2021 NSF CYBER-PHYSICAL SYSTEMS PRINCIPAL INVESTIGATORS' MEETING

# CPS: Small: Collaborative Research: Information Design and Price Mechanisms in Platforms for Cyber-Physical Systems with Learning Agents

**Award #s 1931718 (University of Washington) / 1931696 (Stanford)**

**PI: Lillian Ratliff (UW), Co-PI: Baosen Zhang (UW) / PI: Ramesh Johari (Stanford)**

## Challenge:

- Our project studies the design, and evaluation of pricing and information mechanisms for platforms where agents learn over time.
- *This talk:* How do we evaluate ("A/B test") two policies?
- Problem: One policy changes state seen by the other
- Standard approach in industry is *switchback experimentation*
- But this can be badly biased and sample inefficient

## Solution:

- We use a Markov chain approach to design efficient, consistent experiments and estimators

*Contact:*
Ramesh Johari
(rjohari@stanford.edu)

***Suppose you are one of these:*** lyft Uber DOORDASH

***And compare two pricing policies: A ("high prices") vs. B ("low prices").***

***Standard practice is a* switchback design: *Alternate A then B.***


***Problem*: B will use up supply, so A will look worse than it really is!**

**We develop an adaptive experimental design and estimator for this problem.**
(Glynn, Johari, Rasouli, NeurIPS 2020)

## Scientific Impact:

- "AI at system scale": Policies that are stateful and change the entire system (pricing, information design, etc.) can't be A/B tested classically
- Need novel experimental approaches to evaluate these policies; our work provides a foundation for these designs
- Ongoing work focused on computational efficiency and adaptive clustered crossover designs

## Broader Impact:

- In the real world, proposed changes to system operation (e.g., in ridesharing systems: pricing, matching, information disclosure, etc.) are never just implemented – they are **always** tested first.
- Understanding how to compare stateful algorithms in the field is essential if we plan to see our innovations eventually used in practice.
- Relevant in all platforms where stateful policies are compared (transportation, power, health care, etc.)