The University of Chicago

Departments of Computer Science,
Mathematics, and Statistics

Scientific and Statistical Computing Seminar

MIHAI ANITESCU

Argonne National Laboratory

Scalable Stochastic Programming for Energy Systems Control under Uncertainty

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ABSTRACT

Optimal control of nationally critical complex energy systems such as the power electric grid requires the treatment of large-scale interconnected sub-systems in the presence of multiple sources of uncertainty. For complex energy systems, the source of uncertainty can be incomplete information or reductive modeling of weather conditions, consumer demand, market prices, etc. In this work we investigate scalable approaches for one framework for control under uncertainty: stochastic programming (SP) with recourse. Our methodology relies on approximating the underlying uncertainty of the stochastic problem via sampling, and solving the corresponding sample average approximation (SAA). To that end, we developed PIPS: an interior-point method with a specialized linear algebra layer that solves the stochastic programming problems that appear in rolling horizon nonlinear model predictive control of energy dispatch. We address scalability bottlenecks by using a specialized preconditioning technique and dense massively parallel linear algebra. We demonstrate the scalability of the approach for up to 2 billion variables on 130000 cores on the Argonne BG/P "Intrepid" supercomputer for an energy dispatch problems over the Midwestern United States. We will discuss remaining theoretical and practical challenges.