Long-term Turnaround Planning for Integrated Chemical Sites

Satya Amaran, Tong Zhang, Nick Sahinidis (CMU)
Bikram Sharda, Matt Morrison, Scott Bury, Scott Miller, John Wassick
(The Dow Chemical Company)
Problem Statement

- Exploit network interactions, storage availability, and prices to schedule maintenance over a multi-year horizon

- Scope:
  - Max. profit
  - Continuous processes
  - Time horizon: 5-15 years
  - Site-wide (each unit is an entire plant)
Mixed Integer Linear Programming Model

• **Objective: Max. profit**
  
  Revenue from sold product – maintenance costs – holding costs – demand satisfaction penalties – cost of raw materials and imports

• **Constraints**
  
  – Network flow constraints
    • Inventory and mass balance
    • Nonnegativity constraints
    • Upper and lower bounds on inventory levels
    • Demands
    • Financial-manpower-turnaround constraints
Novelty

- Incorporation of three major concerns:
  - Avoidance of maintenance tasks in unfavorable conditions
  - Bringing down peak manpower requirements
  - Balancing quarterly financial performance
Potential Impact

• Successfully demonstrated
  – Turnaround optimization for an industrial-size network
  – Efficient solution while retaining key model features
  – Incorporation of practical considerations

• Future/current work
  – Medium-term turnaround scheduling under duration uncertainty for manpower and production planning (robust + stochastic approach)