

[ARPA-E] Grid Optimization Competition

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Timeline: FY2019 – present

Challenge:

ARPA-e's Grid Optimization (GO) competition has sought to build the next generation of power systems software by holding an open competition with prize money on the order of \$1,000,000 dollars. Modeled after DARPA's "grand challenge" program, the GO competition has brought together the world's best researchers, has provided a consistent computational platform for rigorous benchmarking of emerging power grid algorithms, and has pushed researchers to solve problems at industry-relevant scales. The first three iterations of the GO competition have focused on AC security constrained optimal power flow (SCOPF), a non-convex nonlinear optimization problem with billions of decision variables and constraints on realistic power network datasets. The competitors are tasked with building optimization software that can reliably solve these problems in 10 minutes or less.

Technical Approach:

Los Alamos leveraged its world-leading expertise in nonlinear optimization for optimal power flow (OPF) to develop novel SCOPF algorithms for solving the GO competition problems. With the SCOPF problem specification spanning over 100 pages and the software required to run in a distributed computing setting with six computers working in parallel, Los Alamos' competition algorithms are extremely sophisticated and demonstrate a high technology readiness level (TRL) that is ready for industry adoption and serve as the reference solution for the competition.

After the conclusion of each competition, all of Los Alamos' software for solving these challenging problems was made open-source as part of the **InfrastructureModels** software ecosystem, which has benefited the research community and commercial software developers by showing how Los Alamos' research can be deployed as reliable and performant grid optimization algorithms. In the first GO competition (2020), Los Alamos staff took two out of the top 10 positions, with one team making it to the top 5. In the second competition (2021), Los Alamos staff won the first and second place in the leaderboard corresponding to the Trial 1 event.

Impact:

Given that modern power markets clear billions of dollars annually, even small improvements in efficiency (on the order of 1%) can save the United States hundreds of millions of dollars annually. The GO competition seeks to build a new generation of optimization algorithms that leverage recent developments in nonlinear optimization to improve the efficiency of the grid while ensuring reliability. To that end, the competition provides its competitors with a computing environment that accurately replicates the conditions of modern grid operating rooms and demonstrates that the proposed algorithms are ready for a realistic production setting.