“An integer programming approach to constructing robust virtual backbone structures in wireless ad-hoc networks”

Je Sang Sung
Ph.D. Candidate,
Department of Industrial and Systems Engineering

Monday, September 2nd, 1:50 – 2:40
4002 Emerging Technologies Building

Abstract:

A connected dominating set is traditionally used to model a virtual backbone of a wireless ad-hoc network. However, the structure can be destroyed by the failure of one node. A k-connected d-dominating set has been proposed as a fault-tolerant virtual backbone and drew considerable attention from computer science and operations research communities. Despite its popularity, no exact approach has been applied to solve the minimum k-connected d-dominating set problem. This could be partially explained by the following intractability result we establish. For every pair of fixed positive integers k and d, it is NP-hard to approximate the minimum k-connected d-dominating set problem within a factor better than O(\log n). Three different mathematical programming formulations based on vertex cuts are proposed. The separation problem for vertex-cut inequalities is a weighted vertex-connectivity problem and can be solved in polynomial time. The research generalizes the concept of a vertex-cut and the corresponding vertex-cut inequalities by introducing the notions of r-robust vertex-cut and r-robust vertex-cut inequalities, respectively. For numerical experiments, a lazy-constraint approach is used, and the test results show that the proposed method compares favorably with existing approaches for the minimum 1-connected 1-dominating set (or minimum connected dominating set) problem.

This presentation is based upon a collaborative effort supported by the AFRL Mathematical Modeling and Optimization Institute

Bio:

Je Sang Sung is a Ph.D. candidate in the Department of Industrial and Systems Engineering at Texas A&M University, College Station. He completed his B.S. in Electric and Electronic Engineering from Korea University, Korea, in 2006 and M.S. in Industrial and Systems Engineering from Texas A&M University, College Station, in 2009. His research interests include graph theory, combinatorial optimization and facility locations with applications in wireless network. His Ph.D. dissertation advisor is Dr. Butenko. In summer of 2012 and 2013, he conducted research as operations research summer intern at Air Force Research Lab in Shalimar, Florida.