Bilevel Optimization Algorithms and Applications

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Friday, February 26, 2016 – 9:00 a.m.
EC 110

Abstract

How can a policy-maker design effective regulations to reduce emissions from power companies that are primarily profit-driven? Many real-world problems involve two decision-makers with incompatible objectives in a similar manner. These problems can be solved by bilevel optimization, in which the upper level (policy-maker, with an objective to minimize emissions) has the authority to perturb the constraints of the lower level, whereas the lower level (power company, with an objective to maximize profit) faces its own optimization problem and must comply with the perturbation. I will present a new algorithm for solving a class of bilevel optimization problems, which is not only much more efficient than the state-of-the-art methods but also the first of its kind to be proven to solve all instances correctly and finitely. I will introduce how bilevel optimization has been applied in several of my research projects, including electric transmission planning, cap-and-trade and carbon tax policy analysis, robust inventory control, and transportation network resiliency assessment. I will also discuss my future research directions, including data-driven and optimization-based genomic selection for plant and animal breeding, bilevel optimization algorithms for data-intensive discovery, and self-learning inventory control strategies for smart manufacturing.

BIOGRAPHY

Lizhi Wang is an Associate Professor in the Department of Industrial and Manufacturing Systems Engineering at Iowa State University. He received his Ph.D. in 2007 in Industrial Engineering from the University of Pittsburgh. Wang's research interests include bilevel optimization algorithm design, power systems modeling and analysis, transportation system resiliency assessment and enhancement, manufacturing supply chain design, and plant breeding. He has published more than 30 journal articles. His research has been funded by the National Science Foundation, Bill and Melinda Gates Foundation, Digital Manufacturing and Design Innovation Institute, Power Systems Engineering Research Center, NSF Center for e-Design, Plant Science Institute, and industry collaborators. He has received more than $9M of research funding, of which more than $2M was his own share. Wang serves as an Associate Editor for two journals: Journal of Energy Engineering and Energy Systems.

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