# First-Mile-Last-Mile Collector-Distributor Systems Using Shared AVs

THE UNIVERSITY OF TEXAS AT AUSTIN
WHAT STARTS HERE CHANGES THE WORLD

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## Introduction

- **Autonomous vehicles (AVs)** should make travel **easier** & **safer**.
- Personal AVs & shared **AVs (SAVs)** may **reduce walking, biking, & transit use**, while **worsening congestion**.
- **Public transit (PT)** can **be more space efficient** than other modes.
- Many cities & regions have made **big transit investments**, in rail etc.
- However, **PT mode share** is just **3%** of U.S. passenger **daily travel**, & **less than 10%** of all **local travel** in most U.S. cities.
- Difficulty of connecting trip **Os & Ds** to **PT stops** is the **first-mile-last-mile (FMLM) problem**.
- **Use of SAVs for FMLM access & egress** is **studied here** to assess **opportunities** for supporting **PT use**.

## Methods

- **Multi-Agent Simulation (MATSim)** used to micro-simulate 5% of **City of Austin's** person-trips over 24 hrs.
- **SAVs** are **endogenously** modeled using Hörl's (2017) code, which allows **dynamic ride-sharing (DRS)** across passengers/strangers & **congestion feedback**.
- **Austin's bus & LRT schedules** are integrated using MATSim's **PT router** .
- **Special PT access & egress function** adapted from Bischoff et al. (2019).
- **Impact** of **SAVs on PT use** tested using **scenario analysis**:
  - → **Case 0: Business-as-usual (BAU)** for current Austin conditions
  - → **Case I:** SAVs provide **door-to-door** service, between Os & Ds
  - → **Case II:** SAVs serve **door-to-door travel** plus **FMLM**

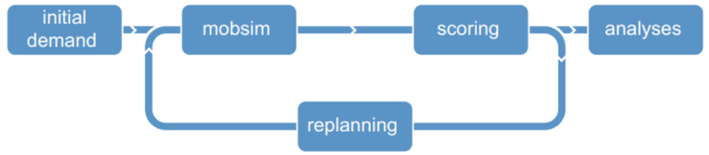


**Figure 1.** MATSim Travel Design Model (Horni et al., 2016)

## Assumptions

- **Just 10%** of Austin's travelers assumed to **not** have access to cars.
- **Two levels** of **SAV fares** tested: **$2/mi** (HF) vs. **$0.50/mi** (LF).
- **1 SAV** available for every **10 persons** w/o DRS & **50 persons** with DRS.
- **Nearest SAV** matched w/o DRS vs SAV had to be **< 30 min** away for DRS.
- **PT walk access distance** had to be < **0.25 mile** unless **mode alternatives** don't exist in that trip-maker's origin zone.

## Results

- **PT use falls** in all SAV scenarios, **regardless** of **SAV fares** & **service characteristics**.
- **Traveler utility rises** with $0.50/mile SAVs from **better accessibility**.
- **Higher PT use** when **SAVs** are **expensive** shows **share of choice riders**.

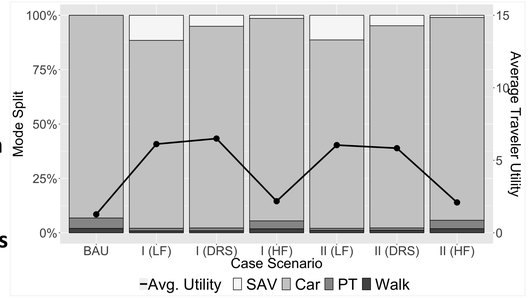


**Figure 2.** Mode shares & average utility

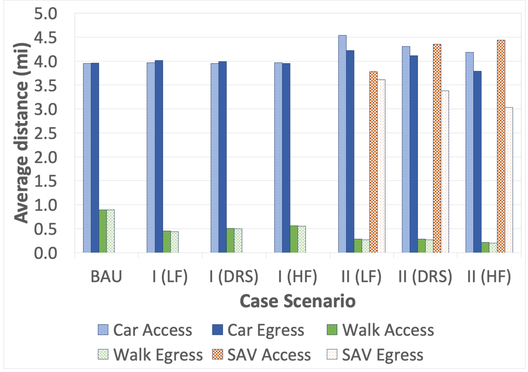


**Figure 3.** Access & egress distances by mode

- **Avg. walk** access/ egress **distance ↓** when **SAVs available** for **FMLM** trips.
- **SAV** access to PT higher than **SAV** egress use when serving **FMLM** trips, especially with high SAV fares.

## More Results

- **Transit** ridership significantly **higher when SAV fares are high.**
- **AM & PM peaks** match **BAU usage** when **SAV fares** are **high.**
- **High-density** areas see **↑** in transit use when **SAVs** are **expensive,** likely from **shorter walk** access.

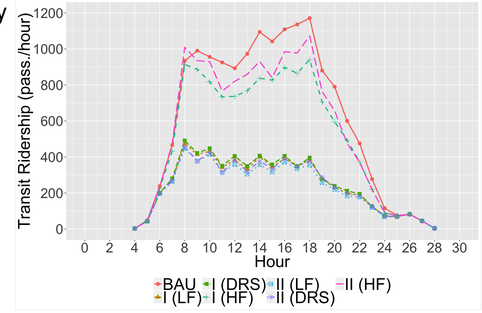


**Figure 4.** Transit ridership by time of the day

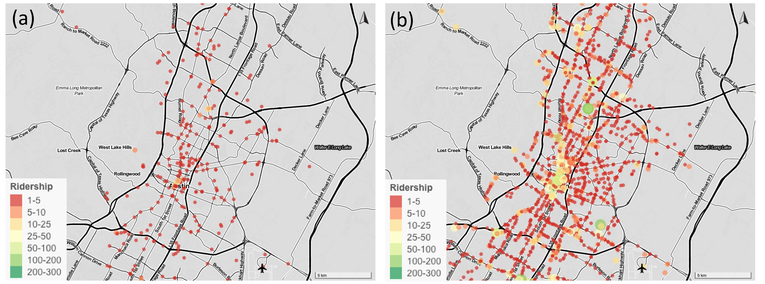


**Figure 5.** Transit ridership by stop location: (a) Case II-LF & (b) Case II-HF

## Conclusions

- Unfortunately, **SAV availability** for **FMLM trips does not increase** Austin **transit demand**, versus BAU conditions.
- **High SAV fares help maintain transit demand** when SAVs are available for Austinites' **FMLM trips**.
- **SAVs seem to complement Austin's transit use** rather than supplement it.
- Methods used here can help agencies **predict spatio-temporal changes** in **transit use** & improve system-wide **levels of service**.