Pacific Northwest NATIONAL LABORATORY

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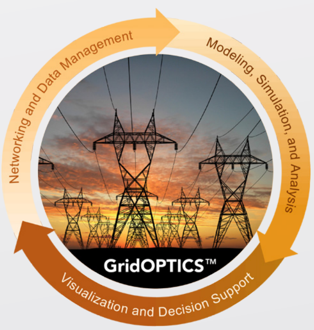


FUTURE POWER GRID INITIATIVE

Modeling of Distributed Energy Resources in the Smart Grid

OBJECTIVE

The project will develop scalable aggregation models to represent the DERs in the distribution systems, which can be used in the studies for the design, operation and control of the future smart grid. Our project will

» study calibration of the aggregated models using measurements

» synchronize and consolidate information from both large and small time scale models

» model a system with large number of DERs with good accuracy and speed

A prototype software tool will be developed that can demonstrate use of the developed models by utility companies to support their demand response operations.

APPROACH

Development of the aggregated models includes the following steps:

» modeling of the individual distributed resources (power module)

» modeling of the response scheme (control module)

» modeling of the aggregated effects, and

» validation and uncertainty quantification

Validation will compare the results from the aggregated model and detailed model and will be followed by a calibration procedure. Approaches to build aggregated models include state transition model and Dynamic Bayesian Network.

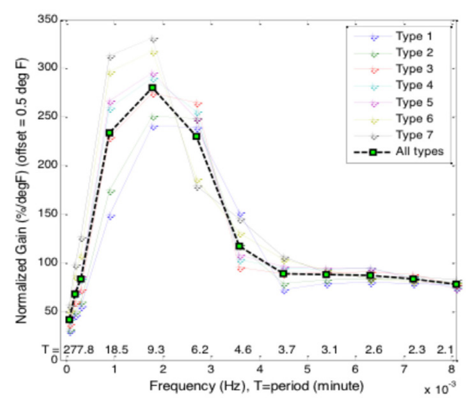
IMPACT

Models representing the characteristics of distributed energy resources are needed in many types of studies for their large-scale deployment, such as

» design of grid services provided by distributed resources and related policies

» generation, transmission and distribution system planning and operation studies

This project is aimed at removing technical barriers by enabling the simulation of functionalities of DERs, and speeding up the design and implementation process of the smart grid.



Gain of A/C load power consumption for different house types, as a function of the frequency of ΔTset, (amplitude of ΔTset is 0.5°F)

U.S. DEPARTMENT OF ENERGY

FOCUS AREA 2 - MODELING AND SIMULATION

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 FPGI website or contact:

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