MATHEMATICAL MODEL FOR RIDESHARING MATCHING ALGORITHM OPTIMIZATION:

ANALYSIS ON MARKET THICKNESS AND BATCHING TIME OF CENTRALIZED MATCHING ALGORITHM

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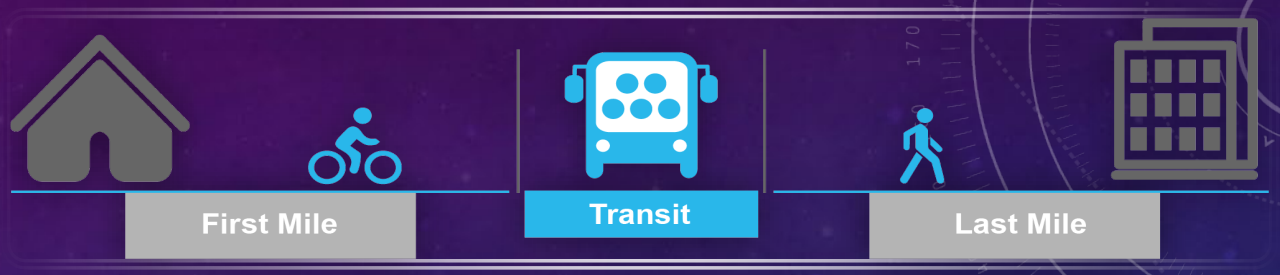
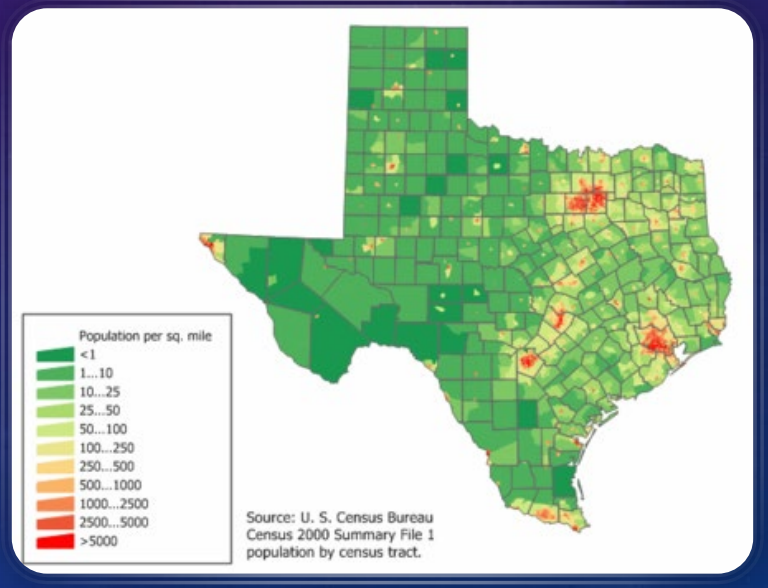
MOTIVATION: DOES THICKNESS MATTER?



- Market Thickness: The total flow of supply and demand in a given market
- Isolation in small towns and rural communities create the Last Mile Problem (LMP) to those who depend on public transportation.
- In thick markets, the LMP is solved by ridesharing companies and other on-demand transportation companies.
- But, we wanted to know if for sparse markets the conditions need to be different for a self-sustainable ride-sharing transportation.



REAL WORLD EXAMPLE

LUBBOCK, TX

OPTIMIZE SHARED MOBILITY SERVICE

- People with limited mobility options are vulnerable in disasters
  - Aging, disabled, rural, etc.
- Minimal size of Shared AV (SAV) fleet to ensure service quality
  - Treated as a two-sided market
  - Service quality determined by several factors, incl. market thickness, matching algorithm, spatiotemporal demand pattern, etc.
- Proposed agent-based model
  - Rider tolerance
  - Coupled dynamics of matching & queuing

MODEL FORMULATION

- Stochastic Processes: Spatio-Temporal Poisson Process
- Agent-Based Modeling
- Matching Mechanism: Batch Matching
- Mixed Integer Linear Programming (MILP)
- Interaction Between Riders and Drivers

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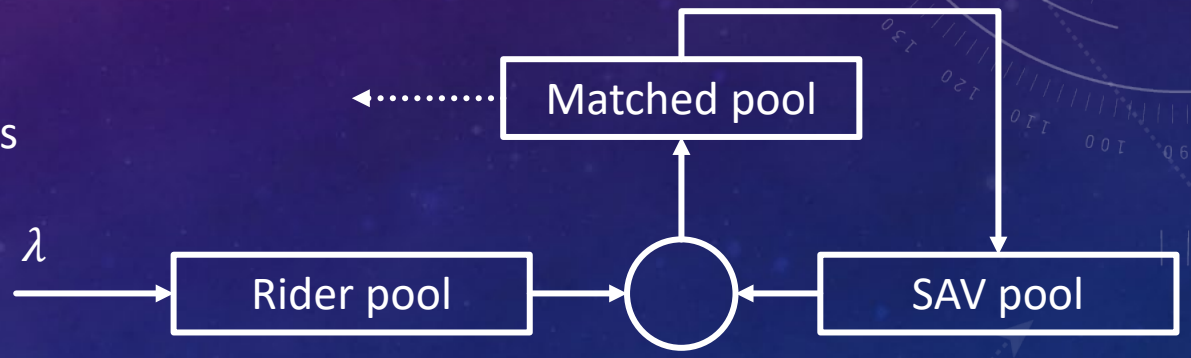
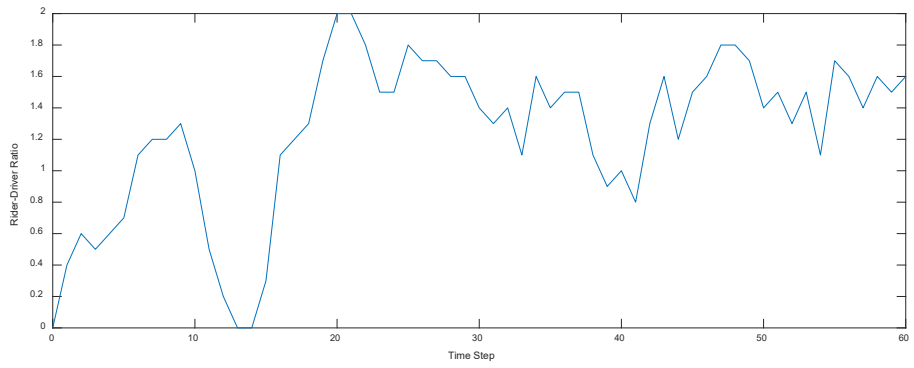
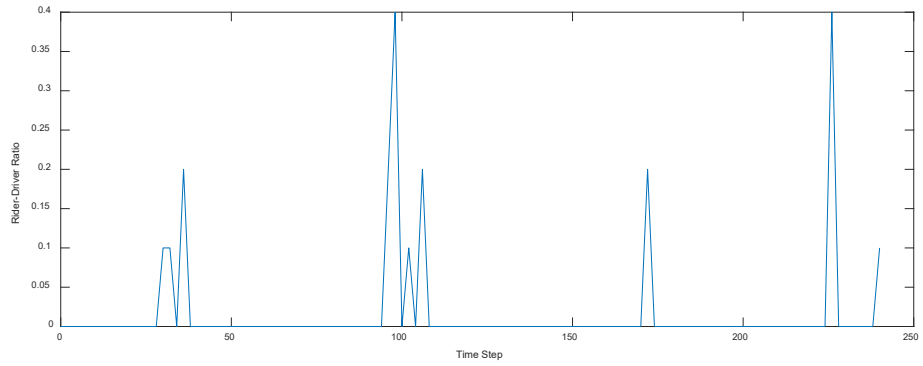


The multi-agent framework

RESULTS

BIFURCATION OCCURS WHEN MARKET THICKNESS CHANGES





POLICY IMPLICATIONS AND NEXT STEPS

- Minimal fleet size to serve to a region
- Two-sided market interpretation
- Next steps: theoretical analysis, fleet optimization