Mixed-integer programming models for Planning and Scheduling for Enterprise-wide Optimization

Ignacio E. Grossmann
Center for Advanced Process Decision-making
Department of Chemical Engineering
Carnegie Mellon University
Pittsburgh, 15217, USA
grossmann@cmu.edu

Enterprise-wide optimization (EWO) is a new emerging area that lies at the interface of chemical engineering and operations research, and has become a major goal in the process industries due to the increasing pressures for remaining competitive in the global marketplace. EWO involves optimizing the operations of supply, production and distribution activities of a company to reduce costs and inventories. A major focus in EWO is the optimization of manufacturing plants as part of the overall optimization of the supply chain. Major operational items include production planning, scheduling, and control.

This course provides an overview of major mixed-integer optimization models for planning and scheduling for the optimization of plants and entire supply chains that are involved in EWO problems. We first briefly review mathematical programming techniques, with an emphasis on mixed-integer linear and nonlinear programming, and generalized disjunctive programming. We describe models and solution strategies for several major problems and applications: a) batch scheduling of multistage plants with parallel units (e.g. food and pharma); b) discrete and continuous time models for short term scheduling (State Task Network and Resource Task Network) (e.g. fine chemicals); c) cyclic scheduling of multiproduct continuous multistage plants (e.g. lubricants); d) petroleum refinery scheduling and blending and multiperiod production planning; e) supply chain optimization model for process networks including various purchase contracts (e.g. petrochemicals); e) multiperiod production planning with nonlinear process models (e.g. reactor models); f) supply chain optimization with stochastic inventory. Finally, we also introduce Constraint Programming as an alternate solution approach to some of these scheduling problems. These described problems have been addressed in collaboration with industry through the Center for Advanced Process Decision-making at Carnegie Mellon University. We report results from some of these industrial application, and show that they have led to improved operations and substantial economic savings.