Multi-Stage Robust Optimization via Copositive Programming

Guanglin Xu, Ph.D.
Systems Engineering and Engineering Management
University of North Carolina at Charlotte
Charlotte, North Carolina

Abstract:

Decision-making under uncertainty arises in a wide spectrum of applications in operations management, engineering, finance, and process control. A prominent modeling approach for decision-making under uncertainty is *robust optimization (RO)*, whereby one seeks for a decision that hedges against the worst-case realization of uncertain parameters. Furthermore, real-life problems are often dynamic in nature, where the uncertain parameters are revealed sequentially, and the decisions must be adapted to the current realizations. The adaptive decisions are fundamentally infinite-dimensional as they constitute mappings from the space of uncertain parameters to the space of actions. These settings give rise to *multi-stage robust optimization* (MSRO) problems which in general are computationally challenging to solve. In this talk, we discuss decision rule approximations for generic MSRO problems. We examine linear decision rules for the case when the objective coefficients, the recourse matrices, and the right-hand sides are uncertain, and examine quadratic decision rules for the case when only the right-hand sides are uncertain. The resulting optimization problems are NP-hard but amenable to copositive programming reformulations that give rise to tight, tractable semidefinite programming solution approaches. We further enhance these approximations through new piecewise decision rule schemes. Finally, we prove that our proposed approximations are tighter than the state-of-the-art schemes and demonstrate their superiority through numerical experiments.

Biography:

Guanglin Xu is Assistant Professor in the Department of Systems Engineering and Engineering Management at the University of North Carolina (UNC) at Charlotte. He received his Ph.D. in Management Sciences in 2017 from Tippie College of Business, University of Iowa. Before joining UNC Charlotte, he was a postdoctoral research fellow in the Institute for Mathematics and Its Applications (IMA) at the University of Minnesota, where he was involved in both academic research at IMA and industrial applications at Cargill. His research interests include decision-making under uncertainty and its applications in operations research, healthcare, supply chain management, and energy systems.