Thesis: Performance Modeling for Network Anomaly Detection and Sensor Networks

Abstract: Computer networks have become one of the fundamental communication infrastructures of the modern world. Data collection and data analysis over computer networks is a broad area of research and is getting more and more complicated with the ever-increasing complexity of computer networks. In this dissertation, I will conduct performance modeling work for a few network scenarios and applications.

In the first part of this thesis, I will focus on two vital perspectives of the Internet, one from network administrators and the other from network users. Network administrators are key to managing and protecting a computer network. I will study how system access data of the daily activities of network administrators can help in building an extra layer of protection for a computer network. On the other hand, with ubiquitous wireless networks, I'm also interested in having an in-depth understanding of the traffic data of wireless networks. Thus, I collected and analyzed Wi-Fi data from multiple locations with interesting observations.

In the second part of this dissertation, I will explore two closely related problems in wireless sensor networks. One is the coverage problem and the other is the pursuit-evasion problem. These two problems are highly dependent on the topology of a sensor network, and thus a very good candidate for applying topological data analysis. For the network coverage problem, I propose an efficient algorithm to compute the Cech complex, which is used to capture the shape of the network and compute simplicial homology groups on top of the Cech complex for verifying the network coverage and showing other characteristics of the coverage. For the pursuit-evasion problem, which is dynamic in its nature, I propose an extension to an existing algorithm such that it can work in a distributed setting.

Committee:

- Professor Ping Ji, Mentor, John Jay College
- Professor Theodore Brown, Queens College
- Professor Shweta Jain, John Jay College
- Professor Mikael Vejdemo-Johansson, College Of Staten Island

Outside member:

- Professor Joseph Burdis, Outside Member, Datarobot Inc.