



Nonlinear Analysis of Power System Oscillations Using Models and Measurements (S-89G)

Saugat Ghimire, Deepak Joshi, Maddipour Farrokhifard, Chad Thomas and Mani Venkatasubramanian (Washington State University)
Gilles Torresan, Stephane Hivart, Paul Chabas, Florent Xavier and Patrick Panciatici (RTE-France)



Research Background

- Growing or sustained electromechanical oscillations can lead to equipment damage and unwanted tripping of transmission lines and generators that could cascade into devastating blackouts.
- Oscillation monitoring algorithms developed at Washington State University (WSU) have previously been implemented in North America and in India.
- In this project, we study oscillations in RTE portion of the European power grid by using all available PMU data.

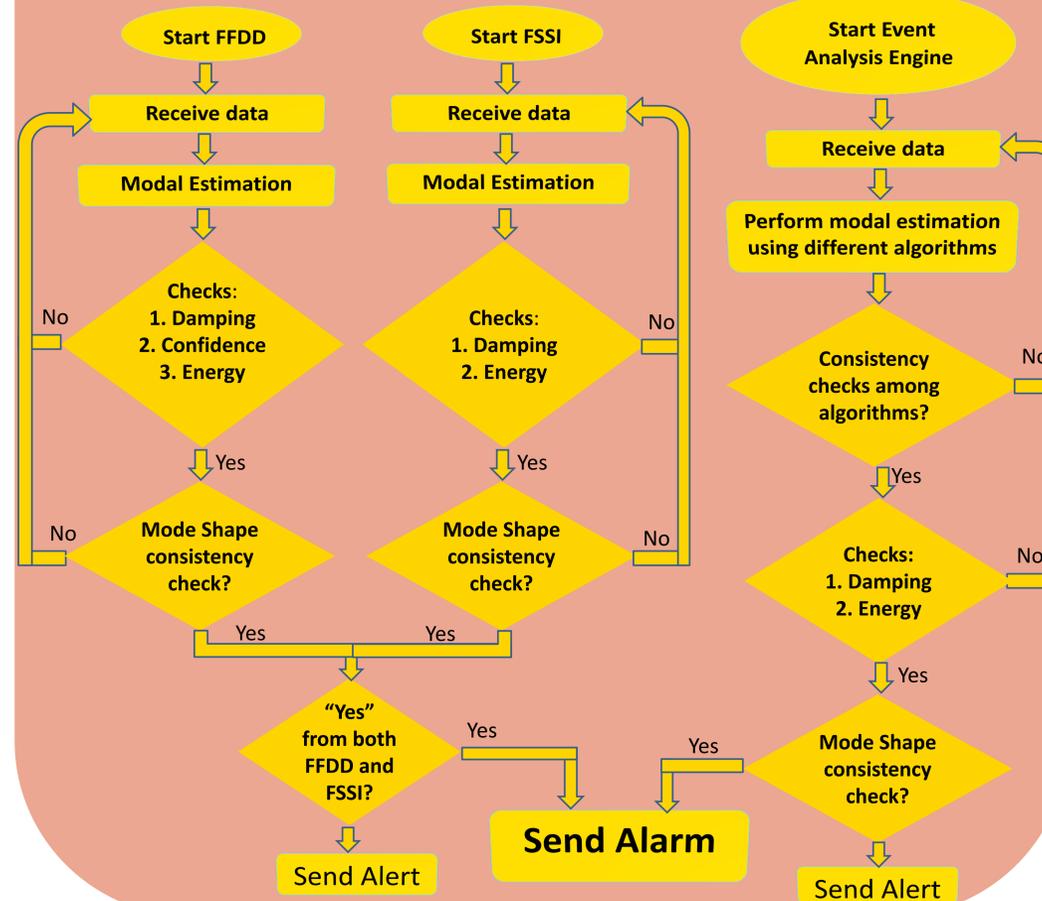
Research Objectives

- Study modal characteristics by signal processing of available PMU data in RTE portion of the European power grid.
- Analyze the computational burden in implementation of Fast Frequency Domain Decomposition (FFDD), Fast Stochastic Subspace Identification (FSSI) and Event analysis algorithms.
- Analyze automatic detection and handling of low damping events using multiple algorithms.

Research Deliverables

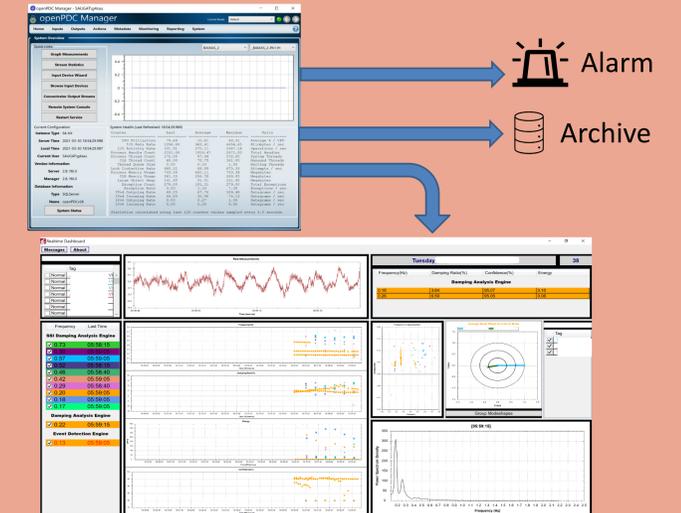
- Analysis of oscillation phenomena in the RTE portion of the European power grid by Implementation of WSU oscillation analysis tools in RTE
- Testing and improving the effectiveness of the oscillation algorithms by using simulated PMU data from dynamic models of the RTE system wherein the expected answers are known from small-signal analysis of the dynamic models.
- Developing new oscillation analysis and control algorithms in the project as needed in collaboration with RTE to address the oscillation issues in RTE.

Low Damping Event Alarms



Real-time Oscillation Monitoring System

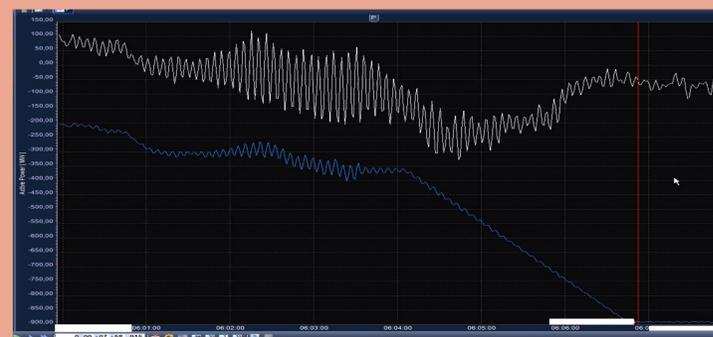
- Real-time modal analysis of PMU data with FFDD, FSSI and Event analysis engines.
- Visualization of results using Real-time Dashboard and/or openHistorian Grafana.
- Generation of Alarm/Alert signals for low damping events
- Archiving of results for post-event analysis



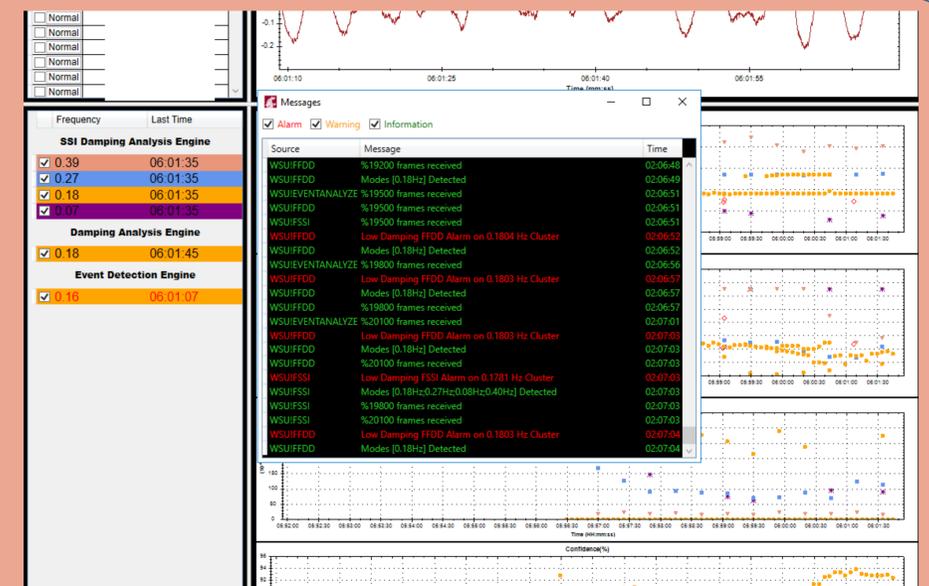
WSU OMS action adapters in operation

Case Study

- Recent low damping event in RTE system
- Alert/alarm from all three engines
- Alarms would have been issued for operator action



Power Oscillation during Low damping event



Alarms generated by WSU engines for the Low damping event