HiPAS GridLAB-D: High-Performance Agent-based Simulation for GridLAB-D

CEC EPC 17-046 Fact Sheet

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SLAC National Accelerator Laboratory

The Issue

Comparative analysis and computational efficiency enabling high performance computing in grid modeling is needed to help customers design DERs into systems that minimize grid impacts. Speeding up the analysis and computational efficiency will help inform agencies, utilities, and ratepayers participating in distribution planning processes of methods to better integrate DERs onto the distribution system.

For example, Integration Capacity Analysis is an iterative method requiring many power flow simulations while varying the DER level throughout the distribution system to determine the maximum amount of DER that can be installed without causing distribution system problems. Due to the large number of iterations required (hundreds or thousands per feeder); iterative analysis can result in long processing times, especially when expanded to large numbers of distribution circuits. Measurably improving the speed and accuracy of an open-source modeling tool capable of dynamic time series modeling is critically needed. Doing so will enable quick and accurate distribution studies that include smart inverters, single phase line sections, and transmission impacts.

Project Description

HiPAS is an open-source project to upgrade GridLAB-D, speed up the analysis performance, and general improve the computational efficiency of GridLAB-D. This commercial-grade version helps inform agencies, utilities, and ratepayers speed up planning processes that integrate DERs onto utility distribution systems. HiPAS includes tools and methods that help user import data, perform fast analysis, and produce useful results for resource integration, tariff design, electrification, and extreme event resilience studies. HiPAS is deployable on laptops, desktop workstations, private servers, and public cloud platforms.

HiPAS GridLAB-D supports the many existing capabilities of GridLAB-D and is distributed by the Linux Foundation Energy as an open-source product available to all users with no license or subscription fees. Online tutorial videos for both users and developers are available, as well as a rich repository of online documentation with examples. Online weather data for both historical weather, as well as real-time weather forecasts are also available. A rich set of sample distribution network models from IEEE and various utilities is distributed, as well as a library of distribution assets typically used in simulations.

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HiPAS GridLAB-D now includes a geodata capability that allows highly local data to be attached to objects in simulations, including local weather data, vegetation, and census data. The rich dataset provided can be used to estimate the benefits and impacts of smart grid technologies including demand response, detailed unbalanced per phase impacts from DERs, and impacts from behind the meter assets such as storage, photovoltaics and wind generation. It models real world conditions such as allowing unlocked voltage regulating devices.

GridLAB-D has a rich depth and breadth of supported research capabilities of the modeling software including Volt-VAR optimization and conservation voltage reduction, demand response research, smart appliance controls, microgrid integration, transactive modeling and simulation, storage integration, DER impacts, behind the meter assets, the use of advance metering infrastructure, and complex multi-disciplinary problems presented by new smart grid technologies.

Anticipated Benefits for California

The HiPAS enhancements to GridLAB-D achieved through this project have been used by utilities analysts to perform DER integration studies, study system resilience during extreme weather events, and perform long-term load forecasting studies to assist utility in planning under deep electrification and high levels of renewable resource and energy storage integration. HiPAS GridLAB-D has established a foundation for long-term user and developer support of high-performance versions of GridLAB-D for California utilities, regulators and DER designers. By supporting other CEC-funded tools like OpenFIDO and GLOW, HiPAS GridLAB-D has addressed the primary barriers to analyzing more locations, for more points in time, more frequently by reducing the computational costs associated with these most common utility analysis use cases.

Project Specifics

Contractor: SLAC National Accelerator Laboratory

Partners: GridWorks, Oakland, California (subcontractor)
Pacific Northwest National Laboratory, Richland, Washington (subcontractor)
National Grid, Hicksville, New York (cost-share)
Linux Foundation Energy (commercialization partner)

Amount: $3,068,781

Co-funding: $300,000 (cost-share)

Term: June 2018 to September 2023

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