CRII: CPS: Towards Efficient Shared Electric Micromobility: An Interaction-aware Management Framework for Mobile Cyber-Physical Systems

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Shared micromobility systems (e.g., shared bikes and scooters), as an emerging example of mobile CPS, have been increasingly popular in recent years. In this project, we aim to design an efficient electric shared micomobility **management framework**, especially considering **human interactions** with the system (e.g., usage, energy consumption, and preferences).

Challenge 1: model human interactions with the system (**Sensing**): Complex spatiotemporal correlations.

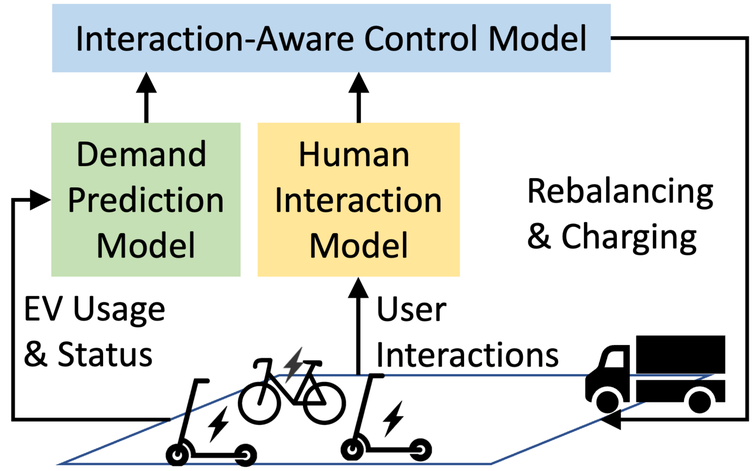
Challenge 2: incorporate interaction models to inform the management framework (**Control**): Uncertainty of interaction models.

Solutions:

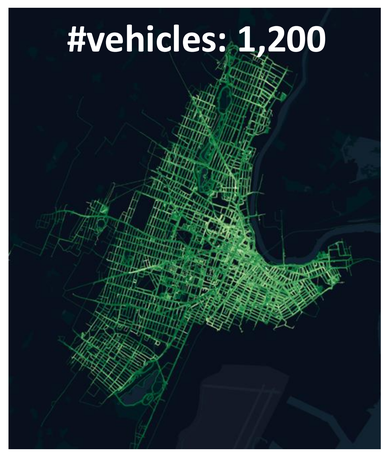
- Shared electric micromobility vehicle rebalancing and charging with energy-informed demand [Best Paper Award at CIKM'23]
- Multi-task offline reinforcement learning with contrastive data sharing for behavior modeling [KDD'24]
- Human preference-aware rebalancing and charging for shared electric micromobility vehicles [ICRA'24]

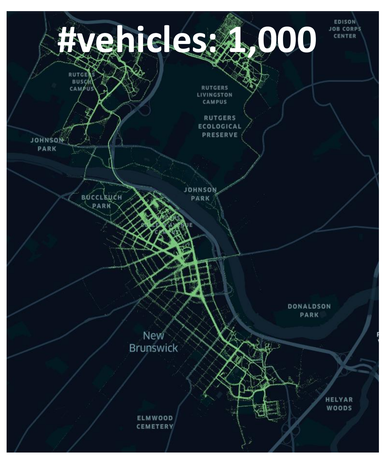
Scientific Impact on CPS

- Data-driven approaches for human interaction modeling
- Model uncertainty quantification with spatial-temporal conformal prediction
- Uncertainty-aware Reinforcement Learning-based Scheduling and Planning



Physical World with Shared Micromobility Vehicles





Testbeds in Newark and New Brunswick, New Jersey

Broader Impacts: Society

- Provide a human centered management framework for service operators with better service quality
- Meet residential demand for mobility and their connections

Broad Impacts: Education and Outreach

- Interaction platforms by REU students
- Research training for undergraduate and graduate students
- Workshop: njbikeped.org/micromobility-workshop-2024, March 22nd

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Award ID#: 2246080