The Hong Kong Polytechnic University
Department of Logistics and Maritime Studies
Research Seminar

A Polyhedral Study of the Integrated Minimum-Up/-Down Time and Ramping Polytope

by

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Time: 10:15am - 11:15am
Venue: R503, Shirley Chan Building
The Hong Kong Polytechnic University

(Conducted in English)

Abstract:

We consider the polyhedral structure of the integrated minimum-up/-down time and ramping polytope, which has broad applications in power generation scheduling problems. The generalized polytope we studied includes minimum-up/-down time, generation ramp-up/-down rate, logical, and generation upper/lower bound constraints. We derive strong valid inequalities for this polytope by utilizing its specialized structures. These inequalities, plus trivial inequalities described in the original formulation, are sufficient to provide the convex hull descriptions for variant two-period and three-period polytopes corresponding to different minimum-up/-down time limits. In addition, we derive more generalized strong valid inequalities (including one, two, and three continuous variable cases respectively) in both polynomial size and exponential size to strengthen the multi-period polytopes, and further prove that these inequalities are facet-defining under certain mild conditions. Finally, extensive computational experiments are conducted to verify the effectiveness of our proposed strong valid inequalities by testing the applications of these inequalities to solve both the network-constrained and self-scheduling unit commitment problems, for which our derived approach outperforms the default CPLEX significantly. This is a joint work with Dr. Yongpei Guan.

Bio:

Kai Pan is a Ph.D. candidate in the Department of Industrial and Systems Engineering at the University of Florida. He holds a Master's degree in Industrial and Systems Engineering from the University of Florida and a Bachelor's degree in Industrial Engineering from Zhejiang University. Previously he worked as a Research Scientist at Amazon (Seattle, Washington) on Supply Chain Optimization and a Power System Engineer at GE Grid Solutions (Redmond, Washington) on Electricity Market Operations.

Kai's research focuses on optimization under uncertainty with its applications in real industrial problems, particularly including 1) data-driven stochastic optimization, 2) stochastic integer programming, and 3) specific applications in various unit commitment problems. For 1), he studies cutting plane approaches to improve the performance of solving data-driven stochastic programs. For 2), he explores theoretical polyhedral studies to investigate the fundamental problem structure which has broad applications in the power industry. For 3), he further conducts extensive application studies to help solve unit commitment problems by utilizing the derived polyhedral studies and solution methodologies. The contribution of Kai's research is two-fold: 1) his solution approaches enrich the methodologies to solve data-driven stochastic programs and stochastic integer programs; 2) his methods help solve large-scale practical power system problems under uncertainty and are beneficial for both independent system operators (ISOs) and generation companies (GENCOs). In future research, Kai will continue exploring data-driven optimization and stochastic optimization theories, and meanwhile seek broader applications in power system operations, transportation, and supply chain management.

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All are welcome!