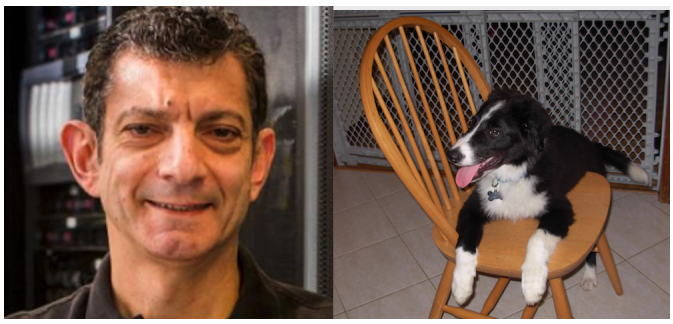
Rocky Mountain INFORMS: November 16, 2022

The Rocky Mountain INFORMS Chapter is pleased to host Professor Daniel Bienstock who holds the Liu Family Professor chair in the Industrial Engineering and Operations Research Department at Columbia University in New York. Professor Bienstock obtained his B.S. in Mathematics from Brandeis University and his Ph.D. in Operations Research from MIT. His current research focuses on two complementary topics related to analysis and operations of power transmission networks: (i) analysis of the vulnerabilities of electrical power grids and (ii) their mathematical complexity.



Title Practical Solution Approaches to Optimization and Engineering: Case Studies in Mine Planning and Electrical Power

Abstract While until recently, problems that involved optimizing the operations of engineered systems remained elusive, advances in mathematical formulations, solution methodologies, hardware, and software now afford practitioners the ability to generate detailed solutions that are of practical use in tactical planning. We present examples from two industries: In the first, we consider an OPEN-PIT MINING OPERATION with millions of notional, three-dimensional blocks, each of which can be extracted to generate revenue, subject to spatial precedence and resource restrictions. Our algorithm solves the linear programming relaxation to optimality within a few minutes of computing time, whereas these problems remain intractable for commercial solvers. We provide extensions on the basic formulation and solution technique, and demonstrate the effectiveness of the algorithm on real mining operations. In the second, we introduce the ALTERNATING CURRENT OPTIMAL POWER FLOW problem that addresses the operation of a power grid under nonlinear (and nonconvex) power flow equations. It seeks to compute a minimum-cost mode of operation that delivers the correct amount of power to each location of the network. Under the current state-of-the-art, it is best to rely on a local solver (such as KNITRO or IPOPT) to compute an approximately feasible solution while using a vastly different body of techniques (spatial branch-and-bound coupled with reformulation) in order to prove lower bounds. We describe an ongoing competition `https://gocompetition.energy.gov/challenges/challenge-3` in which we participate.