Leveraging Shared Autonomous Vehicles for Greater Community Health, Equity, Livability and Prosperity (HELP)

NSF Project ID: 18-31140

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(IRG, FY2018)

Principal Research Investigators

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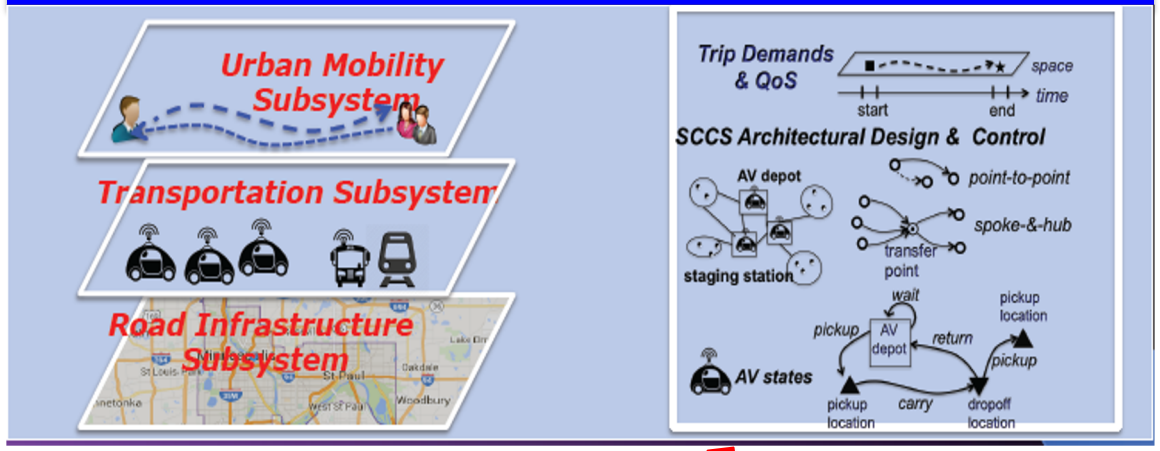
Community Partners

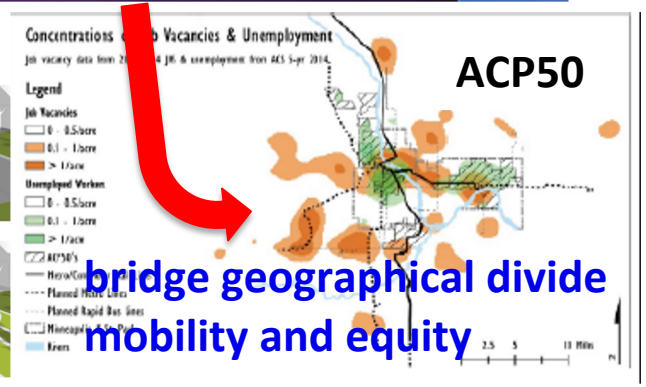
UMN Center for Transportation Systems
Minnesota Department of Transportation (MNDoT)
Twin Cities Metropolitan Council (Met Council)
Metro Transit & Southwest Transit
Cities of Minneapolis/St. Paul,
Destination Medicine Center (Rochester, MN)
Hourcar
Hitch Health
Twin Cities Shared Mobility Equity Task Force
Southeast MN Together
Urban Research Outreach-Engagement Center
Greater MSP

Project Overview

Smart Cloud Commuting Service (SCCS)



urban re-design
better land use



bridge geographical divide
mobility and equity

Self-driving cars are coming!

- envisaging & designing a *transformative* transportation & mobility service based shared autonomous vehicles (SAVs) for future smart cities/communities
  - ➢ bridging technology/geographical divides, bringing benefits to diverse communities & addressing mobility-equity issues
- working w/ stakeholders, policy makers & communities on *five pilot projects* to identify & tackle various socio-economic challenges

Project Overview

Use-Inspired Research

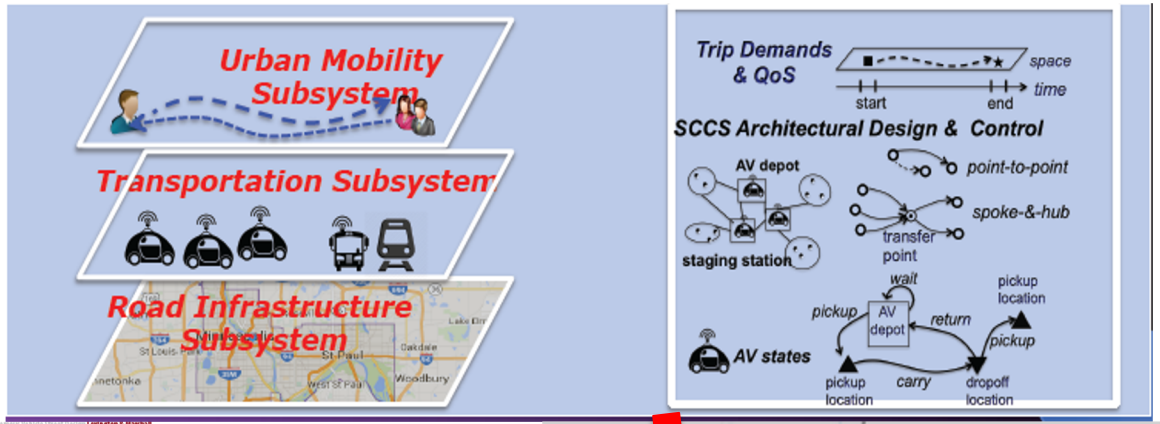
- ***Leveraging giant pools of shared AVs of various types to develop a transformative future transportation services***
  - ➢ targeting daily commutes (instead of ad hoc trips only)
  - ➢ exploiting *economy of scale* & leverage various system *efficiency gains* it brings

- ***Quantifying system efficiency gains*** *of cloud commuting via shared AVs, & analyzing the levels of QoS delivered to users*
- ***Quantifying architectural design choices & operational challenges****: Designing SCCS with the coverage, convenience and QoS to meet user expectations.*
- ***Economic viability & efficiency-equity trade-offs:*** *Studying the cost-effectiveness, economic viability & efficiency-equity tradeoffs of SCCS through modeling and analysis of AV ownership options and market structures.*
- ***Social Impacts of SCCS:*** *Studying the social impacts of AVs on diverse communities, urban re-design and land use issues.*

Fundamental Research Contributions

Smart Cloud Commuting Service (SCCS)

- *as convenient (but cheaper & less hassle) as owning a car*
- *as affordable, but more flexible as public transit services*
- ***tackle inequalities & bridge digital & geographical divides***
- ***offer equitable mobility-on-demand (MoD) services***



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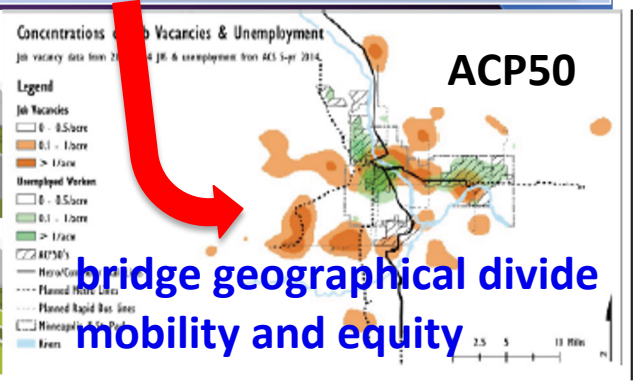
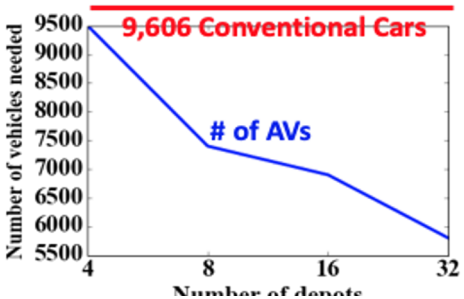


bridge geographical divide

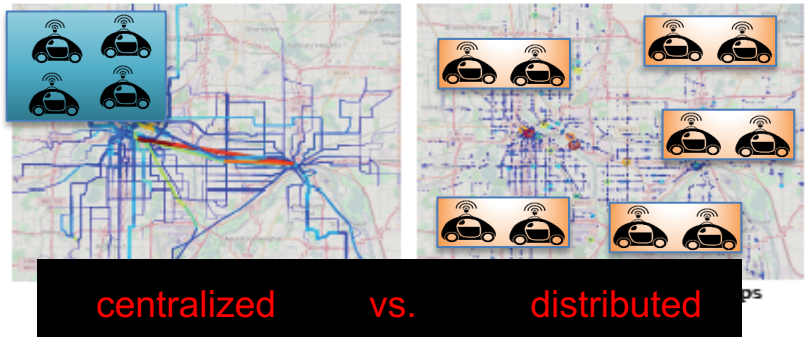
mobility and equity

Project Update

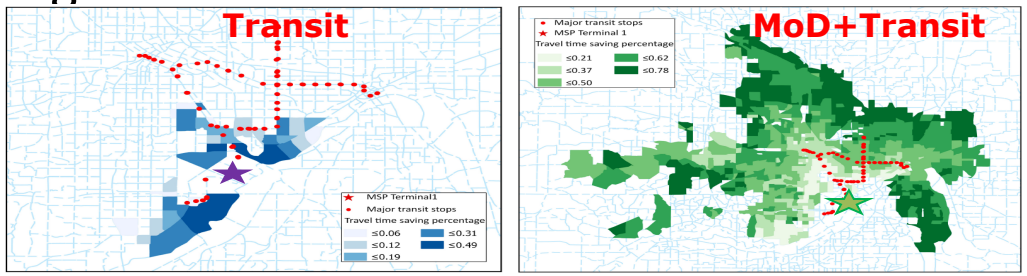
- **Feasibility study of SCCS with shared AVs**
  - the number of needed AVs is much smaller than today's conventional cars
  - Improved vehicle utilization to 90% with AVs



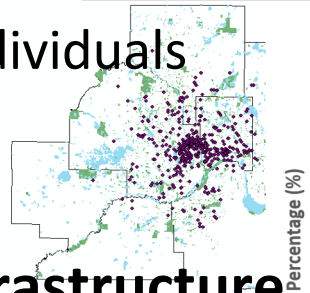
- **Optimal fleet sizing, AV depot design & AV operations**
  - Studied the impacts of AVs on transit and developed *multimodal* network optimization models for AV planning

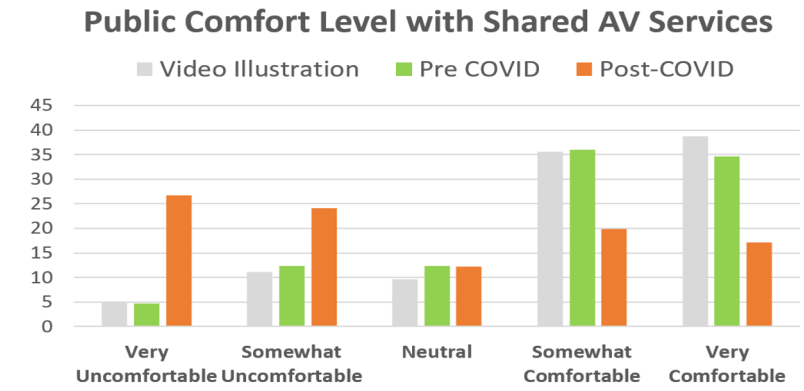


- **AV ownership & sharing business models**
  - Studied trade-offs between AV ownership vs sharing



- **Public perceptions on shared AV services**
  - Online surveys in the Twin Cities regions, w/469 individuals
    - Low-income race & ethnic minorities
    - Downtown commuters





- **Impacts of AVs on street re-designs & physical infrastructure**

Project Evolution

Speakers: Yingling Fan, co-PI, UMN
Lisa Austin, MNDoT, community partner

Improving Transportation Equity for all by Centering the Needs of Marginalized and Underserved Communities

- Illustrate the systemic barriers that marginalized communities confront in everyday life, especially those constructed by transportation policy
- Elicit the coping and survival strategies the communities utilize to navigate these barriers

(Jason Armond / Los Angeles Times via Getty Images)

"Centering in the Margins" Framework

- Experiential knowledge: Emphasize the lived-experiences, assets, and needs of marginalized communities
- Critical consciousness: Dig beneath the surface of information to develop deeper understandings

Participatory Action Research Approach

- Collaborate with community stakeholders
- Community-based decision making throughout the project from defining research questions to disseminate research findings

Quantitative & Qualitative Data

- 15-20 selected communities
- Historical and contemporary information on the communities
- Smartphone-based data collection on observed travel behavior and hidden transportation needs.
- COVID guidelines

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Humphrey School of Public Affairs

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Center for Community Connections

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Metro District Rethinking I-94 Project

Cyrus Knutson
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Center for Urban and Regional Affairs

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Center for Urban and Regional Affairs

Ying Song
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Evaluating Project Impact on Communities

- We have worked with a variety of community partners at various levels on developing & evaluating research ideas

Here are Two Examples:

- ***Example 1: Working with Hourcar (a nonprofit car sharing service in Twin Cities) on applying AV depot designs to electric car charging facilities***
  - ➔ Speaker: Paul Shroeder, CEO Hourcar
- ***Example 2: Working with UMN Center for Transportation Studies (CTS) on Minnesota CTS AV Ecosystem & White Bear Lake Shuttle Trial***
  - ➔ Speaker: Gina Baas, Associate Director, CTS

Anticipated outcomes & success measures for next year

Speaker: Yanhua Li, WPI

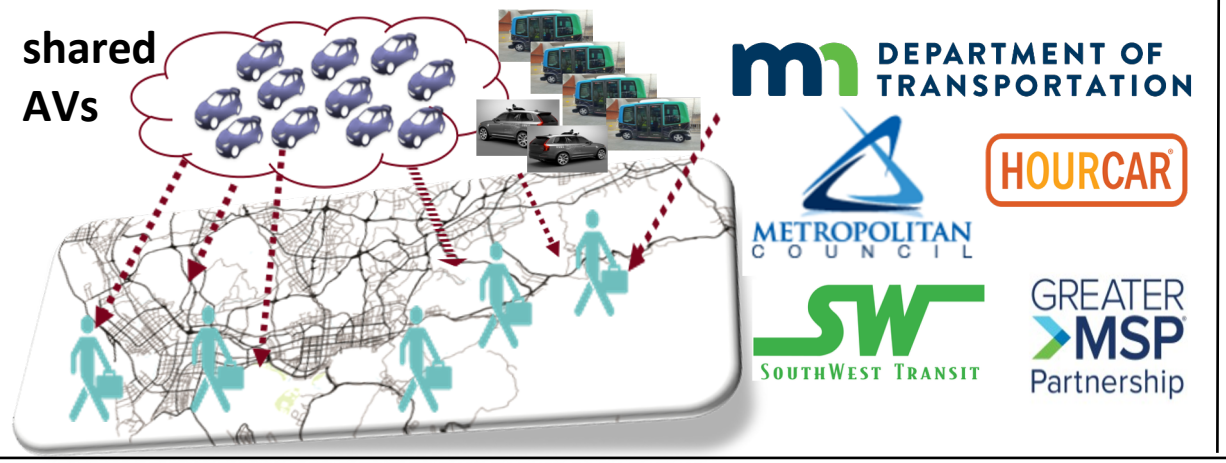
- **Public release of findings on public perceptions & preferences of shared AVs**
  - based on surveys in MSP region; more surveys to be conducted *at Minnesota State Fair'21*
- **AI-based, Data-driven Activity-based Models for Demand Prediction**
  - Using the *Twin Cities Metropolitan Council 2019 Travel Behavior Household Survey* data
- **Transit Mode Choice Analysis for AVs & Planning Tools**
  - providing travels' choices based on preferences; and informing public policies on future of transit systems in co-existence with autonomous MOD systems
- **Enhancing Equity in Transportation**
  - Identify, fund and promote equity in transportation, with a specific focus on planning for deployment of Connected and Automated Vehicles (CAV's)
- **Online, public inventory of post-COVID safety protocols**
  - Crowdsourcing from public transit and shared mobility providers across US
- **Working with MN CTS on *Shared AV Shuttle Trial Service in White Bear Lake*, MN**

SCC: Leveraging Autonomous Shared Vehicles for Greater Community Health, Equity, Livability, and Prosperity (HELP)

Prof Zhi-Li Zhang, University of Minnesota, Twin Cities

IRG + Solicitation FY2018, CMMI-1831140

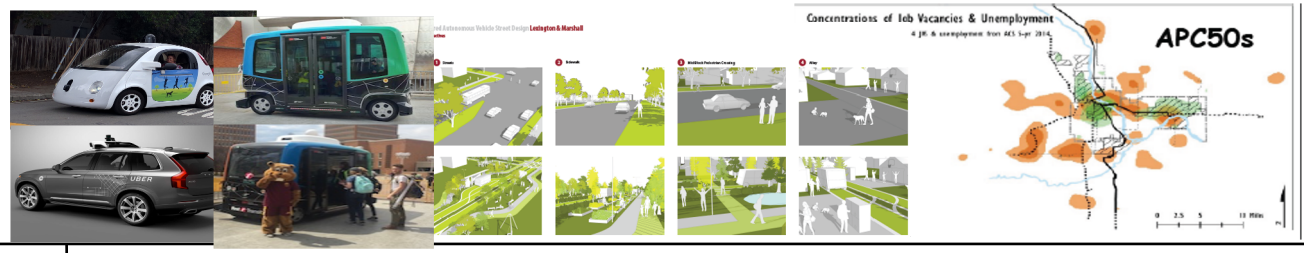
Smart Cloud Commuting Service



Project Vision: Smart Cloud Commuting System (SCCS)

via giant pools of shared AVs of various types

- *as convenient (but cheaper & less hassle) as owning a car*
- *as affordable, but more flexible as public transit services*
- ***bridge digital & spatial divide; offer equitable MOD services***



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Fundamental Research Contributions

Social science, technological advances & broader impacts

- Providing inexpensive mobility services to all people (including people with disabilities and the elderly)
- Helping build stronger family and community ties
- Boosting economic productivity and equity by removing mobility as a constraint
- Bridging digital divide & spatial disparities
- Promoting greater community health, equity, livability, & prosperity (HELP)