EPSTEIN INSTITUTE SEMINAR ▪ ISE 651

"Graph-Structured Optimization: Properties, Algorithms, and Software"

ABSTRACT – We study properties for nonlinear optimization problems whose structures are induced by graphs (collections of nodes connected by edges). These problems arise in many applications such as dynamic optimization (graph is a line), stochastic optimization (graph is a tree), optimization with partial differential equations (graph is a mesh), and network optimization (graph is the network). Specifically, we introduce a fundamental property for graph-structured problems that we call "exponential decay of sensitivity." This property states that, for a given pair of nodes, the sensitivity of the solution at one node against a perturbation at the other node decays exponentially with respect to the distance between the nodes. We discuss how this property provides new and interesting insights on how disturbances propagate through the structure of complex systems and on what factors influence such propagation (e.g., controllability and flexibility). We also show how this sensitivity property enables the design of new decomposition and approximation algorithms that can tackle problems of unprecedented complexity. In addition, we discuss how to implement graph-structured problems in the Julia programming language and how we use these capabilities to tackle diverse problems arising in energy systems (e.g., power systems, natural gas networks, and HVAC).

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SPEAKER BIO – Victor M. Zavala is the Baldovin-DaPra Professor in the Department of Chemical and Biological Engineering at the University of Wisconsin-Madison and a senior computational mathematician in the Mathematics and Computer Science Division at Argonne National Laboratory. He holds a B.Sc. degree from Universidad Iberoamericana and a Ph.D. degree from Carnegie Mellon University, both in chemical engineering. He is on the editorial board of the Journal of Process Control, Mathematical Programming Computation, and Computers & Chemical engineering. He is a recipient of NSF and DOE Early Career awards and of the Presidential Early Career Award for Scientists and Engineers (PECASE). His research interests include statistics, control, and optimization and applications to energy and environmental systems.

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TUESDAY, SEPTEMBER 5, 2023
3:30 PM – 4:50 PM
USC SOCIAL SCIENCES BUILDING (SOS), B2