**PhD Proposal**

**Adaptive Graph-Based Algorithms for Conditional Anomaly Detection**

**Michal Valko**

Monday December 20, 2010   
2:30pm - SENSQ 5317

**Abstract**

The proposal develops and presents new statistical anomaly detection methods for detecting conditional outliers and applies them to the identification of unusual outcomes and patient management decisions.  Our hypothesis is that patient-management decisions that are unusual with respect to past patients may be due to errors and that it is worthwhile to raise an alert if such a condition is encountered. Conditional anomaly detection extends standard unconditional anomaly framework but also faces new problems known as fringe points and unconditional anomalies. We present novel nonparametric graph-based methods to tackle these problems. Our methods rely on graph connectivity analysis and soft harmonic solution.  
  
We also introduce an online formulation of the problem. When data arrive in a stream, the problems of computation and data storage arise for any graph-based method. We propose a fast approximate online algorithm that solves for the harmonic solution on an approximate graph. We show, both empirically and theoretically, that good behavior can be achieved by collapsing nearby points into a set of local representative points that minimize distortion. Moreover, we regularize the harmonic solution to achieve better stability properties. Next, we show the application of the proposed methods to semi-supervised learning. Finally, we present an extensive human evaluation study of our methods by 15 experts in critical care.

**Dissertation Adviser**

Dr. Milos Hauskrecht, Department of Computer Science

**Committee Members**

Dr. Liz Marai, Department of Computer Science  
Dr. Diane Litman, Department of Computer Science  
Dr. John Lafferty, Machine Learning Department, Carnegie Mellon University