Department of Computer Science
University of Houston
Fall 2010 Seminar

WHEN: **THURSDAY, NOVEMBER 11, 2010**
WHERE: **PGH 563**
TIME: **11:00 AM**

SPEAKER: Dr. Ilya Safro, Argonne National Laboratory

Host: Dr. Ricardo Vilalta

TITLE: Multilevel Methods for Large-Scale Combinatorial Optimization Problems

Abstract: The main objective of multilevel algorithms (MA) is to create a hierarchy of problems, each representing the original problem, but with fewer degrees of freedom. We will talk about different strategies of creating these hierarchies for graph related NP-hard optimization problems: linear ordering problems (logarithmic and linear arrangements, 2-sum, bandwidth, workbound), (hyper)graph partitioning and constrained 2D-layout problem. These strategies are based on the classical multigrid frameworks: Geometric Multigrid, Algebraic Multigrid and Full Approximation Scheme. We will present in details a framework for designing linear time Algebraic Multigrid based MA for the minimum linear and logarithmic arrangement problems. Unfortunately, theoretical bounds for MA for combinatorial optimization problems are not known. Our algorithms were developed for practical purposes and we compared them to many different heuristics such as: spectral sequencing, optimally oriented decomposition tree, multilevel based, simulated annealing, genetic algorithms, path relinking, GRASP-based and others (including their combinations). For almost all large-scale instances, we observed significant improvement of the results and/or the computational time. Our MA have proved themselves to be very robust both as a first approximation and as more aggressive energy minimizers.
Time permits, we will discuss the notion of algebraic distance between graph vertices. Algebraic distance is inspired by Bootstrap Algebraic Multigrid. It can be successfully used as ingredient of MA on graphs, and as a preprocessing for greedy choice steps in algorithms for various well know connectivity based problems (such as approximated maximum matching, approximated minimum independent set, TSP, etc.).

Short bio: Ilya Safro studied Mathematics and Computer Science at the Weizmann Institute of Science where he obtained his Ph.D. under the supervision of Achi Brandt and Dorit Ron. Since 2007 Ilya was a postdoctoral fellow at Argonne National Laboratory. Today he is an Argonne Scholar at the Laboratory of Advanced Numerical Simulations at Argonne National Laboratory. His research interests include multiscale and multilevel methods, network analysis and combinatorial optimization problems.