Fundamental and Complete Resolution of Mixed-Binary Linear Programming Problems

Abstract

Mixed-Binary Linear Programming (MBLP) problems involve binary and continuous decision variables with linear constraints and objective functions, and are prevalent in applications, e.g., power system unit commitment and economic dispatch. Since derivatives of an objective function with respect to binary decision variables do not exist, there is no necessary optimality condition. As a result, partial enumeration of binary variables is generally needed, and the complexity to obtain an optimal solution increases exponentially as the problem size increases, limiting the sizes of problems or quality of solutions. In this talk, a fundamental and complete resolution of such problems for near-optimal solutions with quantifiable quality in a computationally efficient way is presented, using unit commitment and economic dispatch as the problem context. The novelties include (1) a decomposition framework to exploit the exponential reduction of complexity upon decomposition; (2) an innovative and systematic way to tighten subproblem formulations offline, noting that if the convex hull of a subproblem can be directly delineated by its constraints, then the subproblem can be solved by using linear programming methods without any complexity; and (3) the novel “Surrogate Absolute Value Lagrangian Relaxation” (SAVLR) method that overcomes all major difficulties of traditional Lagrangian relaxation for accelerated coordination of subproblem solutions while providing lower bounds to quantify solution quality. Numerical testing demonstrates superior performance of the approach, and points a brand new way to formulate and solve practical MBLP problems and beyond.

Biography

Peter B. Luh received his B.S. from National Taiwan University, M.S. from M.I.T., and Ph.D. from Harvard University. He has been with the University of Connecticut since 1980, and currently is a Board of Trustees Distinguished Professor and the SNET Professor of Communications & Information Technologies. He is also a member of the Chair Professors Group, Center for Intelligent and Networked Systems (CFINS) in the Department of Automation, Tsinghua University, Beijing, China; and a member of the Short-Term Thousand-Talent Program, the State Key Laboratory of Synthetical Automation for Process Industry, Northeastern University, Shenyang, China. Professor Luh is a Life Fellow of IEEE, and the Chair of IEEE TAB Periodicals Committee for the 2018-19 term, overseeing 200 IEEE journals and magazines from cradle to grave. He was the VP of Publications of IEEE Robotics and Automation Society (RAS, 2008-2011), the founding Editor-in-Chief of the IEEE Transactions on Automation Science and Engineering (2003-2007), and the Editor-in-Chief of IEEE Transactions on Robotics and Automation (1999-2003). He was also the Founding Chair of the Steering Committee of the IEEE Conference on Automation Science and Engineering (2006-2011). His research interests include smart grid, intelligent manufacturing, and energy-smart and safe buildings. He received RAS 2013 Pioneer Award and 2017 George Saridis Leadership Award.