CAREER: Resilient Design of Networked Infrastructure Systems: Models, Validation, and Synthesis

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Description

Problem: Infrastructure systems (and services) lack robustness and security against failures caused by **natural events and malicious attacks**

Cyber-attacks (Ukraine power cut)

Natural disasters (Hurricane Maria)

Network monitoring

Control and response

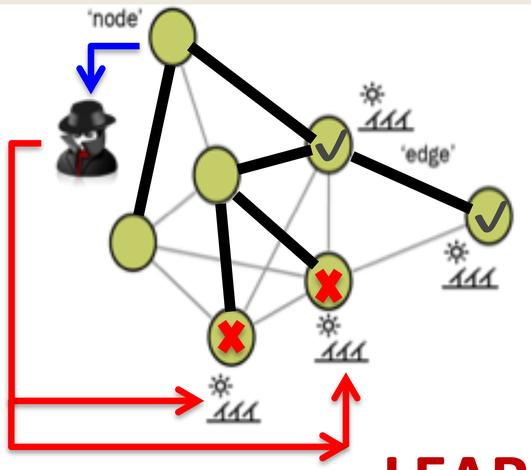
Approach:

Using **control theory and large-scale optimization**, along with **game-theoretic analysis of attack-defense** for the purpose of designing tools to **detect & actively respond to failures**

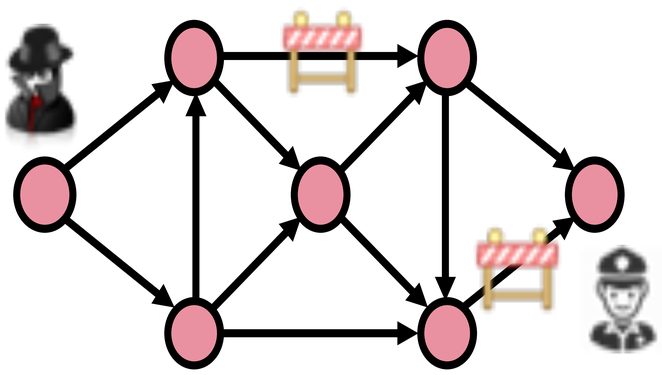
Findings

GAMES FOR ROUTING AND SECURITY

Optimal allocation of flexible resources to improve resilience to attacks

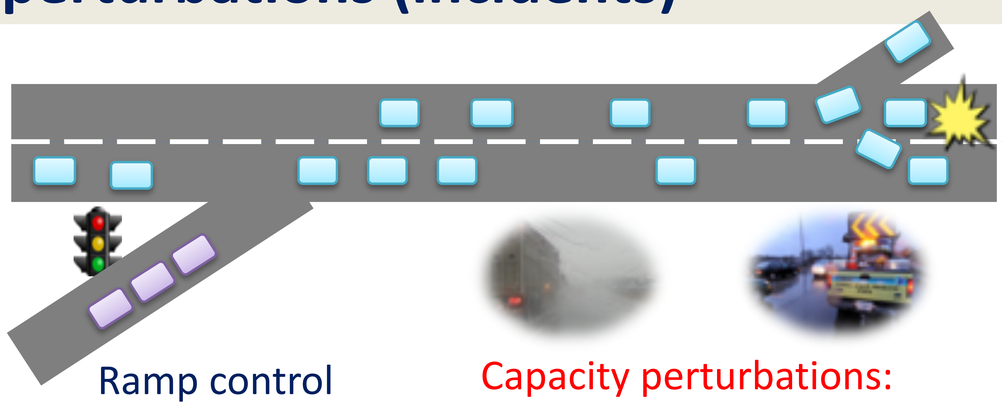


Network interdiction to prevent routing of illegal traffic/goods in flow networks



LEARNING AND CONTROL OF QUEUES

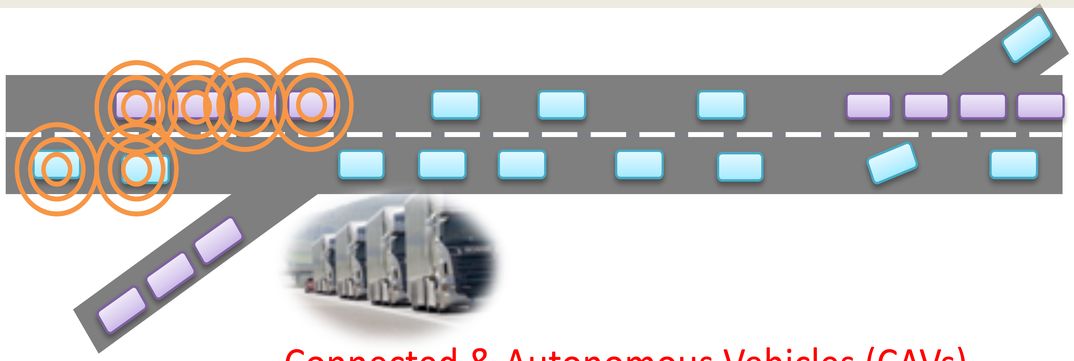
Control in the face of stochastic capacity perturbations (incidents)



Ramp control

Capacity perturbations: weather, incidents

Modeling traffic flow with autonomous vehicle platoons, assessing their impact



Connected & Autonomous Vehicles (CAVs)

All these problems are concerned with **monitoring and response operations in the face of failures, random or adversarial**. **We exploit their structural properties to solve them for large-scale networks with good approximation guarantees.**