Research Statement

My research interests range from efficiency and correctness in networking and distributed systems, Internet of Things(IoT) security and privacy, and interaction testing. I witnessed the rapid growth and vast benefits of 5G networks and IoT as well as associated efficiency and correctness concerns during a 2019 internship at Red Pulse, where I worked as a research analyst for China's technology sector. The broad impacts of these emerging fields motivated me to pursue these research topics. My ongoing research experiences relate to network verification, interoperability, and interaction testing. I will also be participating in a new project dedicated to automated IoT device security evaluation.

I am working with Professor Aaron Gember-Jacobson on a research project for practical bug detection in routing protocols implementations. This research is particularly critical given that past research shows the majority of bugs are detectable by observing control plane messages and automating the detection task grants more practicality and efficiency to bug resolutions. In the summer of 2019, I simulated routers and networks running the BGP routing protocol using Docker and, collaborating with research peers, created a tool that can analyze router logs and exchanged control packets. This tool allows for verifying whether the captured information conforms to the rules that we inferred from the protocol standard documentations.

The standard documentation specifications for network protocols are often abstract and ambiguous, making extraction and formalization of rules difficult for researchers. I am conducting my senior thesis research to automatically identify potential non-interoperabilities in parallel-running OSPF protocol implementations caused by disparate interpretations of ambiguous specifications. Building upon my experience with network verification, my thesis approaches this problem by computing the set of packets that one implementation can forward but other receiving implementations consider non-compliant. This approach could be generalized to other software routing protocols to address non-interoperabilities in these important heterogeneous systems as well.

I am also working closely with Professor Ryan Dougherty on interaction testing for designing software testing suites, where I am investigating the effects of parameter changes in covering array probability and evaluating consistencies of estimated bounds from covering array generation methods. This research indicates that unit increases in covering array strength result in the highest percentage declines in the probability of finding a covering array randomly. This experience with interaction testing is also particularly helpful for my network verification and non-interoperability research, as it connects events and packets to processes and states in covering arrays. I am also co-organizing the continuous covering arrays question proposal in the upcoming 2021 Genetic and Evolutionary Computation Conference.

Considering my career options, I aim to remain active in academia as a professor and share my ideas with others. Specifically, I enjoy the innovative and vibrant atmosphere and working environment that universities provide, where individuals can freely pursue subjects that they are passionate about. While I am eager to gain a deeper understanding of my current topics, I am also looking to expand my interests similar to how I began my interoperability research by combining my knowledge in interaction testing and network verification.