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HIPPO: A Computation Tool for Planning Tomorrow's Electricity

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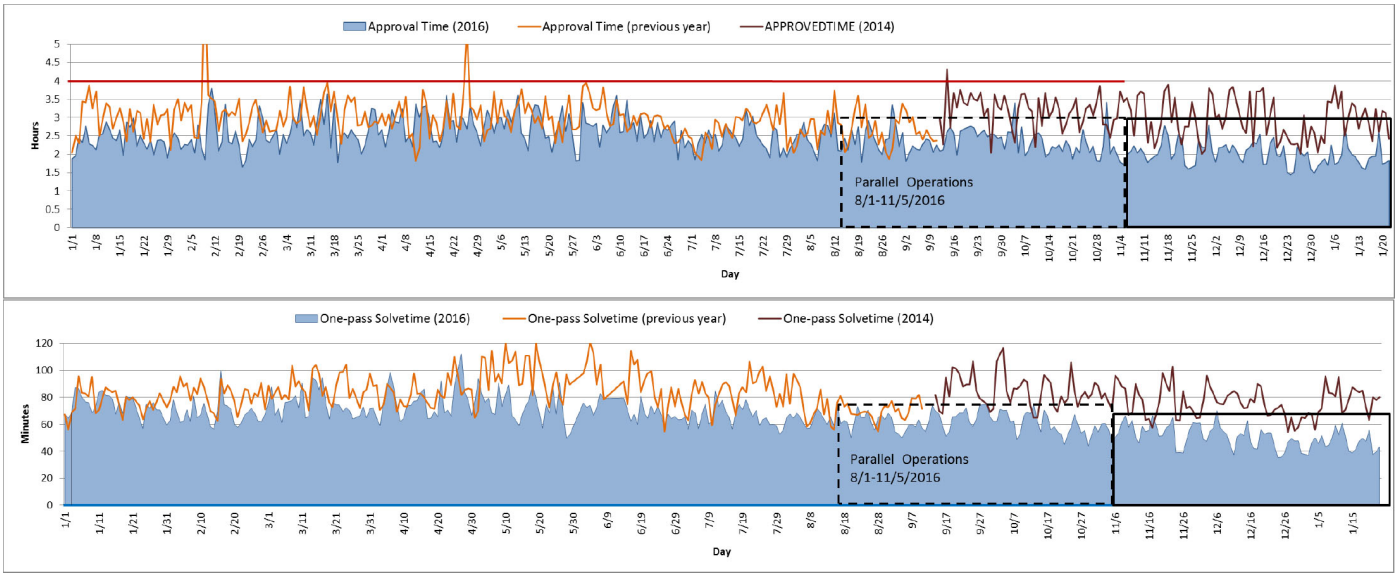
Partners: Midcontinent Independent Service Operator (MISO), GE Grid Solutions, Gurobi Optimization

High-Performance Power Grid Optimization, or HIPPO, is a new computational tool that will help grid operators plan how to generate tomorrow's electricity more efficiently. Funded by ARPA-E, HIPPO is being developed and validated by a research team led by PNNL, along with partners at Midcontinent Independent Service Operator (MISO), GE Grid Solutions, and Gurobi Optimization.

CRITICAL NEED

Transmission organizations and grid system operators are required to develop power generation plans for participants in energy markets. Next-day operations are determined by day-ahead unit commitment decisions through the guarantee of a large percentage of available resources. To ensure power plants can operate reliably at the lowest possible cost, the staple of current scheduling activities involves solving the security constraint unit commitment (SCUC).

As the power grid evolves with the integration of renewable energy and changing electricity demand patterns, calculating resource schedules becomes more complex and the probability for error increases.



Improved optimization tools are essential for managing a next-generation electricity system.

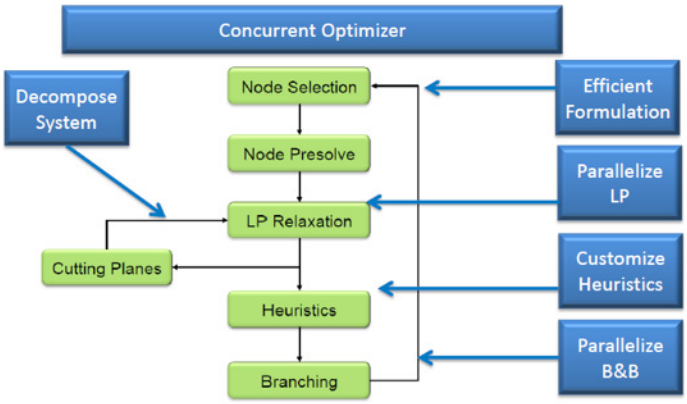
U.S. DEPARTMENT OF ENERGY

OUR SOLUTION

The HIPPO team plans to leverage advances in optimization algorithms and deploy high-performance computing technologies to tackle the SCUC problem. Because new algorithms will have algorithmic memory, HIPPO can leverage knowledge of underlying systems, operational experiences, and past solutions. When inter- and intra-algorithms are adapted to the same processing system, algorithms can share information and reduce computing time.

The four features for developing algorithms are:

- **Domain Knowledge:** Translate operator's experience and knowledge into algorithms
- **Maximum Parallel:** Enable inter- and intra-algorithm parallelization to share information
- **Algorithmic Memory:** Learn from past use cases
- **Efficient Resolvability:** Reduce efforts to solve modified problems



APPROACH AND RESULTS

Researchers anticipate HIPPO will solve the SCUC problem more accurately and in a fraction of the time it takes current methods. They expect HIPPO will provide system operators with improved resource schedules, leading to more flexible and reliable real-time grid operation in a stochastic environment. As a result, HIPPO is expected to:

- Improve power generation schedules
- Enable more efficient, flexible, and reliable grid management
- Allow for increased integration of smart grid technologies and renewable energy
- Save consumers and power grid operators billions of dollars
- Enable greener and more sustainable grid operations
- Promote high-performance computing-based algorithms for complex problems in other industries, such as air traffic control, managing telecommunications, transportation, and other critical national infrastructures.

The HIPPO project officially began in November 2015. The team developed the SCUC engine that was benchmarked with a MISO system to serve as the foundation for algorithm development.

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GUROBI OPTIMIZATION

Grid Solutions

MISO

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