Integrated Multiscale Data Analytics and Machine Learning for the Grid

CHALLENGE

Advances in and reduced costs for computing, memory, and communications technologies have resulted in an abundance of raw data from new sensing and measurement devices. However, there is a dearth of analytical tools that can process the data in motion to draw information that is meaningful and actionable. For example, because they consume so much energy, buildings are an integral part of the electric grid. However, despite the growth of new smart-building systems, methods currently do not exist for leveraging the data they generate for quantifying and predicting beneficial grid services.

With an aggressive growth trajectory of behind-the-meter distributed energy resources, the distribution grid and the building-to-grid interface present an opportunity to reap the benefits of a two-way grid of the future. To get there, analytics need to evolve to be adaptive and integrate multiple data sources from real-world systems and settings, and analysis and decision algorithms must take that variability into account. However, even today's most sophisticated analytics depend on singular, siloed data sources and techniques.

APPROACH

Machine learning is a new but reasonably well developed approach for conducting complex, adaptive analytics when a data domain is poorly understood. This project tackles the computational research needed to develop advanced machine learning techniques that account for complex power-systems physics, data in motion, and variability at the building-to-grid interface, along with added constraints of latency and computational burden.

In collaboration with industry partners, the research team, led by Lawrence Berkeley National Laboratory, Lawrence Livermore National Laboratory, and Los Alamos National Laboratory, is conducting the following key activities over the course of the project:

- Develop, validate, and deploy the first high-value use case application for grid analytics at the building-to-grid interface.
- Demonstrate integrated predictive reliability and grid service response verification.
- Develop and publish concept white papers addressing overall application of machine learning across programmatic and technical boundaries.

At-A-Glance

PROJECT LEADS

- **Emma Stewart**
  Lawrence Livermore National Laboratory
  stewart78@llnl.gov
- **Michael Chertkov**
  Los Alamos National Laboratory
  chertkov@lanl.gov

PARTNERS

- PSL
- Sentient
- PingThings
- National Instruments
- Riverside Public Utilities
- Duke Energy
- OSISoft
- PG&E

BUDGET

$3.73 million

DURATION

May 2016 – April 2019

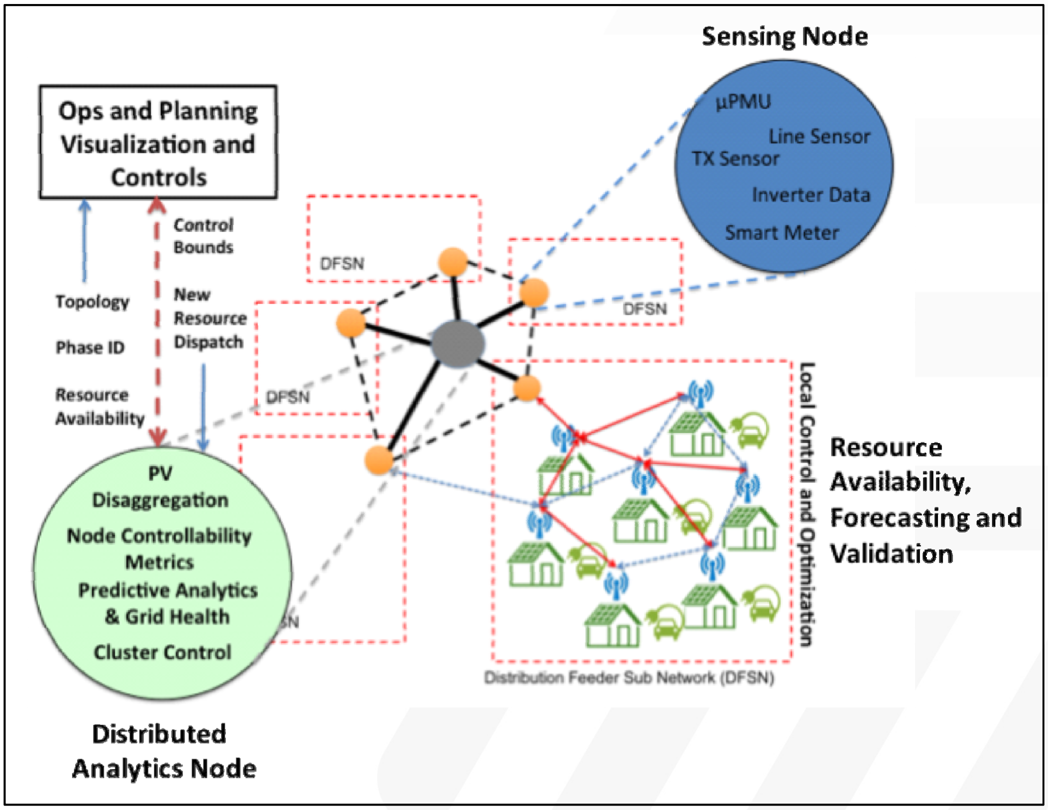
TECHNICAL AREA

Sensing and Measurements

Lead: Tom King
Oak Ridge National Laboratory
kingtjjr@ornl.gov

EXPECTED OUTCOMES

This project will demonstrate the full value and capability derived by synchronizing disparate data sources from distribution grid and buildings control for improving grid analysis and control using novel techniques of machine learning. The initial application development will enable future distributed applications such as transactional energy validation, fault analytics, and failure prediction to improve resilience. Application and integration of the application with control theory framework will provide a point-to-point solution.



With improved controls and analytics from machine learning, outages are avoided, utilities save money, and reliability is improved for customers.

LAB TEAM

Lawrence Livermore National Laboratory

Los Alamos National Laboratory

Launched in November 2014 under the U.S. Department of Energy's Grid Modernization Initiative, the GMLC is a strategic partnership between DOE Headquarters and the national laboratories, bringing together leading experts and resources to collaborate on national grid modernization goals. The GMLC's work is focused in **six technical areas** viewed as essential to modernization efforts:

Devices and Testing | Sensing and Measurements | Systems Operations and Control
Design and Planning | Security and Resilience | Institutional Support