Massively Parallel Empirical Dynamic Modeling for Network Traffic Analysis

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Abstract (should be within 1st page)

Dynamical system is a system that cannot find an actual pattern of the system and the behavior is changed from time to time by multiple unpredicted factors. Dealing with the dynamical system is one of the challenges. Empirical Dynamic Modeling (EDM) is a mathematical framework for modeling nonlinear dynamical systems. EDM is applied in multiple fields, such as biology, oceanography, and others. However, EDM is rarely seen in computer science fields. Network traffic is a system that can be assumed as a dynamical system.

In this dissertation, I propose to leverage EDM into the HPC and SDN fields. First, I develop an EDM library for HPC systems, called mpEDM. mpEDM is a massive parallel implementation of EDM. From the result, mpEDM is faster than the existing EDM implementation up to 1,530 times. Second, I develop a monitoring system for the OpenFlow network to monitor and collect the network traffic information, called Opimon. Opimon is an OpenFlow network monitoring system that can monitor, visualize, and analyze network traffic in real-time. The monitoring module is optimized to be low-latency and transparent to the network. Finally, I leverage EDM to analyze the network traffic data for predicting abnormal behavior in the network. I also compare the performance with traditional machine learning, which are auto regression and LSTM. The preliminary results show that EDM can predict the traffic faster than the LSTM with the near accuracy and lower error than auto regression with the same dataset.