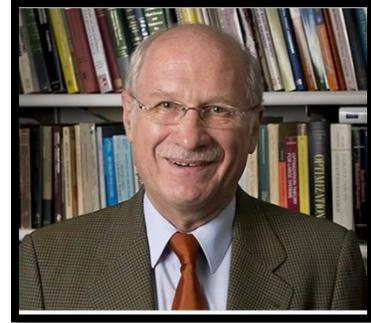


# EPSTEIN INSTITUTE SEMINAR ▪ ISE 651

## Global Optimization of Nonconvex Nonlinear Generalized Disjunctive Programs

**ABSTRACT** - Inspired by pioneering work of Egon Balas in disjunctive programming, we address in this talk the global optimization of nonconvex nonlinear generalized disjunctive programming (GDP) problems that include for instance bilinear, concave and linear fractional terms. In order to solve these nonconvex problems a convex nonlinear GDP relaxation is obtained by using suitable convex envelopes for the nonconvex terms. In order to predict tighter lower bounds to the global optimum we consider a sequence of basic steps for the convex relaxation that take a disjunctive set to another one with fewer conjuncts. We show that the strength of these bounds increases as the number of conjuncts decreases leading to a hierarchy of relaxations. Based on this procedure for strengthening lower bounds, we describe two major solution methods for globally optimizing nonconvex GDP problems. One relies on a disjunctive branch and bound algorithm that makes use of bound contraction, logic inference and a spatial branch and bound search. The other solution method relies on a logic-based outer-approximation algorithm that involves the solution of mixed-integer linear programming master problems and nonlinear programming subproblems for which new cuts are proposed, as well as a two-stage partition. A number of basic theoretical properties are proved for the proposed methods, and we illustrate the application of these methods in the global optimization of several process systems to demonstrate the computational savings that can be achieved with the tighter lower bounds.



**Dr. Ignacio E. Grossmann**  
Professor, R. R. Dean University  
Professor of Chemical Engrg.,  
Director, Center for Advanced  
Process Decision-Making,  
Carnegie Mellon

**SPEAKER BIO** – Ignacio E. Grossmann (B.S. Universidad Iberoamericana; M.S., Ph.D. Imperial College) is the R. R. Dean University Professor of Chemical Engineering at Carnegie Mellon, and director of the "Center for Advanced Process Decision-making." A member of the National Academy of Engineering, he has received many awards from AIChE and INFORMS, including the 2003 INFORMS Computing Society Prize, the first Sargent Medal by the Institution of Chemical Engineers in 2015, and the distinction of being named "One of the Hundred Chemical Engineers of the Modern Era" by AIChE in 2008. He has honorary doctorates from Technical University of Dortmund, Abo Akademi, University of Maribor, University of Cantabria, Russian Kazan Technological University, University Nacional del Litoral, University of Alicante and RWTH University Aachen. His research interests are in mixed-integer, disjunctive and stochastic programming, energy and power systems, water networks, and planning and scheduling for enterprise-wide optimization. He has authored over 700 papers, and the recent book "Advanced Optimization for Process System Engineering." He has supervised 64 Ph.D. and 23 M.S. students, from which 11 are faculty members in the U.S. and overseas.

**USC Viterbi**

School of Engineering  
Daniel J. Epstein Department of  
Industrial and Systems Engineering

**TUESDAY, MARCH 29, 2022**

**3:30 PM – 4:50 PM**

ZOOM/ONLINE \*PLEASE EMAIL [OWH@USC.EDU](mailto:OWH@USC.EDU) FOR PASSWORD\*