Slowing COVID-19 Spread – Simulating Bus Seating Strategies

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21SAUNM03

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$ 100,000

Simulating bus seating strategies to slow down Covid-19 spread

Taking public transportation is a critical way of commuting for many individuals living in cities across the United States. Public transit is also an important mode for older adults, wheelchair users, and individuals to whom biking, walking, and driving may not be feasible, for example, one who has arthritis or other chronic pain that limits his/her level or type of activity. Because the World Health Organization (WHO) reports that coronavirus can last on surfaces for a few hours up to several days, like the other indoor spaces, a potential risk of exposing to COVID-19 exist when using public transit. Motivated by this, the research proposes to develop a python-based agent modeling tool that enables simulation of in-bus passenger seating behavior based on the "social distancing" awareness and supported with in-vehicle sanitizing practices. With application of the proposed simulation tool in the City of Albuquerque transit system, the research aims at identifying optimal and practically feasible seating strategies under multiple scenarios of transit capacities, seats configurations, passenger volume (occupancy), and bus schedules. The research is expected to help slow the spread of COVID-19 on public transit, gain travelers' confidence on the safety of transit during the pandemic situation, and improve public health conditions, especially for transit riders with low-income, disability, and other potentially underserved communities that have higher risk for severe illness from COVID-19.

Problem Statement

Taking public transportation is a necessary way of commuting for many individuals living in cities across the United States. Commuting by transit makes up 12.7% of trips in areas with populations over 5 million, 5.9% in areas between 2.5 and 5 million, and 2.5% in areas between 1 and 2.5 million. In 2019, Americans took 9.9 billion trips on public transportation. Public transit is also an important mode for older adults, wheelchair users, and individuals to whom biking, walking, and driving may not be feasible, for example, one who has arthritis or other chronic pain that limits his/her level or type of activity. Like the other

indoor spaces, there is a potential risk of exposing to COVID-19 when using public transit. The Centers for Disease Control and Prevention (CDC) has released several principles for public transit riders, including hand hygiene, social distancing, wearing masks, avoiding touching surfaces, and improve ventilation. Almost all the transit agencies in Region 6 have released "Transit Guide" for both riders and operators in response to COVID-19. Among all the transit actions, one commonly used practice is limiting the occupancy to adhere to manage overcrowding. For example, a 50-seat bus is operated to limit the number to 25. One widely implemented way is to tag every other seat as unavailable, so that there is at least a seat empty in between people. To the author's best knowledge, there hasn't been research showing clear evidence that "tagging seat" or which form of seating strategy is more effective than others to lower the exposure risk in public transport. Motivated by this, the research proposes to simulate passengers' seating behaviors from transit buses in the City of Albuquerque, and aims at identifying optimal and practically feasible seating strategies (supported with in-vehicle sanitizing practices) under multiple passenger loads and scheduling scenarios.
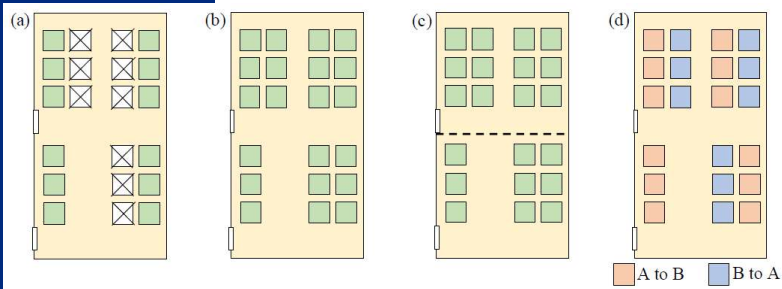
Objectives

The proposed research will develop a python-based agent modeling tool that enables simulation of in-bus passenger seating behavior based on the "social distancing" awareness. The python tool will be designed to allow users to customize bus seats configurations, bus scheduling and stops distribution, duration between stops, and passenger volumes, to support evaluation analysis of different bus vehicle types, or even other public transportation modes (including intercity buses, rails, and airplanes).

Figure 1. Examples of Seating Strategies; a) "tag every other seat" strategy, b) "maintaining social distancing" strategy, c) blocking strategy, and d) dynamic seating strategy

Intended Implementation of Research

Peer reviewed paper will be published in high-quality, high-visibility transportation and policy journal. For professional outreach, the team will present materials at peer-reviewed conferences prior to journal publication. Peer-review will establish the intellectual merit of the materials developed. All of the researchers affiliated with the project are involved in the activities of leading professional organizations including, but not limited to, TRB, ASCE, and ITE. One graduate student (Ph.D. or Master) is expected be involved in the research for one semester, respectively. The majority of the project funding will be used to support a Gradate Research Assistant (GRA) position for one semester, under supervision of professor Haobing Liu. This project offers opportunities to intensively train graduate students' technical capabilities, including the use of high-performance parallel computing cluster for simulation development, python programing, statistical analysis, and technical writing skills.

Anticipated Impacts/Benefits of Implementation

This will be a timing research with a significant implementation potential. The simulation tool and results of the proposed research – a series of optimal seating strategies under multiple scenarios of transit capacities, seats configurations, passenger volume (occupancy), and routes schedules collected from the City of Albuquerque transit system – can be easily implemented by transit operators at very low costs. From technical perspective, the integration of transit passenger behavior simulation model and COVID-19 spread model to be developed in this research provides an intuitive and innovative procedure that can be easily transferred for

seating strategy evaluation on other public transport modes, for example, metros, rails, intercity buses, and airplanes. The research is expected to help slow the spread of COVID-19 on public transit, gain travelers' confidence on the safety of transit during the pandemic situation, and improve public health conditions, especially for transit riders with low-income, disability, and other potentially underserved communities that have higher risk for severe illness if infected by COVID-19.

Web links

Tran-SET

Tran-SET is Region 6's University Transportation Center. It is a collaborative partnership between 11 institutions (see below) across 5 states (AR, LA, NM, OK, and TX). Tran-SET is led by Louisiana State University. It was established in late November 2016 "to address the accelerated deterioration of transportation infrastructure through the development, evaluation, and implementation of cutting-edge technologies, novel materials, and innovative construction management processes".

Learn More

For more information about Tran-SET, please visit our website, LinkedIn, Twitter, Facebook, and YouTube pages. Also, please feel free to contact Dr. Momen Mousa (Tran-SET Program Manager) directly at transet@lsu.edu.