TIFR Centre for Interdisciplinary Sciences
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Seminar

An efficient data-driven approach to static and dynamic ambulance location for emergency medical services

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We present an efficient, data-driven computational approach to ambulance deployment for Emergency Medical Services (EMS) systems. Central to our approach is the use of simulation to accurately determine the impact of ambulance deployments to a given distribution of emergency requests. Our simulator allows us to directly measure a wide range of metrics (e.g., the number of requests serviced within 15 minutes, or the opportunity cost of abandonment) while accounting for complex interdependencies (e.g., from overlapping requests). It also allows the capture of non-stationary or transient effects that cannot be captured easily using analytical models. Leveraging our simulator, we present a computational approach to ambulance fleet allocation and dynamic redeployment, where the goal is to position ambulances to bases to maximize the systems service level. Despite the combinatorial complexity, we show that a simple and efficient greedy algorithm produces good solutions, and can be repeatedly employed in real-time for dynamic repositioning. We derive data-driven performance guarantees with provably small optimality gap for our approach in practical settings. Our data-driven analysis is general and can be applied to range of simulators that exhibit more (or less) realism than the simulator employed in our empirical evaluations - the key requirement is the ability to efficiently compute the behavior of an omniscient policy with perfect information regarding future requests. We conduct simulation experiments based on real usage data of an EMS system from a large Asian city, and demonstrate significant improvement in the system's service levels using static allocations and redeployment policies discovered by our approach.

Wednesday, May 20th 2015

4:00 PM (Tea/Coffee at 3:45 PM)

Seminar Hall, TCIS