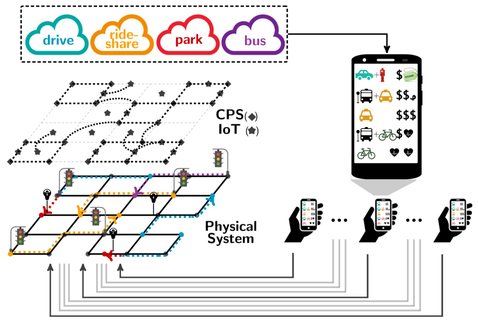
2021 NSF SMART AND CONNECTED COMMUNITIES PI MEETING

Data-Informed Modeling and Correct-by-Design Control Protocols for Personal Mobility in Intelligent Urban Transportation Systems; NSF Award 1736582

PIs: Lillian J. Ratliff, Behcet Acikmese, Samuel Coogan, Juan Matute; Students: Yue Yu, Sarah H.Q. Li, Tanner Fiez Daniel Calderone

Project Aim

Rich data streams available through collaborators are being leveraged to learn **data-informed models** and **correct-by-design policies** such as demand-based pricing for parking and traffic light control.



Integrative Research Approach

The project is organized along three key, integrated thrusts:

1. **Data informed stochastic dynamical models** of personal mobility (vehicle sharing, personal vehicles, and parking) including Markov decision processes and stochastic games
2. **Correct-By-Design** optimal decision policy synthesis using formal methods and convex optimization
3. **Formal verification and validation** of algorithms via rigorous simulation and a series of living lab experiments.

Community Partners

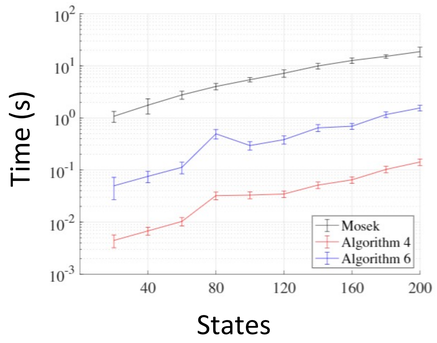
THE U DISTRICT PARTNERSHIP; downtown santa monica third street promenade; WESTWOOD VILLAGE; City of Santa Monica; SDOT Seattle Department of Transportation; idax DATA SOLUTIONS; LADOT; smarking

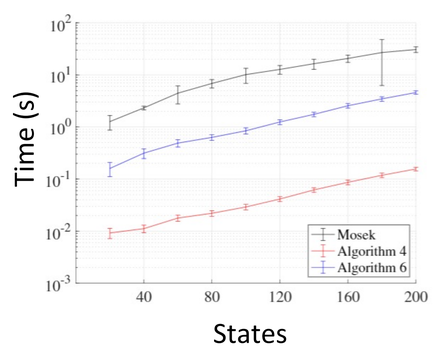
Significant Accomplishments

Significant accomplishments on the project can be categorized into theoretical outcomes and experimental outcomes.

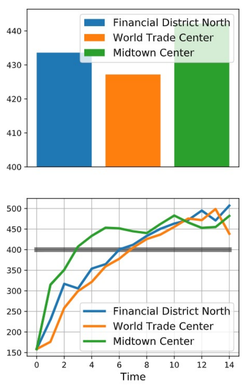
Theoretical Outcomes:

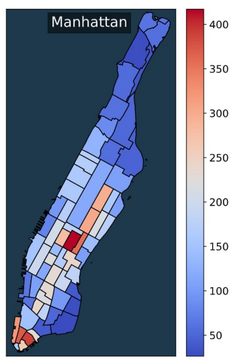
- Development of algorithmic tools for solving routing games with stochastic dynamics for individual decision makers that can be used to construct simple, but effective control policies for traffic flow. **Application**: to derive highly efficient numerical algorithms for generating individual agent policies under multi-agent congestion dynamics.

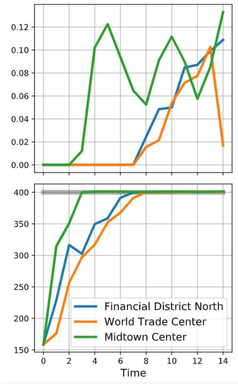


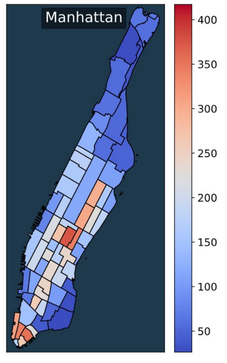


- Optimization framework for synthesis of incentives for constraint satisfaction within stochastic games. **Application:** to redistribution of rideshare drivers in Manhattan, New York; outcome: 20% decrease in ride-share traffic congestion by imposing less than $2 toll per taxi zone on the ride-share drivers.



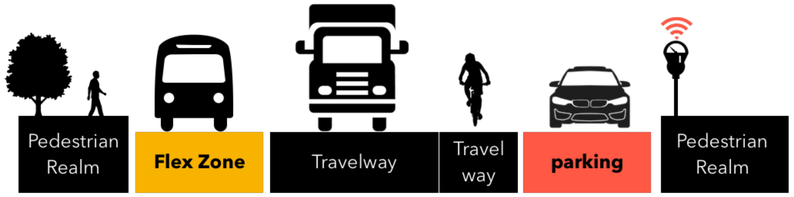






Anticipated Outcomes in the Next Year

- Leverage existing data sets and machine learning machinery to develop multi-agent learning algorithms.
- Apply incentive design techniques to improve efficiency average efficiency in highly congested traffic networks.
- Work with PNNL to develop auction mechanisms for flex zones in curbside markets.



Toughest Challenges

- Coordinating between companies, academic researchers, and government organizations—everyone has different interests and timelines!
- Changing laws: now required to get permits for placing cameras

Community Engagement & Outreach

- We engage with several commercial districts in the partner cities (**Seattle, Santa Monica, LA**) that are significant stakeholders in mobility and parking systems and serve very diverse communities. The goal of this engagement is to identify **real-world conditions** and **policy objectives** that will inform the proposed research.
- We will hold **Mobility Policy & Engineering Bootcamps** to engage students and the broader community in the discussion in order to increase impact.
- Towards **Broadening Participation in Computing,** we have REU students developing augmented reality visualization tool

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