Pacific Northwest NATIONAL LABORATORY

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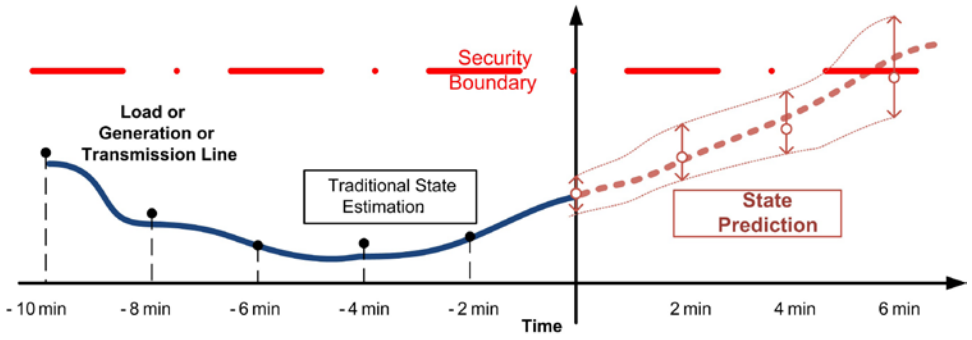
FUTURE POWER GRID INITIATIVE

A Statistical State Prediction Methodology to Improve Reliability and Efficiency of Power Grid Simulation

OBJECTIVE

This project aims to develop a short-term prediction methodology (with minutes to hours in lead time) for power system states and quantify the uncertainty of prediction. This research is motivated by the challenges of increasing uncertainty and variation introduced into power system operation by the high penetration of variable generation. Under ever changing operational conditions, operating a power system based on the measurements in the past is costly and risky. By predicting the system future states, the project will enable proactive operation to improve the operational reliability and efficiency.



Estimation versus Prediction

APPROACH

Because many underlying mechanisms influence power system states, the project team

- developed multiple prediction methods (e.g., regression methods, machine learning methods)
- established a model structure for predicting net interchange schedule as a user case
- evaluated the performance using field measurement data

IMPACT

To balance generation and load, reserves have to be purchased to manage the uncertainty in the future brought in by load, variable generation, market behaviors. This study will result in a power system state predictor at grid level, which cannot only predict power system behaviors, but also quantify prediction errors

U.S. DEPARTMENT OF ENERGY

FOCUS AREA 2 - MODELING AND SIMULATION

(or uncertainty). Our prediction methodology will

- provide a look-ahead vision for system operation
- the predicted NIS is used in economic dispatch for engaging proper amount of generation and reserves

FOCUS AREA

Focus Area Two targets research in the areas of advanced mathematical models, next-generation simulation and analytics capabilities for the power grid. Projects in Focus Area Two will use high-throughput data streams produced by projects in Focus Area One and integrate them with sophisticated mathematical models to conduct large-scale power grid simulation and analysis. Focus Area Two strives to advance the state-of-the-art in modeling and simulation in order to achieve much higher fidelity situational awareness and global comprehension for power grid stability, efficiency and flexibility. **Focus Area Leads:** Ian Gorton (ian.gorton@ pnnl.gov), and Ning Zhou (ning.zhou@ pnnl.gov)

ABOUT FPGI

The Future Power Grid Initiative (FPGI) will deliver next-generation concepts and tools for grid operation and planning and ensure a more secure, efficient and reliable future grid. Building on the Electricity Infrastructure Operations Center (EIOC), the Pacific Northwest National Laboratory's (PNNL) national electric grid research facility, the FPGI will advance the science and develop the technologies necessary for meeting the nation's expectations for a highly reliable and efficient electric grid, reducing carbon emissions and our dependence on foreign oil.

ABOUT PNNL

Pacific Northwest National Laboratory is a Department of Energy Office of Science national laboratory where interdisciplinary teams advance science and technology and deliver solutions to America's most intractable problems in energy, the environment and national security. PNNL employs 4,900 staff, has an annual budget of nearly $1.1 billion, and has been managed by Ohio-based Battelle since the lab's inception in 1965.

For more information, please visit the GridOPTICS™ website or contact:

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