

## Information Science and Technology Center Seminar Series

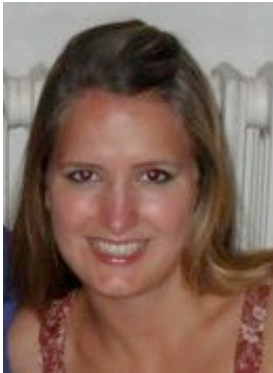


**Nick Heard and Melissa Turcotte**  
**Imperial College London**

### "Bayesian Anomaly Detection Methods for Social Networks"

**Wednesday, August 3, 2011**  
**2:00 - 3:00 PM**

**TA-3, Bldg. 1690, Room 102 (CNLS Conference Room)**



**Abstract:** Anomaly detection on graphs of social or communication networks has important security applications. However, learning the network structure of a large graph is computationally demanding, and dynamically monitoring the network over time for any changes in structure threatens to be more challenging still.

This talk presents a two-stage method for anomaly detection in dynamic graphs: the first stage uses simple, conjugate Bayesian models for counting processes to track the pairwise links of all nodes in the graph to assess normality of behaviour; the second stage applies standard network inference tools on a greatly reduced subset of potentially anomalous nodes identified in the first stage.

Two alternative methods are considered for monitoring communications (stage 1). The first method aggregates the data into discrete time periods and fits a probability model to the communication counts. Outlying counts according to this probability model then define the anomalies. Such a procedure is computationally very fast, but there are also limitations which will be discussed.

The second method assumes communications to be event times from an inhomogeneous Poisson process with piecewise constant intensity. There, anomalous behaviour is defined by a recent change in intensity. This more flexible modelling framework does not carry the limitations of the first method but also adds an extra computational challenge; to address this, a novel sequential Monte Carlo algorithm is introduced which allows the rapid inference required.

**Biographies:** Heard currently is a lecturer in Statistics and Postdoctoral Research Associate at the Imperial College London. He received his PhD at the Imperial College London in 2000 and his BSc at the University of Bristol in 1996. He has research interests in Computational Bayesian inference; cluster analysis; Markov chain Monte Carlo (MCMC) and Sequential Monte Carlo (SMC) simulation techniques; application of statistical methods to cDNA microarray data sets; dynamic anomaly detection in large graphs; and survival models in retail finance.

Turcotte is currently a PhD student at the Imperial College London. She received her MSci at the Imperial College London in 2009. Her research topic is Real time Anomaly Detection with Applications in Dynamic Networks. In 2009, she received the Tensor Society Mathematical Prize for Excellence in Applied Mathematics and the Winner of Science, Engineering and Technology national project prize in the Mathematics category.