Dinesh P. Mehta: Research Interests & Style

My research area is in applied algorithms and data structures. My research papers typically consist of formulating an algorithmic problem, arguing that this formulation is practical in the context of the application area, developing theory to better characterize the problem, and then exploiting the theory to develop an efficient algorithm. When the problem is inherently intractable, as a lot of real-world problems are, pure algorithmic theory only takes you so far. In these cases, my research involves developing algorithms that are expected (but not guaranteed) to do well. Software that implements the algorithms is then developed and evaluated by running experiments on benchmarks. The performance of the algorithm is judged on run time (how long it takes to execute) and on the quality of the solution it obtains. Thus, my research usually makes both a theoretical and an experimental contribution. Some of the application areas I have studied recently or am currently studying include

1. *VLSI Floorplanning.* Floorplanning is the placement of large circuit components on a chip to optimize various criteria and is an integral step in the design of modern chips. Most of my recent work in this area is joint with Yan Feng, who received his PhD in 2004. Yan's research resulted in two publications in IEEE Transactions on CAD and was presented at three conferences. Our contribution was to formulate the floorplanning problem (which has been around for several decades) in a manner that is more suitable to industry (our formulation was developed in collaboration with scientists at Intel) and then solve our version of the problem using a combination of graph- theoretic, geometric and iterative techniques. Our algorithms were implemented and run on established benchmarks. Yan is now at Cadence after a stint at U. Minnesota as a post-doctoral researcher with Prof Sapatnekar.

2. *Mobile computing.* My recent work in this area is with Sahar Idwan, who received her PhD in 2005. Sahar's work is on the pursuer-evader problem. This problem enjoyed a resurgence because it was posed as a challenge problem by the DARPA NEST (Network Embedded Software Technology) program. The objective of this research was for the pursuer to capture the evader in minimum time using a minimum number of updates in a road network. Sahar's research involved developing

lower bounds and approximation algorithms for the problem, developing probabilistic graph-based algorithms and employing hierarchical graphs to improve computation time. Algorithms were developed using LEDA and were run on several benchmarks including a roadmap of the Denver metropolitan area. We currently have one journal and one conference publication, with a few more in the pipeline. Sahar is currently an Assistant Professor at Hashemite University in Jordan.

3. *Algorithmic vulnerability.* This was joint work with Andrew Johnson and Prof. Ramki Thurimella (University of Denver). Andrew received a thesis-based M.S. degree in 2005. Andrew used an innovative combination of simulated annealing and architectural and software tools to automatically find the worst case inputs of sorting algorithms. His methods were based on supplying the algorithms with inputs and determining the algorithm's runtime using architectural or software techniques.

4. *Cheminformatics.* This is ongoing work with John Crabtree, a PhD candidate in the Math & CS department at the Colorado School of Mines and with Profs Dean and McKinnon in the Chemical Engineering department. The overall goal of this research is to automate the analysis of large mechanisms that describe the operation of large industrial chemical processes. At the heart of this are difficult graph-theoretic problems (note that graphs arise in this context because graphs can be used to model molecular structure) that we are trying to solve.