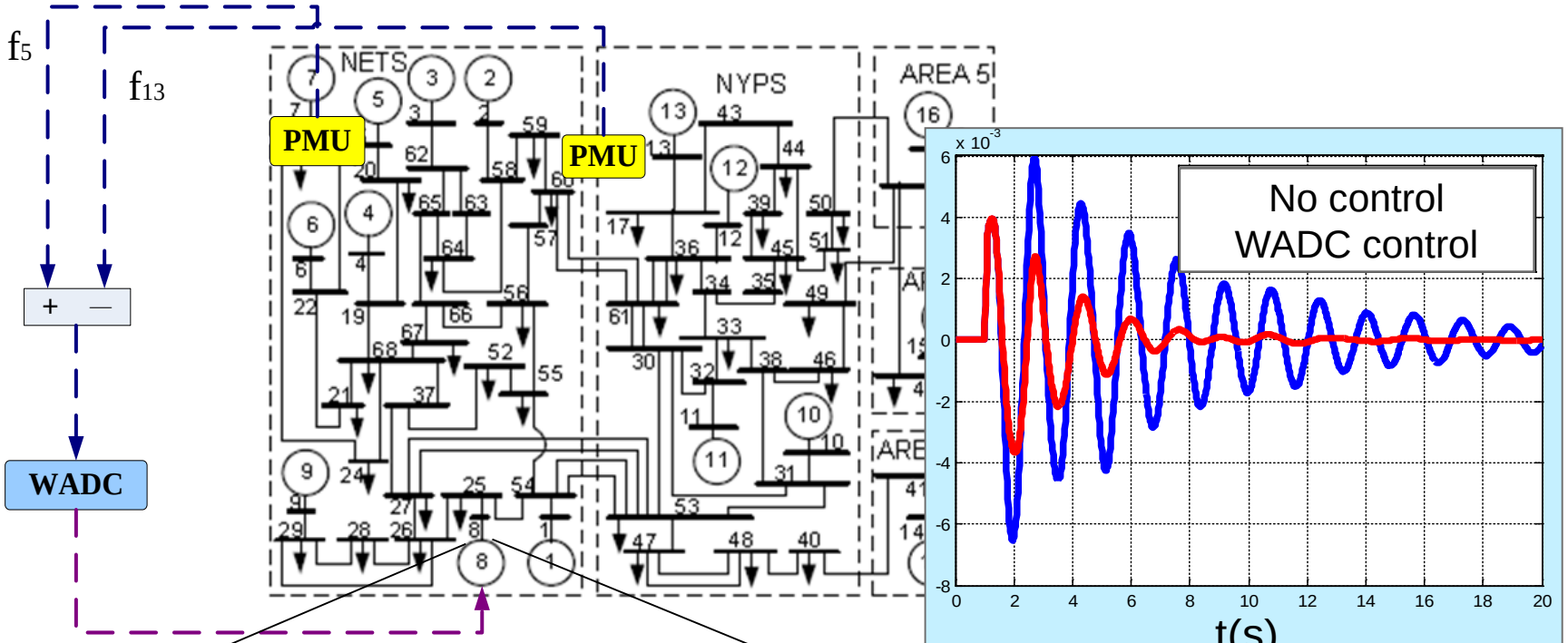
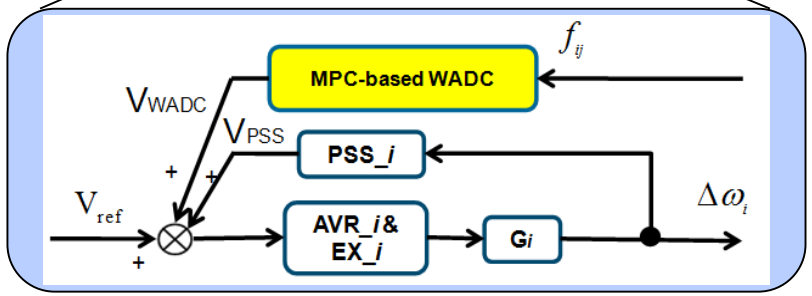
1. Synchrophasor-Based Wide Area Oscillations Damping Controller





In collaboration with University Tennessee Knoxville (UTK)

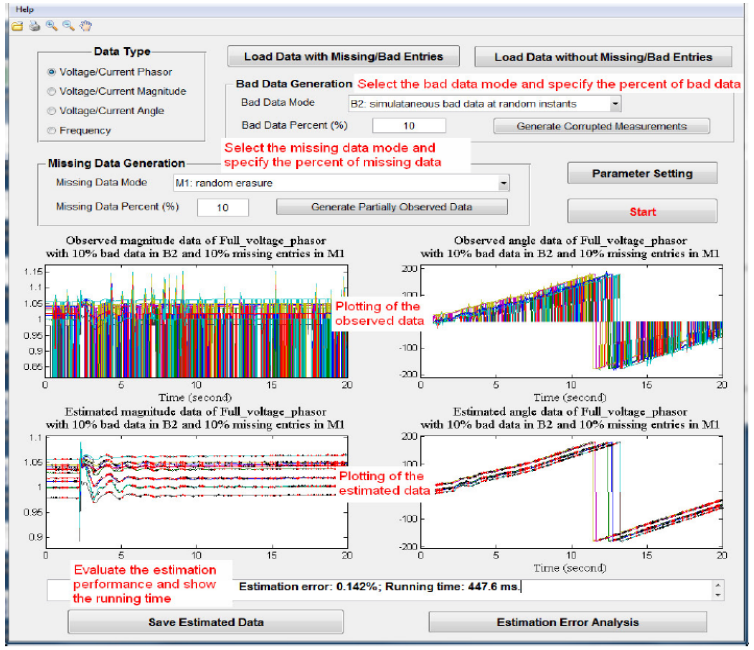
- WADC via additional input to generator excitation system or FACTS/HVDC controller
- Adaptive controller
  - Measurement-derived transfer function model
- Ongoing case studies with NYPA, TERNA (Italy) & SEC (Saudi Arabia)
- Next: Hardware-In-the-Loop (RTDS/Opal-RT) implementation and demos

• Improved Damping of Target Inter-area/Intra-area Oscillations Mode
• Application of Synchrophasor Technology in Closed Loop Wide Area Control

2. Data Quality Conditioning of Streaming Synchrophasor Data

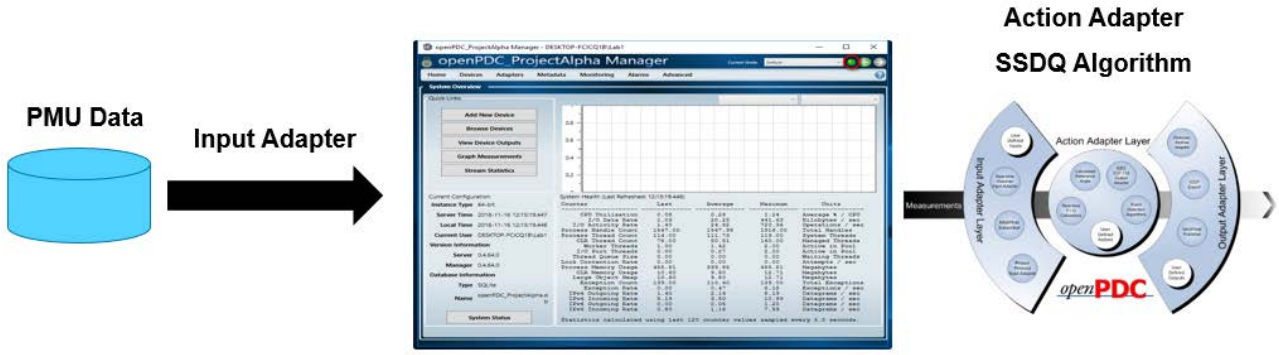
- Goal: Improve synchrophasor data quality by estimating missing data and replacing bad data in synchrophasor streams
- Model free technique, no need for topology information or system parameters
- Computationally efficient for real-time implementation
- Algorithms have been tested with recorded synchrophasor data provided by EPRI members
- Ongoing: Demos with streaming synchrophasor data hosted by utilities/ISOs
- Next: Collaboration with vendors for implementation in commercial platforms

Offline SSDQ Tool



In collaboration with RPI

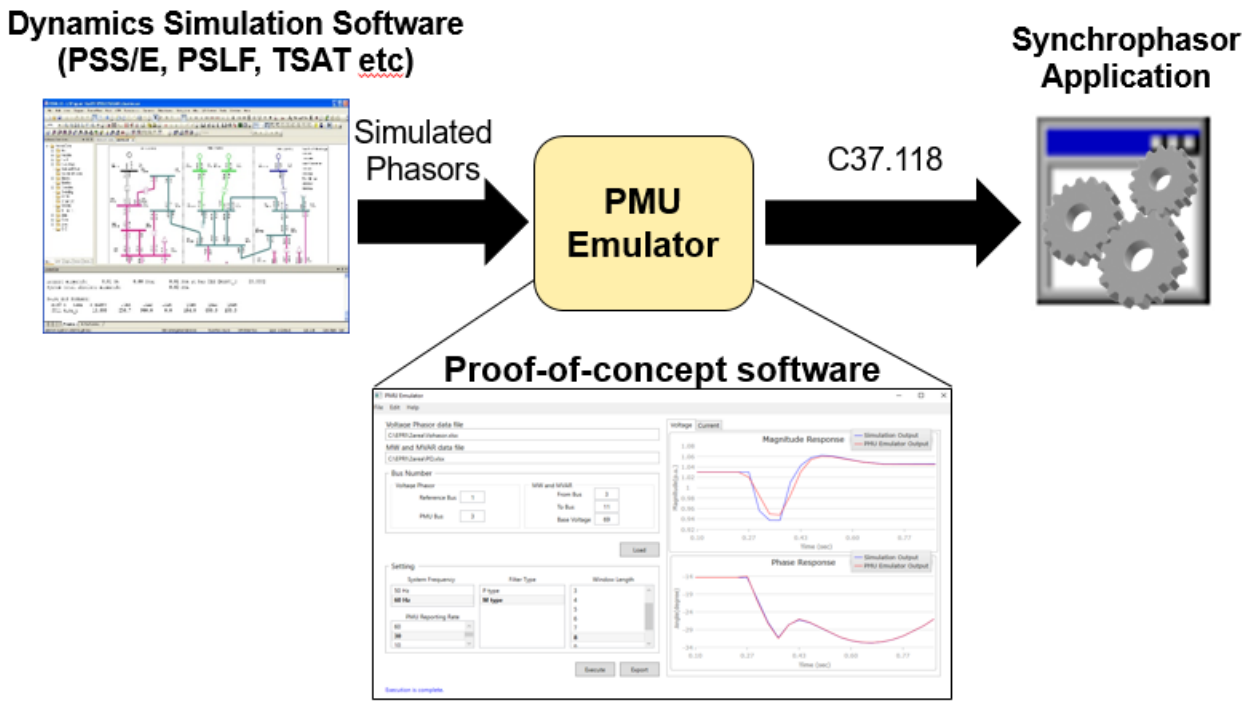
Online SSDQ Tool



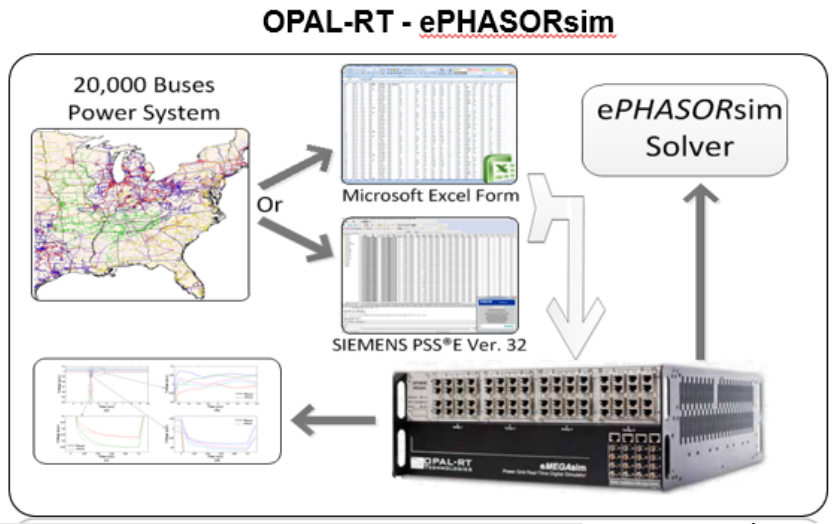
3. PMU Emulator

- Interfaced with power system dynamics simulators to produce “simulated synchrophasors” taking into account PMUs internal signal processing
- Ongoing: Collaboration with vendors for implementation in commercial platforms

In collaboration with WSU



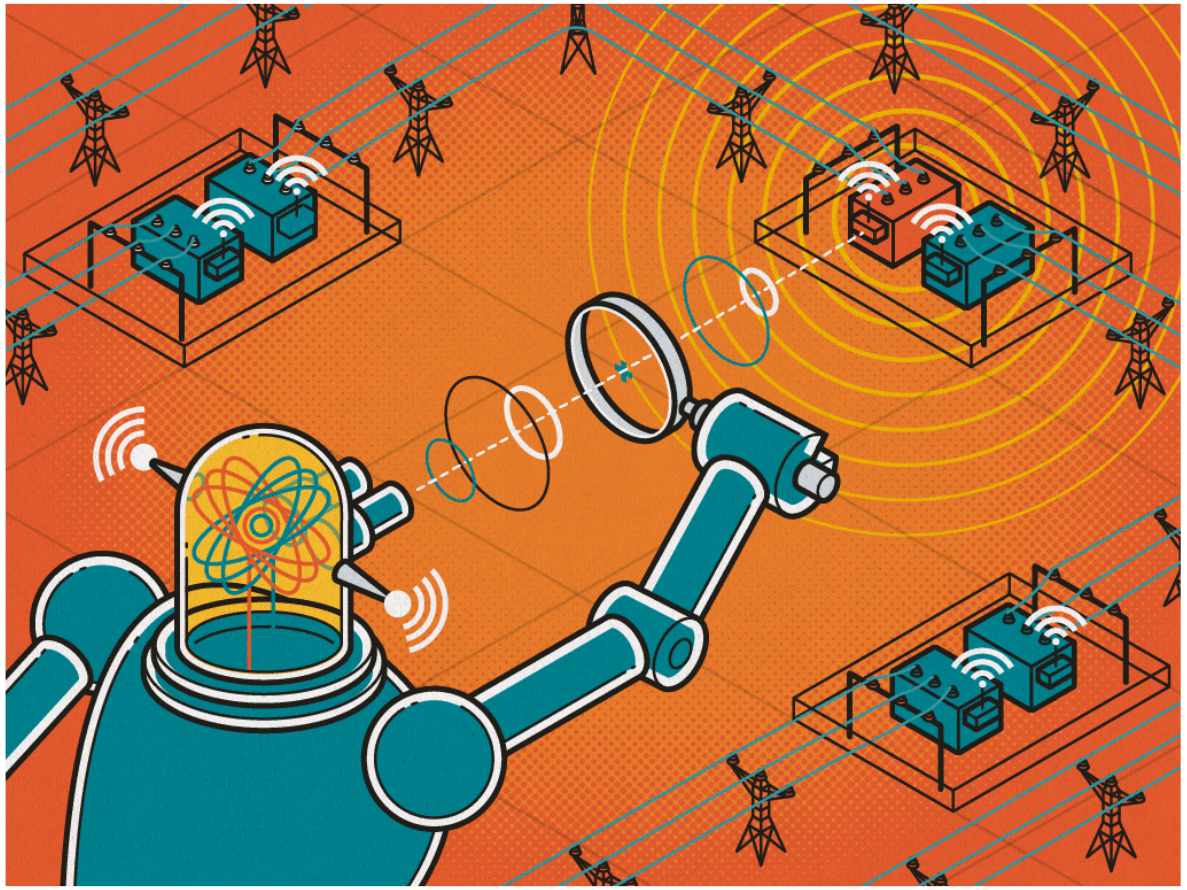
Vendor Engagement



4. Machine Learning Using Synchrophasor Data

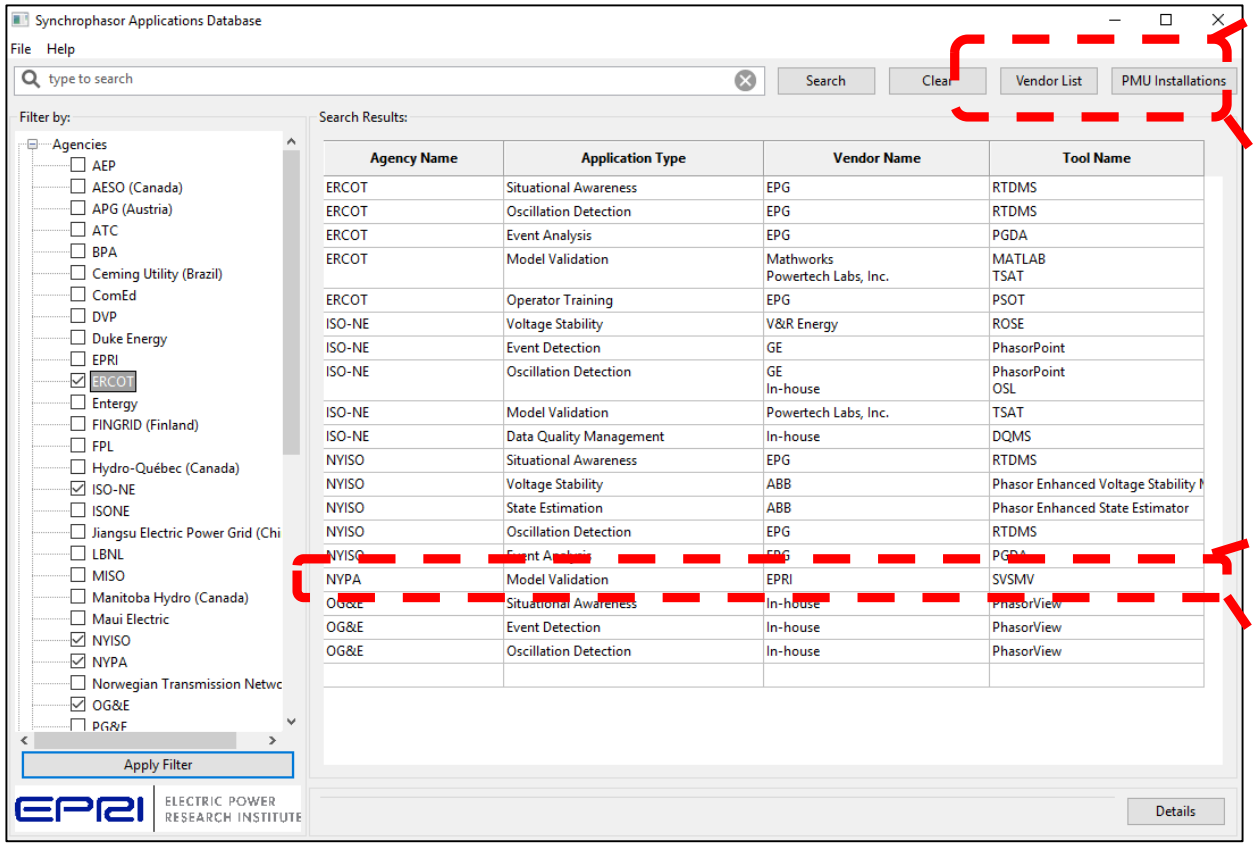
- Data mining/pattern recognition/machine learning techniques that use streaming synchrophasor data to:
  - Characterize in a near real-time environment the operating condition of the system
  - Classify secure vs insecure operating conditions
  - Identify events
  - Perform early-event detection
  - Provide guidance to operators for potential mitigation actions
  - Define metrics as precursors of system insecurity
  - Define system performance indicators (Grid Health Index)
- Ongoing: Software development

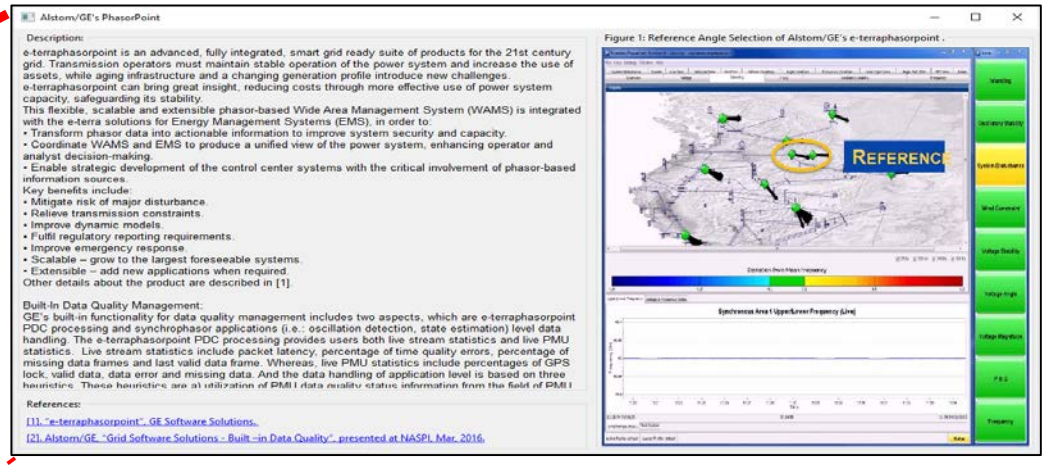
In collaboration with ASU

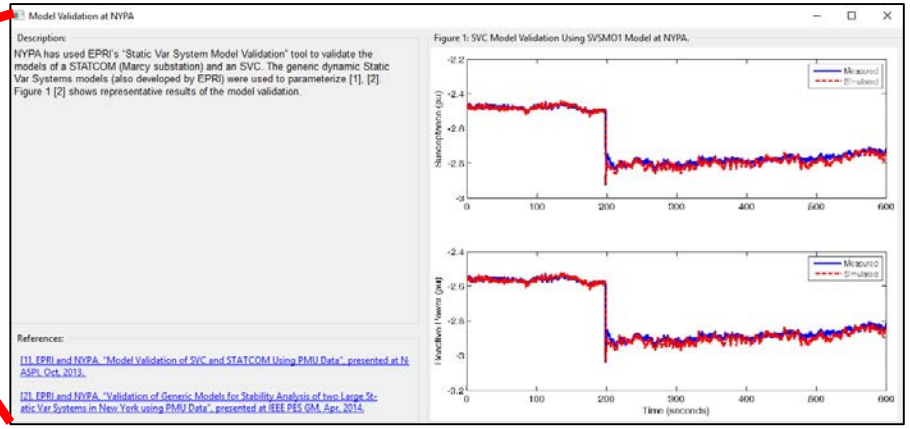


Value: Increased System Reliability Through Advanced Situational Awareness & Security Assessment

5. Synchrophasor Applications Database







- Entries based on publicly available documents
- For each entry, summary description of application and related references

Value: Inform utility/ISO engineers and executive management about uses cases and derived value of synchrophasor technology

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