2022 CAMMSE Virtual Research Symposium

FINAL PROGRAM

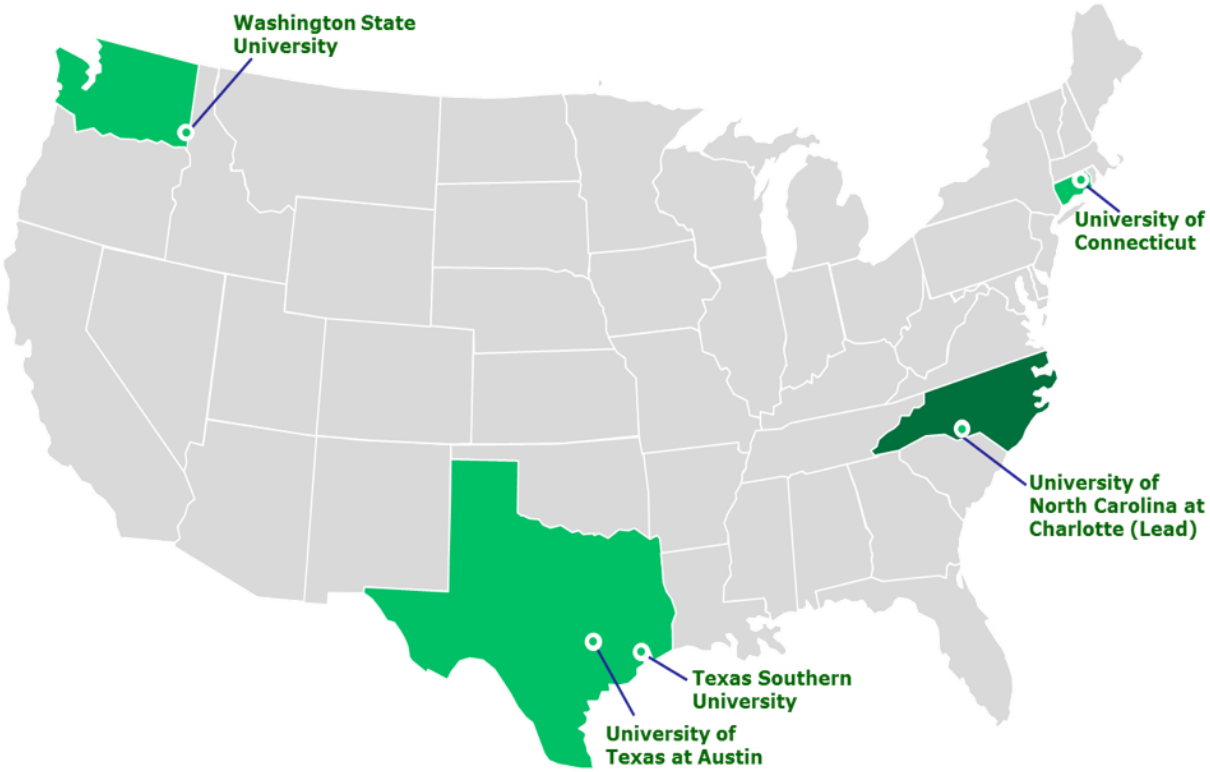
November 10-11, 2022

Charlotte, NC, USA

Center for Advanced Multimodal Mobility Solutions and Education

A Consortium of Five Universities:

The University of North Carolina at Charlotte (Lead)
The University of Texas at Austin
University of Connecticut
Washington State University
Texas Southern University



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Welcome Message from CAMMSE Director

It is truly an honor to welcome you, our dear CAMMSE family members, colleagues and friends, and general participants that are coming from across the country. Even though we are unable to meet in person again this year, I am truly glad that we can still hold this important event remotely! Thank you for attending our Fifth Annual CAMMSE Research Symposium with the main purpose to share results and findings of recent and ongoing research funded by the Center for Advanced Multimodal Mobility Solutions and Education (CAMMSE). CAMMSE is a six year multi-campus Tier 1 University Transportation Center (UTC) funded by USDOT that began operations in November 2016 under the FAST ACT. We are a consortium of five universities, including The University of North Carolina at Charlotte (UNCC) as the lead, the University of Texas at Austin (UT Austin), the University of Connecticut (UConn), Washington State University – Pullman (WSU), and Texas Southern University (TSU) each with unique records as education and research hubs engaging diverse populations and nurturing the success of our students. The main focus or theme of CAMMSE is to address the FAST Act research priority area of "***Improving Mobility of People and Goods***" by conducting multi-disciplinary, multi-modal research, education and workforce development, and technology transfer. It has already been almost six years now since CAMMSE was established at UNCC back in November 2016 and significant progress has been made in all activities, including research, education and workforce development, and technology transfer. I am confident that this symposium will provide a great opportunity for CAMMSE researchers, graduate students, and the community at-large who are interested in multimodal mobility to share their recent and on-going research in multimodal mobility solutions.

This booklet provides the symposium program and general information we hope is useful to you as you explore the event. We have two outstanding keynote lectures. The morning keynote is on "An Update on Alternative Intersections" by Dr. Joseph Hummer of North Carolina Department of Transportation. And an afternoon keynote lecture on "Going My Way? What Role Do the Built Environment and Incentives Play in Supporting Pooling with Shared Mobility? A Photovoice Study in the San Francisco Bay Area" by Dr. Susan Shaheen of University of California, Berkeley. The one and a half day program also includes three technical sessions and two student presentation sessions. On the first day, the morning sessions will be on "Advanced Models for Transportation Planning and Operations" and "Transforming Transportation with Machine Learning", and the afternoon session will focus on "Public Transit and Emerging Mobility Services". On the second day, we will have two graduate student research presentation sessions where we hope students and faculty can engage in productive discussions with constructive feedback to our students. All keynote presentations and technical sessions will offer Professional Development Hours (PDHs).

In closing, I hope that this virtual event will provide an opportunity to exchange ideas, foster collaborations, and generate new ideas. Participants from industry and the government are highly encouraged as they will further enable opportunities for technology transfer. On behalf of the symposium organizing committee, we are glad to have you join us and I hope that you will enjoy this symposium. Thank you very much and again and stay safe!

Sincerely,

Wei (David) Fan

Symposium Planning Committees

General and Technical Chair: Dr. Wei Fan, UNC Charlotte

Organizing and Planning Committee:

Dr. Wei Fan, UNC Charlotte

Dr. Martin Kane, UNC Charlotte

Dr. David Weggel, UNC Charlotte

Ms. Kim Wilson, UNC Charlotte

Student Presentation Session Committee:

Dr. Wei Fan, UNC Charlotte

Mr. Chengying Hua, UNC Charlotte

Mr. Tianjia Yang, UNC Charlotte

Technical Support:

Mr. Tianjia Yang, UNC Charlotte

Mr. Chengying Hua, UNC Charlotte

Fifth Annual CAMMSE Research Symposium - FINAL PROGRAM

Day 1: Thursday, November 10 (8:00AM-3:20PM)

8:00-8:15AM **Welcome** (Dr. Wei Fan, Director of CAMMSE)

8:15-9:00AM **Keynote Presentation No. 1** (Moderator: Dr. Wei Fan)
Title: **"An Update on Alternative Intersections"**
Speaker: **Dr. Joseph Hummer**, North Carolina DOT

9:00-10:20AM **Technical Session #1: *Advanced Models for Transportation Planning and Operations***
Moderator: Dr. Randy Machemehl, University of Texas at Austin

"Estimation of Pedestrian Compliance at Signalized Intersections Considering Demographic and Geographic Factors"
Speaker: John Ivan, Ph.D., P.E., University of Connecticut

"A Simulation Study on the Traffic Delay and Fuel Consumption of Connected and Autonomous Vehicles in Superstreet with Platooning, Signal Optimization, and Trajectory Planning"
Speaker: Shaojie Liu, Ph.D., Zhengzhou University of Aeronautics

"Travel Preference Survey and Mode Choice Model Development for the University of Texas at Austin"
Speaker: Randy Machemehl, Ph.D., P.E., University of Texas at Austin

"An Enhanced Understanding of Resilience Assessment Using Points-of-interest (POI) Visit Dataset under Disaster"
Speaker: Jin Zhu, Ph.D., University of Connecticut

10:20-10:30AM **Break**

10:30-11:50AM **Technical Session #2: *Transforming Transportation with Machine Learning***
Moderator: Dr. Christian Claudel, University of Texas at Austin

"Performance of State-Shared Multi-Agent Deep Reinforcement Learning Controlled Signal Corridor with Platooning-Based CAVs"
Speaker: Li Song, Ph.D., Wuhan University of Technology

"Prediction of Traffic Mobility Based on Historical Data and Machine Learning Approaches"
Speaker: Xianming Shi, Ph.D., P.E, Washington State University

"HAR-GCNN: Deep Graph CNNs for Human Activity Recognition from Highly Unlabeled Mobile Sensor Data"
Speaker: Christian Claudel, Ph.D., University of Texas at Austin

"Combining Emerging Hotspots Analysis with XGBoost for Modeling Pedestrian Injuries in Pedestrian-Vehicle Crashes: A Case Study of North Carolina"
Speaker: Yang Li, Ph.D., University of Wisconsin-Milwaukee

11:50AM-1:00PM **Lunch**

1:00-1:45PM **Keynote Presentation No. 2** (Moderator: Dr. Wei Fan)
Title: **"Going My Way? What Role Do the Built Environment and Incentives Play in Supporting Pooling with Shared Mobility? A Photovoice Study in the San Francisco Bay Area"**
Speaker: **Dr. Susan Shaheen**, University of California, Berkeley

1:45-3:05PM **Technical Session #3: *Public Transit and Emerging Mobility Services***
Moderator: Dr. Yi Qi, Texas Southern University

"COVID-19 Effects on Bike Share Usage and Ridership in Houston"
Speaker: Mehdi Azimi, Ph.D., P.E., Texas Southern University

"Characteristics of Pooled Trips Offered by Ride-sourcing Services in Chicago"
Speaker: Carol Atkinson-Palombo, Ph.D., University of Connecticut

"Impacts of COVID-19 on Public Transit Ridership"
Speaker: Yi Qi, Ph.D., Texas Southern University

"A Research Perspective of Integrating Equity into Public Transportation Planning"
Speaker: Nicholas Lownes, Ph.D., P.E., University of Connecticut

3:05-3:20PM **Closing Day 1** (*Dr. Wei Fan, CAMMSE Director*)

Notes: - End of Day 1 marks the end of the keynotes and faculty presentations component of the CAMMSE Research Symposium. Student presentations will be offered in Day 2.

Day 2: Friday, November 11 (8:00AM-12:15PM)

8:00-8:05AM **Welcome** (Dr. Wei Fan, Director of CAMMSE)

8:05-9:35AM **Student Presentations: Session #1**
Moderator: Mr. Chengying Hua, University of North Carolina at Charlotte
(*See Student Presentation section in Page 26 of this booklet for more information on presentation titles. For the abstracts see pages 27 to 31.*).

9:35-9:50AM **Break**

9:50-11:40AM **Student Presentations: Session #2**
Moderator: Mr. Tianjia Yang, University of North Carolina at Charlotte
(*See Student Presentation section in Page 26 of this booklet for more information on presentation titles. For the abstracts see pages 32 to 37.*).

11:40 -12:00PM **Break**

12:00-12:15PM **Student Awards Ceremony**
Notes: - Announcement of Student Presentation Awards (Top 6) will be made.

12:15PM **Closing Announcements** (*Dr. Wei Fan, CAMMSE Director*)

2022 CAMMSE RESEARCH SYMPOSIUM - KEYNOTE SPEAKERS:

Keynote No. 1 (Morning Presentation): Thursday November 10, 8:15 - 9:00 AM

Dr. Joseph Hummer, North Carolina Department of Transportation
Title: *"An Update on Alternative Intersections"*
Location: Virtual
Moderator: Dr. Wei Fan, UNC Charlotte

Abstract: Many arterials and intersections are terribly congested and prone to crashes, and conventional measures offer little prospect for relief. Alternative designs offer some potential for relatively inexpensive improvements to those congested arterials and intersections. These are designs that have been used in some state or have been researched but have not been placed into widespread use. Examples include reduced conflict intersections (superstreets), median u-turns, and continuous flow intersections. In the right place with the details designed well, an alternative design can deliver safety, efficiency, environmental, and cost benefits to motorists and transportation agencies. The purpose of this talk is to inform the audience of the latest in the area of alternative intersections. I will describe several new and promising designs and show several new ways to measure the performance of competing designs. I will compare many of the designs and show that, because no design is perfect, engineers have to choose well at any particular spot. I will also highlight several avenues that are promising for future research.

Speaker Bio: Joseph E. Hummer, PhD, PE, is the State Traffic Management Engineer in the Mobility and Safety Division of the NCDOT. Joe began researching alternative designs in 1990, has published numerous articles about them, and has invented several new intersection and interchange designs. His two-part series in the ITE Journal in 1998 helped spark interest in the area. More recently, he was a co-author of the FHWA informational report on six of the most promising designs, he was the Principal Investigator of the FHWA research project investigating the effects of diverging diamond interchanges, and he was the primary author of the FHWA guidebook on reduced conflict intersections. Joe was an Assistant Professor at UNC Charlotte, a Professor at North Carolina State University, and the Chair of the Department of Civil and Environmental Engineering at Wayne State University before joining NCDOT in May 2016. Since joining NCDOT he has contributed to over 60 TIP projects.

Zoom Meeting Technical Support: ***Tianjia Yang*** **or** ***Chengying Hua***

Keynote No. 2 (Afternoon Presentation): Thursday November 10, 1:00 - 1:45 PM

Dr. Susan Shaheen, UC Berkeley
Title: "*Going My Way? What Role Do the Built Environment and Incentives Play in Supporting Pooling with Shared Mobility? A Photovoice Study in the San Francisco Bay Area*"
Location: Virtual
Moderator: Dr. Wei Fan, UNC Charlotte

Abstract: Transportation network companies (TNCs) and microtransit are changing the way people travel by providing dynamic, on-demand mobility that can supplement public transit and personal vehicle use. Well-designed policy strategies are needed to fully leverage the potential of pooling to lessen congestion, energy use, and emissions by reducing private-vehicle ownership and enabling higher vehicle occupancy. Policy and planning tools could help to leverage pooling strategies and more efficient TNC routing to reduce deadheading and excess vehicle miles traveled. There is an opportunity to increase pooling rates by:1) improving pickup/dropoff infrastructure and 2) offering promotions to encourage pooling to public transit stations, employment centers, and designated pickup/drop-off locations. These strategies are the focus of this University of California, Berkeley project in which the research team employed the photovoice methodology among TNC users (pooled and non-pooled), as well as user/stakeholder workshops in the San Francisco Bay Area.

Speaker Bio: Susan Shaheen is a pioneer in innovative mobility strategies. She was among the first to research and write about the changing dynamics in shared mobility and likely scenarios through which automated vehicles might gain prominence and is actively working on advanced air mobility and urban air mobility. She is a professor in Civil and Environmental Engineering at the University of California, Berkeley. She is a Co-Director of the Transportation Sustainability Research Center of the Institute of Transportation Studies (ITS)-Berkeley and Director of the UC ITS' Resilient and Innovative Mobility Initiative. She has a Ph.D. from UC Davis and a M.S. from the University of Rochester. She has authored 85 journal articles, over 160 reports and proceedings articles, 35 book chapters, and co-edited three books. She served as Chair of the Transportation Research Board (TRB) Executive Committee from 2021 to 2022 and Vice Chair from 2020 to 2021. In January 2022, she became the Chair of the Subcommittee for Planning and Policy Review for the TRB Executive Committee. She received the 2017 Roy W. Crum award from TRB for her distinguished achievements in transportation research. In May 2016, she was named one of the top 10 academic thought leaders in transportation by the Eno Transportation Foundation.

Zoom Meeting Technical Support: ***Tianjia Yang*** **or** ***Chengying Hua***

TECHNICAL SESSIONS & ABSTRACTS FOR FACULTY PRESENTATIONS:

Technical Session #1: - November 10, 9:00-10:20AM
Advanced Models for Transportation Planning and Operations

9:00 – 9:20 AM:
Estimation of Pedestrian Compliance at Signalized Intersections Considering Demographic and Geographic Factors
Speaker: John Ivan, Ph.D., P.E., University of Connecticut
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9:20 – 9:40 AM:
A Simulation Study on the Traffic Delay and Fuel Consumption of Connected and Autonomous Vehicles in Superstreet with Platooning, Signal Optimization, and Trajectory Planning
Speaker: Shaojie Liu, Ph.D., Zhengzhou University of Aeronautics
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9:40 – 10:00 AM:
Travel Preference Survey and Mode Choice Model Development for the University of Texas at Austin
Speaker: Randy Machemehl, Ph.D., P.E., University of Texas at Austin
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10:00 – 10:20 AM:
An Enhanced Understanding of Resilience Assessment Using Points-of-interest (POI) Visit Dataset under Disaster
Speaker: Jin Zhu, Ph.D., University of Connecticut
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Technical Session #2: - November 10, 10:30-11:50AM
Transforming Transportation with Machine Learning

10:30 – 10:50 AM:
Performance of State-Shared Multi-Agent Deep Reinforcement Learning Controlled Signal Corridor with Platooning-Based CAVs
Speaker: Li Song, Ph.D., Wuhan University of Technology
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10:50 – 11:10 AM:
Prediction of Traffic Mobility Based on Historical Data and Machine Learning Approaches
Speaker: Xianming Shi, Ph.D., P.E, Washington State University
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11:10 – 11:30 AM:
HAR-GCNN: Deep Graph CNNs for Human Activity Recognition from Highly Unlabeled Mobile Sensor Data
Speaker: Christian Claudel, Ph.D., University of Texas at Austin
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11:30 – 11:50 PM:
Combining Emerging Hotspots Analysis with XGBoost for Modeling Pedestrian Injuries in Pedestrian-Vehicle Crashes: A Case Study of North Carolina

Speaker: Yang Li, Ph.D., University of Wisconsin-Milwaukee
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Technical Session #3: - November 10, 1:45-3:05PM
Public Transit and Emerging Mobility Services

1:45 – 2:05 PM:
COVID-19 Effects on Bike Share Usage and Ridership in Houston
Speaker: Mehdi Azimi, Ph.D., P.E., Texas Southern University
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2:05 – 2:25 PM:
Characteristics of Pooled Trips Offered by Ride-sourcing Services in Chicago
Speaker: Carol Atkinson-Palombo, Ph.D., University of Connecticut
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2:25 – 2:45 PM:
Impacts of COVID-19 on Public Transit Ridership
Speaker: Yi Qi, Ph.D., Texas Southern University
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2:45 – 3:05 PM:
A Research Perspective of Integrating Equity into Public Transportation Planning
Speaker: Nicholas Lownes, Ph.D., P.E., University of Connecticut
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Estimation of Pedestrian Compliance at Signalized Intersections Considering Demographic and Geographic Factors

Technical Session #1: Advanced Models for Transportation Planning and Operations

9:00 – 9:20 AM - Speaker: John Ivan, Ph.D., P.E., University of Connecticut

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Abstract:
Walking as a main mode of transportation is continuously growing as a choice of mobility. This is due largely in part to its positive impacts on environmental and socioeconomic sustainability of the surrounding area. However, it is crucial that city planners and transportation engineers provide facilities that are safe for these vulnerable road users. Surrounding land use and demographic factors may be associated with pedestrian compliance with a given traffic signal.

This project seeks to create an understanding of how the surrounding land use and demographic characteristics of an intersection influence pedestrian compliance with a given crossing signal. This study uses pedestrian observation data collected from 145 crosswalks at 42 intersections in Connecticut. Pedestrians were recorded as being compliant if they crossed on the correct signal phasing and remained in the designated crosswalk for the entire crossing. The odds of compliance at each crosswalk are used as the response variable in a log-linear regression model which is being predicted by collected physical crosswalk site characteristics and geo-spatial data, including demographics and land use. The study analyzes three different buffer sizes for the geo-spatial data: half-mile, quarter-mile, and eighth-mile. The results from the study show that the quarter-mile land use buffer yielded the best model fit with all variables included being statistically significant at 95%. High density land use area, weighted population density, sidewalk presence, intersections with exclusive phasing, and day of the week all decrease the odds of pedestrian compliance with signal phasing. Medium density land use area, low density land use area, and crosswalk presence increase the odds of pedestrian compliance with signal phasing.

A Simulation Study on the Traffic Delay and Fuel Consumption of Connected and Autonomous Vehicles in Superstreet with Platooning, Signal Optimization, and Trajectory Planning

Technical Session #1: Advanced Models for Transportation Planning and Operations

9:20 – 9:40 AM - Speaker: Shaojie Liu, Ph.D., Zhengzhou University of Aeronautics

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Abstract:
Connected and Autonomous Vehicles (CAVs) are a promising technology that is ready to be deployed in the near future to improve traffic efficiency and safety as well as the environment. Extensive studies have been done to investigate the potential performance of CAVs on freeways, at roundabouts, and at conventional intersections. Nevertheless, innovative intersections, as an important component of today's transportation infrastructure, have been seldom investigated. Hence, this research is designed to examine how CAV technologies can influence the performance of a superstreet, one of the popular innovative intersection designs. In this research, the car-following model, platooning, trajectory planning, and adaptive signal control are specified for CAVs and signal controllers in a superstreet. An equivalent conventional intersection with the same lane configurations is also constructed in the simulation environment to make a fair comparison and gain important insights. More importantly, the findings from this research may provide references for studies on other innovative intersections which share similar design characteristics.

This research utilized Intelligent Driver Model (IDM) for the CAVs. The platooning control logic is a model-based approach that has been popularly applied and acknowledged in the transportation academia. CAVs approaching the signalized intersection would implement segmented trajectories with constant acceleration/deceleration so that the driver's comfort and fuel consumption could be optimized to some extent. Lastly, for signal optimization, this research considered a mixed integer linear programming approach to optimize the green duration of each phase in the signal timing settings. The signal timing was optimized based on the real-time incoming vehicles from each approach so that the traffic delay can be minimized. The research findings suggested that adaptive signal control with CAVs can yield the largest improvement compared to trajectory planning and platooning in terms of both traffic delay and fuel consumption. CAV with trajectory planning performs better in conventional intersection design while CAVs with adaptive signal control perform better in the superstreet.

Travel Preference Survey and Mode Choice Model Development for the University of Texas at Austin

Technical Session #1: Advanced Models for Transportation Planning and Operations

9:40 – 10:00 AM - Speaker: Randy Machemehl, Ph.D., P.E., University of Texas at Austin

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Abstract:
A travel preference survey was distributed to all members (approximately 70,000) of the University of Texas at Austin community during the months of March and April 2022. The survey purpose was to gather information describing the travel modes and patterns for trips to and from the UT Austin main campus. The survey asked respondents about their UT primary role, time, and frequency of commute as well as their primary and secondary modes of transportation.

A total of 9,116 responses were recorded. The sampling fractions for those in each UT primary role were calculated as 6.2 percent for 40,916 undergraduate students, 17.3 percent for 11,075 graduate students, 24.1 percent for 13,426 staff members and 23.4 percent for faculty.

Impacts of Covid 19 restrictions on travel frequency were apparent with only 43% of undergraduate students commuting 5 days a week or more. Staff reported 11% work remotely and a large percentage of all categories do not commute daily to campus. One of the most important points explored in the survey is the primary mode of transportation used in commuting to the UT main campus. As expected, walking is the most common primary mode of transportation among undergraduate students living near the UT main campus. In fact, 39% of undergraduate students walk to campus. On the other hand, 73% of faculty and 83% of staff commute by car confirming our expectations given that most faculty and staff live away from campus opting for cheaper housing options.

The survey data was used to develop nested mode choice models for each of the four primary population groups, namely, undergraduate students, graduate students, faculty and staff. A second repetition of the survey is planned for late fall or spring 2023.

An Enhanced Understanding of Resilience Assessment Using Points-of-interest (POI) Visit Dataset under Disaster

Technical Session #1: Advanced Models for Transportation Planning and Operations

10:00 – 10:20 AM - Speaker: Jin Zhu, Ph.D., University of Connecticut

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Abstract:
Cities are facing unprecedented challenges from natural disasters due to climate changes in recent years. A lot of work has been done recently to obtain a better understanding of human behaviors and resilience to natural disasters utilizing large-scale human mobility datasets. Despite the efforts, there still lacks a comprehensive exploration of disaster preparedness, disaster impact, as well as disaster response and recovery with quantification indicators. To fill the knowledge gap, the objective of this study is to develop a comprehensive understanding of disaster resilience through preparation, disaster impact, and disaster residual effect using human mobility data under a natural disaster. To this end, a quantification methodology was proposed to measure unique characteristics of human mobility patterns in specific North American Industry Classification System (NAICS) sectors under disaster. Three metrics, including the preparation indicator, the impact indicator, and the residual effect indicator, were proposed for different disaster stages. The proposed method was implemented in a case study of four cities, including Panama City, Panama City Beach, Lynn Haven, and Tallahassee in Florida under the impacts of Hurricane Michael. Through the case study, human mobility patterns across different cities under different levels of disaster severity were examined. The patterns and relationships between the NAICS sector function, the preparation indicator, the impact indicator, and the residual effect indicator in different cities were compared. This study provides new methods and knowledge regarding disaster resilience and can help decision-makers to make informed decisions to better prepare for and respond to future disasters.

Performance of State-Shared Multi-Agent Deep Reinforcement Learning Controlled Signal Corridor with Platooning-Based CAVs

Technical Session #2: Transforming Transportation with Machine Learning

10:30 – 10:50 AM - Speaker: Li Song, Ph.D., Wuhan University of Technology

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Abstract:
The emerging technologies of connected and automated vehicle (CAV) and deep reinforcement learning (DRL) provide new solutions to improve the intersection systems. Based on the multi-source data collected from the environments, CAVs with the cooperative adaptive cruise control (CACC) system could merge into platoons and cross the intersection quickly and smoothly. Meanwhile, the traffic information of the CAVs enables intelligent traffic signal controls with the help of DRL technologies. This research investigates the performance of a state-shared multi-agent deep reinforcement learning (MARL) controlled signal corridor with platooning-based CAVs. A corridor with seven intersections from the Ingolstadt Traffic Scenario (InTAS) of Germany is selected as a case study. The state information is shared between neighbor intersections to overcome the partial information observation of the decentralized agents in the MARL framework. A platooning framework with specific CACC systems for the leading and following vehicles is proposed. Results indicate that the state-shared MARL with CAV platoons could significantly decrease the total waiting time, average queue length, and total CO2 emission of the corridor by 80%, 73%, and 54%, respectively, which could be beneficial to further improving the intersection efficiency, designing future intersections, and cooperating signals and CAVs platoons.

Prediction of Traffic Mobility Based on Historical Data and Machine Learning Approaches

Technical Session #2: Transforming Transportation with Machine Learning

10:50 – 11:10 AM - Speaker: Xianming Shi, Ph.D., P.E, Washington State University

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Abstract:
Traffic mobility plays an important role in the intelligent transportation system (ITS). Traffic mobility is a factor significantly affecting road safety and efficiency (as well as environmental stewardship), and its prediction has attracted continuous attention over the past decades. With the rapid development of machine learning (ML) techniques, the accuracy and stability of predictive models for traffic mobility have been improved substantially. The goal of this project is to develop predictive models for traffic mobility using ML approaches. The focus is placed on two essential components - traffic speed and traffic volume. To this end, this project identifies appropriate WSDOT highway segments for this modeling study and collecting the relevant historical data related to traffic mobility; develops ML models suitable for predicting the traffic mobility, from model type selection to model validation; and compares different ML models and traditional models in terms of accuracy and stability.

Traffic speed and traffic volume of the Interstate highway I-5 in the Washington state were modelled in this project. A total of 8928 dataset was collected for both speed and volume at each milepost along this highway throughout 2016 with the interval of five minutes. The data at a randomly selected milepost was further compressed to 744 with the length of one month and interval of one hour. Out of the 744 records, the first 672 (28 days x 24 hours) were utilized for model training and the rest 72 (3 days x 24 hours) were utilized for model validation. This work explored the use of the statistical model seasonal autoregressive integrated moving average (SARIMA), traditional ML model multilayer perceptron (MLP) and deep learning (DL) models convolutional neural network (CNN) and long short-term memory (LSTM), in the modeling and prediction of traffic speed and traffic volume. For each of these models, mathematical expression and illustrative model structure were provided; and model construction procedures from hyperparameter determination, input and output process, parameter calibration to model performance evaluation and comparison were introduced. Specifically, typical indicators were

utilized for model fitting and prediction performance evaluation and comparison, such as coefficient of determination (R2) and root mean square error (RMSE) for model accuracy, autocorrelation function (ACF) and partial autocorrelation function (PACF) values for model residual correlations, confidence interval for model stability and Shapiro-Wilk statistic for residual normality.

In general, SARIMA, MLP, CNN and LSTM achieved similar and satisfactory performance in both fitting and predicting traffic volume development. In contrast, the performance of these models was poorer for traffic speed, possibly due to its data characteristics such as distribution and dependencies.

HAR-GCNN: Deep Graph CNNs for Human Activity Recognition from Highly Unlabeled Mobile Sensor Data

Technical Session #2: Transforming Transportation with Machine Learning

11:10 – 11:30 AM - Speaker: Christian Claudel, Ph.D., University of Texas at Austin

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Abstract:
Better understanding of pedestrian paths leads to safer and more efficient interactions between pedestrians and vehicles. To better forecast what pedestrians will do in the future, it is essential to accurately predict their current and future activities. The problem of human activity recognition from mobile sensor data applies to multiple domains, such as transportation engineering, but also in health monitoring, personal fitness, daily life logging, and senior care. In the context of transportation safety, a key objective of human activity recognition is to detect and classify current activities of a road user (for example a pedestrian), and use this information to forecast future actions. This forecasting of future actions is essential to solve the problems of latency, in autonomous vehicles or other advanced driver assist systems (ADAS).

A critical challenge for training human activity recognition models is data quality. Acquiring balanced datasets containing accurate activity labels requires humans to correctly annotate and potentially interfere with the subject's normal activities during data collection. Since the performance of learning and classification schemes improves with larger datasets, it is essential to generate accurate, extremely large datasets of human activities. While there exists a likelihood of incorrect annotation (or lack of annotation), there is often an inherent chronology to human behavior. For example, some activities tend to follow other precursor activities. This implicit chronology can be used to learn unknown labels in the training dataset and classify future activities.

The objective of this work is to propose a new method for predicting correct labels of unclassified or partially classified activities. To this end, we propose HAR-GCCN, a deep graph CNN model that leverages the correlation between chronologically adjacent sensor measurements to predict the correct labels for unclassified activities that have at least one activity label. We propose a new training strategy to ensure that the model predicts missing activity labels by leveraging the known ones. HAR-GCCN shows superior performance relative to previously used baseline methods, improving classification accuracy by about 25% and up to 68% on different standard datasets, including the PAMAP dataset.

Combining Emerging Hotspots Analysis with XGBoost for Modeling Pedestrian Injuries in Pedestrian-Vehicle Crashes: A Case Study of North Carolina

Technical Session #2: Transforming Transportation with Machine Learning

11:30 – 11:50 AM - Speaker: Yang Li, Ph.D., University of Wisconsin-Milwaukee

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Abstract:
As one of the most vulnerable entities within the transportation system, pedestrians might face more dangers and sustain severer injuries in traffic crashes than others. However, the inherent heterogeneity of the traffic crash data can cause incorrect conclusions in many ways. Also, the crash data has inherent patterns related to both space and time. Crashes that happened in locations with highly aggregated uptrend patterns should be worth exploring to examine the most recently deteriorative factors affecting the pedestrian-injury severities in crashes. Therefore, developments and applications of proper modeling approaches are needed to identify causes of pedestrian-vehicle crashes to better ensure the safety of pedestrians. In this study, an emerging hotspot analysis is firstly utilized to identify the most targeted hotspots, followed by a proposed XGBoost model that analyzes the most recently deteriorative factors affecting the pedestrian- injury severities. Variable importance and partial dependence of the top 15 contributing factors are identified and discussed to interpret the models and evaluate the significance of each independent variable. The overall accuracy of the best model on the hotspot dataset is 94.49%, which shows a relatively high

performance compared to conventional models. Results of recent hotspots with the uptrend of crash occurrences in this research could give a solid reference for the identifications of contributing factors affecting the pedestrian-injury severities to policymakers and researchers.

COVID-19 Effects on Bike Share Usage and Ridership in Houston

Technical Session #3: Public Transit and Emerging Mobility Services

1:45 – 2:05 PM - Speaker: Mehdi Azimi, Ph.D., P.E., Texas Southern University

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Abstract:
Bicycle share programs refer to the provision of bicycles to enable short-term rental from one docking station to another. The programs have received increasing attention in recent years with initiative to increase cycle usage, improve the first mile/last mile connection to other modes of transportation, and lessen the environmental impacts of transportation activities. They have increased from operating in a few European cities to expanding in the United States at an increasing pace. The systems have become common in large cities, and a number of cities have designed and launched the bike share programs.

During the COVID-19 pandemic outbreak, many commuters opted to bike instead of riding transit to avoid exposure to the coronavirus. To enhance mobility and open space access during the COVID-19 pandemic outbreak, a number of city councils in the United States and Canada considered proposals to close some lanes to cars, redistribute street space to widen sidewalks and create temporary protected bike lanes using cones or other temporary infrastructure. At the same time, there were some cities that experienced reductions in bikeshare trips during the pandemic. The goal of this study is to investigate the impact of the pandemic outbreak on bike share usage and ridership and understand the change in ridership of public bike usage in Houston.

Characteristics of Pooled Trips Offered by Ride-sourcing Services in Chicago

Technical Session #3: Public Transit and Emerging Mobility Services

2:05 – 2:25 PM - Speaker: Carol Atkinson-Palombo, Ph.D., University of Connecticut

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Abstract:
Ride-sourcing companies or transportation network companies (TNCs) are still in the process of establishing a role in the transportation system in urban areas across the world. The costs and benefits—both intended and unintended—are still being identified not only in academic literature but also by governments trying to regulate them. Two issues are of particular concern: affordability in low-income communities with limited car ownership and transit options and the increase in vehicles miles traveled (VMT) that 'deadheading' from one trip to another generates. TNCs have responded to these concerns by offering pooled rides where customers can choose to share a ride with stranger(s). However, the extent to which these services are used across different communities, especially low-income areas, is not well understood. This paper explores the spatial and temporal patterns of pooled rides in the City of Chicago and discusses the resultant equity implications for low-income communities in the city. The paper uses cluster analysis with demographic, transportation-related, and built environment characteristics at the census tract level and derives key trip statistics using data mining. A change in ride pooling policy from the TNCs that took place in April 2019 provided a natural experiment that allows us to examine the sensitivity of ridership in different neighborhoods. The results show that the reliance on pooling is greater in low-income neighborhoods and that income and proximity to the downtown negatively correlate with the willingness of the rider to share a ride. Of additional importance, willingness to pool is very sensitive to fare changes in pooled rides, and low-income neighborhoods are especially impacted. These findings raise important questions about the lack of transparency surrounding pricing and service provision by TNCs, and the feasibility and equity implications of for-profit companies filling gaps in mobility, especially for low-income communities.

Impacts of COVID-19 on Public Transit Ridership

***Technical Session #3*: Public Transit and Emerging Mobility Services**

2:25 – 2:45 PM - Speaker: Yi Qi, Ph.D., Texas Southern University

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Abstract:
In this paper, a national-wide study is conducted to investigate the impacts of COVID-19 on the public transit ridership in the top twenty metropolitan areas in the U.S. At first, COVID-19 composite index was developed to qualitatively measure the level of public fear toward COVID-19 in different metropolitan areas. After that, to analyze the impact of COVID-19 and some socioeconomic factors on transit ridership reduction during the COVID-19 pandemic, a random-effects panel data model was developed, and the traditional correlation analysis was also conducted. According to the results of both analyses, it was found that the areas with higher median household income, a higher percentage of the population with a Bachelor's degree or higher, higher employment rate, and a higher percentage of the Asian population are more likely to have more reductions in public transit ridership during the COVID-19 pandemic. On the other side, the areas with a higher percentage of the population in poverty, and a higher percentage of the Hispanic population are more likely to experience smaller reductions in public transit ridership.

A Research Perspective of Integrating Equity into Public Transportation Planning

Technical Session #3: Public Transit and Emerging Mobility Services

2:45 – 3:05 PM - Speaker: Nicholas Lownes, Ph.D., P.E., University of Connecticut

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Abstract:
The past decade has seen an acceleration in the amount of data available to transportation researchers and an increased focus on equity in public transportation systems planning and operations. There is a tension between the use of copious data and advanced methodologies and the practical realities of implementation and adherence to federal, state and local policies. This presentation will describe research efforts in support of equitable public transportation systems and identify challenges and opportunities moving forward. Research targeting access to public transportation, measures of equity and the relationship to affordable housing and development will be presented.

STUDENT SESSIONS & ABSTRACTS FOR PRESENTATIONS:

Student Sessions: Friday, November 11 (8:00AM-12:15PM)
(Coordinators: Mr. Chengying Hua and Mr. Tianjia Yang)

Student Session #1: 8:05-9:35 AM

ID	Authors	Title	Institution
S01	Quinn Packer	Pedestrian Signal Compliance Under Concurrent and Exclusive Phasing at Traffic Signals Considering Geo-Spatial Factors	UCONN
S02	Chengying Hua	Freeway Traffic Speed Prediction under the Intelligent Driving Environment: A Deep Learning Approach	UNCC
S03	Saki Rezwana	A Modified Social Force Model (SFM) for Pedestrian Behavior in the Presence of Autonomous Vehicles (AVs)	UCONN
S04	Tianjia Yang	Evaluation of Transit Signal Priority at Signalized Intersections under Connected Vehicle Environment	UNCC
S05	Sruthi Mantri	An Analysis of the Impacts of Autonomous Vehicles on Private Household Vehicle Ownership in The State of Connecticut	UCONN

Student Session #2: 9:50-11:40 AM

ID	Authors	Title	Institution
S06	Zheng Ren	An Enhanced Understanding of Disaster Resilience Assessment Using Points-of-interest (POI) Visit Dataset Under a Natural Disaster	UCONN
S07	Olajumoke Omosebi	Investigating the Impact of Airport Surface Technology (ASDE-X, RWSL and ASSC) in Mitigating Runway Incursion	TSU
S08	Jennifer Hall	Equity as A Criterion for Transit Service Reduction During the Covid-19 Pandemic	UT Austin
S09	Sandip Acharya	Exploring Traffic Big Data for Real-Time Traffic Congestion Analysis	TSU
S10	Suyash Vishnoi	Traffic State Estimation for Connected Vehicles using the Second-Order Aw-Rascle-Zhang Traffic Model	UT Austin
S11	Zakiya Percy	Investigate Age impacts on Controlled Flight into Terrain Aircraft Crashes in General Aviation	TSU

See Abstracts for student presentations in Pages 27 through 37.

Abstracts for Student Presentations:

Student Session S01:

Pedestrian Signal Compliance Under Concurrent and Exclusive Phasing at Traffic Signals Considering Geo-Spatial Factors

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Abstract:
Walking as a main mode of transportation is continuously growing as a choice of mobility. This is due largely in part to its positive impacts on environmental and socioeconomic sustainability of the surrounding area. However, it is crucial that city planners and transportation engineers provide facilities that are safe for these vulnerable road users. Surrounding land use and demographic factors may be associated with pedestrian compliance with a given traffic signal.
This thesis seeks to create an understanding of how the surrounding land use and demographic characteristics of an intersection influence pedestrian compliance with a given crossing signal.

This study uses pedestrian observation data collected from 145 crosswalks at 42 intersections in Connecticut. Pedestrians were recorded as being compliant if they crossed on the correct signal phasing and remained in the designated crosswalk for the entire crossing. The odds of compliance at each crosswalk are used as the response variable in a log-linear regression model which is being predicted by collected physical crosswalk site characteristics and geo-spatial data, including demographics and land use. The study analyzes three different buffer sizes for the geo-spatial data: half-mile, quarter-mile, and eighth-mile. The results from the study show that the quarter-mile land use buffer yielded the best model fit with all variables included being statistically significant at 95%. High density land use area, weighted population density, sidewalk presence, intersections with exclusive phasing, and day of the week all decrease the odds of pedestrian compliance with signal phasing. Medium density land use area, low density land use area, and crosswalk presence increase the odds of pedestrian compliance with signal phasing.

Student Session S02:

Freeway Traffic Speed Prediction under the Intelligent Driving Environment: A Deep Learning Approach

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Abstract:
The continuous growth in the number of vehicles leads to various mobility issues in the current transportation system, such as traffic congestion and high commuting time. Benefiting from the increasing popularity and deployment of artificial intelligence technology, intelligent vehicles (e.g., connected and autonomous vehicles) are expected to greatly help alleviate traffic congestion. For intelligent vehicles to perform effectively and improve mobility, real-time prediction of traffic speed is undoubtedly essential to the entire Intelligent Transportation System (ITS).

Considering the complex spatiotemporal dependency inherent in traffic data, conventional prediction models encounter many limitations. To enhance the accuracy of traffic speed prediction, this study focuses on emerging deep neural networks (DNNs) using the Caltrans Performance Measurement System (PeMS) data. This research also establishes an intelligent driving environment in the simulation, and compares the traditional car-following model with deep learning methods in terms of multiple performance metrics. The results indicate that both supervised learning and unsupervised learning are superior to the simulation-based model on the freeway, and the two deep learning networks are almost identical to one another. Besides, the result reveals that all models have their latent features for different time dimensions under the low traffic loads, transition states, and heavy traffic loads. This is critical in the application of prediction technologies in ITS. The findings can assist transportation researchers and traffic engineers in both traffic operation and management, such as bottleneck identification, platooning control, route planning, etc.

Student Session S03:

A Modified Social Force Model (SFM) for Pedestrian Behavior in the Presence of Autonomous Vehicles (AVs)

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Abstract:
Walking is a healthy, environmentally friendly mode of transportation. It constitutes the first and last part of almost any trip, regardless of what mode of transportation the user will choose later. Therefore, pedestrian behavioral analysis is crucial for transportation safety and transportation planning. For example, designing for urban roadway characteristics such as signalized or un-signalized crosswalks or public transport stations with varying volumes of pedestrian flow. Predicting the changes in traffic conditions due to the presence of pedestrians is an essential aspect of planning. To make these predictions, planners and engineers need accurate, quantitative models of pedestrian traffic. The Social Force Model (SFM) is widely used to predict pedestrian behavior.

This research develops a modified social force model to understand pedestrians' behavior at a signalized crosswalk with only autonomous vehicles (AVs) on the road. Previous research indicated that pedestrians are likely to feel less safe around driverless vehicles like AVs, and repulsive behavior of the pedestrians is observed towards AVs. Therefore, a survey is conducted in the community to see the general public perception of AV. A reluctant behavior has been observed in the survey results. Hence, a new repulsive force is incorporated into the traditional SFM to account for this phenomenon, and the modified SFM's principle is used to simulate pedestrian behavior. Simulation of pedestrian behavior is performed using the open-source crowd simulation software VADERE. Simulation results show that pedestrians' walking behavior becomes chaotic, indicating that pedestrians may require more time to cross the road in this scenario. Finally, the work discusses the results of these simulation experiments and their implications on transportation engineering.

Student Session S04:

Evaluation of Transit Signal Priority at Signalized Intersections under Connected Vehicle Environment

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Abstract:
Traditional transit signal priority (TSP) control strategies generally have negative impacts on other traffic involved. In this study, two typical signal control strategies under connected vehicle (CV) environment that give priority to transit vehicles at signalized intersections are investigated, i.e., actuated TSP with CV and optimized TSP with CV. The optimization algorithm used in this study is genetic algorithm (GA) and the goal of the optimization is to minimize the total person delay. A real-world intersection is modeled in microsimulation environment to evaluate the performance. The results are compared with fully actuated signal control strategies with and without TSP. Results show that the proposed optimization control strategy can reduce the average bus delay by 24.5% during peak hours while minimizing the negative impact on conflicting traffic. Under the low traffic demand condition, the actuated control with TSP using CV has a better performance in terms of average delay.

Student Session S05:

An Analysis of the Impacts of Autonomous Vehicles on Private Household Vehicle Ownership in The State of Connecticut

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Abstract:
The development and implementation of Autonomous Vehicles (AVs) has the potential to revolutionize current transportation mode choice. In June 2017, Connecticut Public Act No. 17-69 "An Act Concerning Autonomous Vehicles" authorized the testing of AVs on Connecticut roads. In April 2018, Connecticut launched the Fully Autonomous Vehicle Testing Pilot Program (FAVTPP), which set the permitting and testing requirements for AVs on public roads. Research has yet to be conducted on potential impacts of AVs to personal vehicle ownership in Connecticut, the result of which could have significant economic, social and infrastructure effects. This study focuses on the impacts of AV introduction on private household vehicle ownership, and is informed by data collected from the 2016 Connecticut Statewide Transportation Study (CSTS). The method we propose to use is a novel technique adapted from an application in the Atlanta Metropolitan region. A greedy algorithm is applied to the data to optimize local trip choice and determine the number of private household vehicles reduced due to the switch to private AVs. Our results show that 44.7% of households within the study area can reduce at least one vehicle given current trip demand, resulting in a 29.9% reduction in private vehicle ownership. The spatial and temporal limitations from the dataset will be discussed within the scope of our study, as well as suggestions for future work.

Student Session S06:

An Enhanced Understanding of Disaster Resilience Assessment Using Points-of-interest (POI) Visit Dataset Under a Natural Disaster

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Abstract:
As cities are facing unprecedented challenges from natural disasters due to climate changes in recent years, it is significant to understand how residents and businesses react to disasters. A lot of work has been done to obtain a better understanding of human behaviors and resilience to natural disasters utilizing large-scale human mobility datasets. Despite the efforts, there lacks a comprehensive exploration of disaster preparedness, disaster impact, and disaster recovery in different POI (point-of-interest) categories with quantification indicators. To fill the knowledge gap, the objective of this study is to develop a comprehensive understanding of disaster resilience through disaster preparation, disaster impact, and disaster residual effect through the POI visit dataset under a natural disaster. To this end, a quantification methodology was proposed to measure visit behaviors at different disaster stages through three indicators, including the preparation indicator, the impact indicator, and the residual effect indicator. With three quantification indicators proposed, POI visit patterns under a natural disaster were summarized. The proposed method was implemented in a case study of four cities, including Panama City, Panama City Beach, Lynn Haven, and Tallahassee in Florida under Hurricane Michael. Through the case study, visit patterns of different POI categories across different cities under different levels of disaster severity were examined. Relationships between the POI category function, the preparation indicator, the impact indicator, and the residual effect indicator in different cities were compared. This study provides new methods and knowledge regarding disaster resilience and can help decision-makers make informed decisions to better prepare for and respond to future disasters.

Student Session S07:

Investigating the Impact of Airport Surface Technology (ASDE-X, RWSL and ASSC) in Mitigating Runway Incursion

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Abstract:
A runway incursion, defined by the FAA, is "any occurrence at an aerodrome involving the incorrect presence of an aircraft, vehicle or person on the protected area of a surface designated for the landing and takeoff of aircraft" These occurrences, including wrong runway landings and takeoffs (FAA, 2020). During the last two decades, the number of runway incursions at airports in the United States has increased from 987 in 2002 year to 25,036 in 2020 year. (FAA runway safety Office runway incursions (RWS). Runway incursions are a major threat to aviation safety and can cause major delays and collisions that have significant human and financial implications for airlines. The FAA, along with independent companies, is working to understand and develop feasible, cost-effective technologies to help reduce incursions. Among the measures that have been implemented are 1) Installation of improved signage and markings, 2) changing airport layouts 3) installation of improved lighting systems, and 4) runway safety technologies.

A recent study done by the Federal Aviation Administration (FAA) found that nearly 80% of all reported runway incursions could have been prevented if the individuals involved had better awareness of their surroundings. Three out of Ten technologies recommended in mitigating runway incursions are implemented, installed and operational in 63 US airports. The three operational technologies which are Airport Surface Detection System Model X (ASDE), Airport Surface Surveillance Capability (ASSC), and Runway Status Lights (RWSL) are designed to increase situational awareness. There has not been formal research on the effectiveness of the airport surface technologies installed at all 63 airports in mitigating runway incursion, the effectiveness of these various airport surface technologies implemented has not been substantially empirically analyzed. (Ison, 2020) investigated the before and after Runway Status Lights (RWSL) one of the three operational runway incursion technology installed at Los Angeles International Airport in 2012 and Dallas Fort Worth International Airport in 2004. The author's findings indicated that there were no significant differences that the Runway Status Lights (RWSL) technology helped to reduce runway incursions. The author only investigated 2 out of 63 airports and one out of the three technologies available. However, due to the author's small sample size, it is difficult to jump to conclusion that the implemented runway incursion technology does not improve safety. The findings of this study outline the importance of assessing empirically based impacts of airport surface technologies (ASDE-X, RWSL and ASSC) installed at all the 63 airports as the steadily increasing air traffic in the U.S increases the likelihood of fatal runway incursions by aircraft.

Student Session S08:

Equity as A Criterion for Transit Service Reduction During the Covid-19 Pandemic

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Abstract:
The COVID-19 pandemic has exacerbated social disparities in public transportation due to service reductions. Transit authorities justified these decisions by ridership levels along routes. However, such logic neglected socio-demographic information, meaning captive riders and essential workers who commute by bus were left without a means of travel.

To determine whether captive riders/essential workers were able to commute by bus during the pandemic, this paper assessed numerous socio-demographic variables along three bus routes within Austin, Texas that either continued, reduced, or cancelled their operations during the pandemic. By utilizing the socio-demographic variables powerful statistical models were created to estimate and profile of people who commute along these routes.

Results indicated that ridership along the continued route is significantly affected by people who work in the food service industry and social services. The reduced route's noteworthy variables included people who work in education and healthcare. Finally, significant variables in the cancelled route include people who do not have a personal vehicle (captive riders), and people who work in the food service industry. Equitable travel was provided to riders along the continued route, however the reduction and cancellation of the other routes forced essential workers, such as people in education and healthcare, to search for alternative forms of travel. This method proved that basing route planning solely on ridership levels is flawed, as it could strip essential workers their means of transport during an emergency. The application of this methodology saves transit authorities money, but more importantly ensures the provision of equitable travel.

Student Session S09:

Exploring Traffic Big Data for Real-Time Traffic Congestion Analysis

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Abstract:
Congestion has been a major and challenging issue for urban transportation systems in the recent years. With emerging growth of traffic, congestion management and reduction have been even more complex. Various state Departments of Transportation (DOTs) and transportation agencies have started to use big transportation data for analysis, forecasting and ultimately reducing traffic congestion problems. Many of them have adopted data initiatives either with the support of private companies or by developing their own databases. This study explores different types of data that have the potential to be used in congestion management, as well as the commercial big datasets and big data platforms that can enhance the reduction of congestion on roadways. Additionally, different Artificial Intelligence and statistical algorithms that could be used for real-time traffic congestion prediction were reviewed and the strength and weakness of them were summarized.

Student Session S10:

Traffic State Estimation for Connected Vehicles using the Second-Order Aw-Rascle-Zhang Traffic Model

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Abstract:
This paper addresses the problem of traffic state estimation (TSE) in the presence of heterogeneous sensors which include both fixed and moving sensors. Traditional fixed sensors are expensive and cannot be installed throughout the highway. Moving sensors such as Connected Vehicles (CVs) offer a relatively cheap alternative to measure traffic states across the network. Moving forward it is thus important to develop such models that effectively use the data from CVs. One such model is the nonlinear second-order Aw-Rascle-Zhang (ARZ) model which is a realistic traffic model, reliable for TSE and control. A state-space formulation is presented for the ARZ model considering junctions in the formulation which is important to model real highways with ramps. Linear approximation of the state-space model is investigated with respect to two techniques, first-order Taylor series approximation and Carleman linearization. A Moving Horizon Estimation (MHE) implementation is presented for TSE using a linearized ARZ model. Various state-estimation techniques used for TSE in the literature along with the presented approach are compared with regard to accuracy, computational tractability and parameter tuning with the help of a case study using the VISSIM traffic simulation software. Several research questions are posed and addressed with thorough analysis of the results.

Student Session S11:

Investigate Age impacts on Controlled Flight into Terrain Aircraft Crashes in General Aviation

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Abstract:
Controlled Flight into Terrain (CFIT) crash is defined as an unintentional collision with terrain (the ground, a mountain, a body of water, or an obstacle) while an aircraft is under positive control. It is one of three high-risk accident occurrence categories identified by the International Civil Aviation Organization. Although advanced technologies have dramatically reduced the number of General Aviation CFIT crashes over the past 20 years, CFIT crashes continue to occur and at least half of them are fatal. Therefore, it is quite momentous to identify the contributing factors and recommend countermeasures to prevent or mitigate CFIT crashes.

This research will utilize the General Aviation CFIT crash data collected from National Transportation Safety Board (NTSB) and pilots' information from Federal Aviation Administration (FAA), to perform statistical analysis to reveal the impacts of pilots' age and other pilot related contributing factors on the occurrence of CFIT crashes in General Aviation. Based on the analysis, technology-based and policy-level countermeasures will be proposed to reduce the CFIT crashes. The research findings will help policymakers to better understand the underlying reasons for General Aviation CFIT crashes and update their current practices and regulations.