Stochastic Systems

Research in Stochastic Systems focuses on using stochastic modeling and probabilistic analysis to capture the uncertainty in real-world systems, and combining with optimization and optimal control techniques to provide insights and solutions for the design and management of various systems. Research at ISE can be divided into the following related areas:

- Queueing systems
- Emerging stochastic networks
- Optimal control

**Queueing systems:** Many real-life systems can be characterized as queueing systems consisting of customers that wait for service from a collection of servers. Research in this area concerns developing suitable stochastic models, analytical techniques and simulation methods for predicting performance, helping make strategic decisions on resources, and identifying the optimal design for such systems. Applications broadly exist in call centers, manufacturing systems, voting systems, vehicle sharing systems, supply chain and logistics, etc. (Allen, Bayraksan, Xia)

**Emerging stochastic networks:** This area of research concerns the development of new stochastic models and analytical methods to understand the dynamics of today's emerging stochastic networks such as social networks, cloud computing, big data processing networks, etc. Focus is more on nonconventional performance metrics such as scalability, reliability, availability, influenceability, etc. (Allen, Xia).

**Optimal control:** This area of research focuses on the management of stochastic systems at the operation stage. It deals with the problem of finding the optimal dynamic policies on scheduling, load balancing, resource allocation, admission control, pricing, inventory management, etc such that a certain optimality criterion (e.g. cost, revenue, delay) is achieved. Such decisions are typically data driven and adaptive to dynamic environment changes. Techniques include Markov decision processes, Bayesian adaptive control, learning, distributed algorithms, etc. Applications at OSU include but not limit to: e-commerce, wireless networks, cloud computing, smart grids, and cyber security systems, etc. (Allen, Bayraksan, Xia).