Parametric Valid Inequalities in Discrete Optimization

Suresh Bolusani
Ph.D. Advisor: Ted K. Ralphs

1COR@L Lab, Department of Industrial and Systems Engineering, Lehigh University

**Multilevel/Multistage Mixed Integer Linear Optimization**

**Motivation**
- Many real-world applications have:
  - Discrete/indivisible decisions
  - Multiple decision-makers
  - Multiple objectives
  - Multiple time periods

**Application Areas**
- Airline pricing and capacity allocation
- Natural gas shipping
- Road network construction
- Toll revenue maximization
- Hazardous material transportation
- Electricity demand management
- Chemical process optimization
- Gene-deletion strategy development
- Attacker-defender type problems
- Pollution control

**Methodology**
- Generalized Benders' decomposition framework
- Theory of Duality
- Algorithm for problems with two decision-makers
- Coding in an open-source optimization solver (C++)

**Warm Starting for Mixed Integer Linear Optimization**

**Motivation**
- Many applications require re-solving a problem:
  - Thousands of times per minute
  - Closely-related problems
  - Minor data changes

**Application Areas**
- Online optimization
- Routing
- Stochastic matching
- Resource allocation
- Optimization problem classes
- Bilevel optimization
- Multi-criteria optimization
- Stochastic optimization

**Algorithms**
- Decomposition
- Lagrangian relaxation

**Methodology**
- Solving a problem
- Gathering relevant information
- Reusing above information for solving another problem
- Coding in an open-source optimization solver (C/C++)