



2018 CAMMSE Research Symposium

FINAL PROGRAM

August 6-7, 2018

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

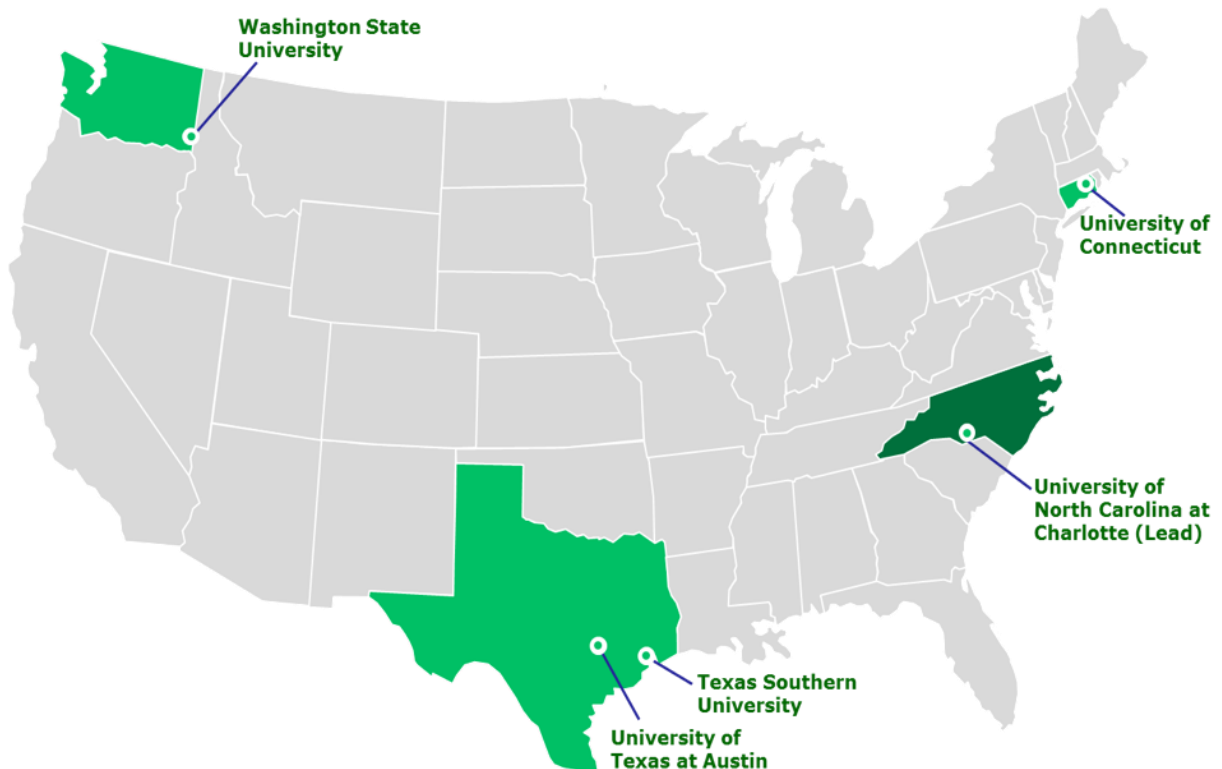


Table of Contents

Welcome Message from CAMMSE Director	4
Symposium Planning Committees	5
Final Program	6
Keynote Speakers	8
Technical Sessions & Abstracts For Faculty Presentations.....	9
Poster Session & Abstracts for Poster Presentations	16
Other Useful Information	26



Welcome Message from CAMMSE Director

It is truly an honor to welcome you, CAMMSE family members, friends and general participants that are coming from the Northwest, Southwest, and Northeast to the Southeast part of the country. It is with great pleasure that I welcome you to UNC Charlotte and to the City of Charlotte! Thank you for attending our very first 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 five 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. 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 during your visit. We have two outstanding keynote lectures. The morning keynote is on “Transitioning to Connected and Automated Vehicles” by Dr. Chris Hendrickson of Carnegie Mellon University. And a lunch keynote lecture on “Do Bicycle Riders Exhibit Different Behavior in Different Riding Environments?” by Dr. Randy Machemehl of the University of Texas at Austin. The one day program also includes two technical sessions. The morning session will be on emerging technologies and algorithms for advancing transportation operations and management, and the afternoon session will focus on improving multimodal mobility. In addition the program will include a graduate student poster session in the afternoon where we hope students and faculty can engage in productive discussions with positive feedback to our students.

In closing, I hope that this 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 see that you are here and I hope that you will enjoy this symposium and what this great city has to offer. Thank you very much and again, welcome to the beautiful Queen City!

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. Miguel Pando, UNC Charlotte

Dr. David Weggel, UNC Charlotte

Ms. Kim Wilson, UNC Charlotte

Poster Session Committee:

Dr. Miguel Pando, UNC Charlotte

Mr. Miao Yu, UNC Charlotte

Social and Catering Committee:

Dr. Martin Kane, UNC Charlotte

Ms. Kim Wilson, UNC Charlotte

First Annual CAMMSE Research Symposium - FINAL PROGRAM

Day 1: Monday, August 6 (8:00AM-6:00PM) – At **UNC Charlotte Center City**

- 7:45-9:00AM **Registration** (Registration desk located first floor of UNCC Center City)
- 8:00-9:00AM **Continental Breakfast** (*Atrium* located 2nd floor of UNCC Center City)
- 8:30-9:00AM **Welcome Ceremony** (*Lecture Hall, 2nd Floor UNCC Center City Bldg.*)
Moderator: Dr. Wei Fan
8:30-8:40 Dr. Robert E. Johnson, Dean, College of Engineering, UNCC
8:40-8:50 Dr. Rick Tankersley, Interim Vice Chancellor for Research
 and Economic Development, UNCC
8:50-9:00 Dr. Wei Fan, CAMMSE Director
- 9:00-10:00AM **Keynote Presentation No. 1** (*Lecture Hall, Moderator: Dr. Wei Fan*)
Title: **“Transitioning to Connected and Automated Vehicles”**
Speaker: **Dr. Chris Hendrickson**, Carnegie Mellon University
- 10:00-10:30AM Coffee Break (*Atrium*)
- 10:30-11:45AM **Technical Session #1: Advancing Transportation Operations and Management: Emerging Technologies and Advanced Algorithms**
Moderator: Dr. David Weggel (Lecture Hall)
- “The Potential Impacts of Connected Vehicle Technology in Improving Multimodal Winter Travel”
Speaker: Xianming Shi, Ph.D., P.E, Washington State University
- “Tabu Search Strategies for Variable Speed Limit Control at a Lane Drop Bottleneck”
Speaker: Wei (David) Fan, Ph.D., P.E., University of North Carolina at Charlotte
- “Optimization of Last Mile Vehicle Deliveries in Cities Using the Fast Lax Hopf Algorithm”
Speaker: Claudel Christian, Ph.D., University of Texas at Austin
- 11:45-Noon **Break** (Transition to lunch)
- Noon-1:30PM **Lunch** (Served at *Atrium*)
- 12:30-1:30PM **Lunch Keynote Presentation** (*Lecture Hall, Moderator: Dr. Wei Fan*)
Title: **“Do Bicycle Riders Exhibit Different Behavior in Different Riding Environments?”**
Speaker: **Dr. Randy Machemehl**, University of Texas at Austin
- 1:30-3:00PM **Student Research: Poster Presentations** (*Atrium and Mezzanine*)
(Coordinator: Dr. Miguel Pando)
- (*See Poster section in Page 11 of this booklet for more information on poster titles. For poster abstracts see pages 19 to 27.*).

Day 1 (Continued):

2:15-2:45PM **Coffee Break** (Served at Atrium during poster session)

3:00-4:15PM **Technical Session #2: Improving Multimodal Mobility**
(Moderator: Dr. Miguel Pando) (Lecture Hall)

“Impacts of CTfastrak on Real Estate and Urban Economic Development: Phase 1”

Speaker: Jeffrey P. Cohen, Ph.D., University of Connecticut

“Safety Performance of Displaced Left Turn Intersections: Case Studies in San Marcos, Texas”

Speaker: Yi Qi, Ph.D., Texas Southern University

“Determining the Accuracy of Vessels’ Estimated Time of Arrival (ETA) in a Multimodal System”

Speaker: Mehdi Azimi, Ph.D., P.E., Texas Southern University

4:30-6:00PM **Reception** (Atrium and Mezzanine)

Note: Announcement of Student Poster Awards (Top 3) will be made during the reception.

6:00PM **End of Day 1**

- Notes:**
- Attendees are encouraged to explore and dine in “Uptown” Charlotte.
 - End of Day 1 marks the end the research component of the CAMMSE Research Symposium.

Day 2: Tuesday, August 7 (8:30AM-3:00PM) – At **UNC Charlotte, Main Campus**

Closed meeting, CAMMSE members only.

8:00-9:00AM Continental Breakfast (*EPIC Room 3344, Main Campus*)

9:00-11:45AM Executive Meeting (Closed meeting, CAMMSE members only)

Part 1: Reports from CAMMSE UNCC:

9:00-9:15 CAMMSE Vision and Past Research Activities (Wei Fan)

9:15-9:30 Education & Outreach Activities (Miguel Pando)

9:30-9:45 Technology Transfer Plan (Dave Weggel)

9:45-11:00 Coffee Service (*Coffee station located outside EPIC 3344*)

Part 2: Reports from CAMMSE Sites:

9:45-10:25 CAMMSE Site Reports (10 minutes each)

10:25-11:25 FY19 Call for Proposals, Current Status, Future Research Direction (Wei Fan)

11:25-11:50 Discussions (All)

11:50-11:55 Date for 2nd CAMMSE Research Symposium (All)

Noon-1:20PM Lunch (*Served outside EPIC 3344*)

1:30-3:00PM *Optional Tour of UNC Charlotte and CEE Facilities (or End of Day 2).

2018 CAMMSE RESEARCH SYMPOSIUM - KEYNOTE SPEAKERS:

Keynote No. 1: Monday August 6, 9:00 - 10:00 AM (Lecture Hall, UNCC Center City)



Dr. Chris Hendrickson, Carnegie Mellon University

Title: "Transitioning to Connected and Automated Vehicles"

Moderator: Dr. Wei Fan, UNC Charlotte

Abstract: Transportation is experiencing three simultaneous technology revolutions: alternative fuel propulsion, data analytics and connected & automated vehicles. These revolutions are at different stages of impact and are proceeding along different timelines. This talk will take stock of where each revolution is currently and examine approaches to aid in the transition to connected and automated vehicles.

Speaker Bio: Chris Hendrickson is the Hamerschlag University Professor Emeritus, Director of the Traffic 21 Institute at Carnegie Mellon University, member of the National Academy of Engineering and Editor-in-Chief of the ASCE Journal of Transportation Engineering. His research, teaching and consulting are in the general area of engineering planning and management, including design for the environment, system performance, construction project management, finance and computer applications. He has co-authored eight books. In addition, he has published numerous articles in the professional literature. Dr. Hendrickson pioneered models of dynamic traffic equilibrium, including time-of-day departure demand models. He was an early contributor to the development of probabilistic network analysis for lifeline planning after seismic events. His work in construction project management emphasized the importance of the owner's viewpoint throughout the project lifecycle. With others at Carnegie Mellon's Engineering Design Research Center, he developed a pioneering, experimental building design system in the early 1990s that spanned initial concept through construction scheduling and animation.

Keynote No. 2 (Lunch Presentation): Monday August 6, 12:30 - 1:30 PM (Lecture Hall, UNCC Center City)



Dr. Randy Machemehl, University of Texas at Austin

Title: "Do bicycle riders exhibit different behavior in different riding environments?"

Moderator: Dr. Wei Fan, UNC Charlotte

Abstract: Bicycle riding for both recreation and commuting purposes is beneficial, to the health of the rider, as well as the urban transportation network. The only possible negative aspect of on-street bicycle usage is a safety concern. A variety of on-street bike lane configurations, pavement markings, signs and now bicycle signals have been developed to enhance safety. However, development of bicycle traffic control devices has generally assumed that bicycle riders would respond to control devices in a consistent fashion wherever the devices might be installed. This assumption may not always be appropriate. A before-after study of bicycle signal installations at eleven intersections in Austin tends to show rather different bike rider behavior across the spectrum of locations. Among the eleven intersections, the bicycle riding environment, characterized in terms of Level of Traffic Stress, varies from best case scenarios featuring a control device rich environment to cases where essentially no control devices are provided. Responses of riders measured in terms of control device compliance and bicycle-automobile interactions tend to show very different rider behavior to the different riding environments.

Speaker Bio: Dr. Randy Machemehl is the Nasser I. Al-Rashid Centennial Professor in Transportation Engineering at The University of Texas at Austin and Associate Chair of the Civil Architectural and Environmental Engineering Department. He served as Director of the Center for Transportation Research for more than thirteen years. He was in private engineering practice as a staff member of Wilbur Smith and Associates before joining the faculty of The University of Texas at Austin in 1978. He is active in many professional organizations, having served in the American Society of Civil Engineers and The Institute of Transportation Engineers at both the state and national levels and as President of the Council of University Transportation Centers. His research interests include transportation system operations, public transportation systems planning and design, traffic data acquisition, traffic simulation, optimization, and bicycle safety. Dr. Machemehl has been a principal or co-principal investigator on more than 300 research studies for the U. S. Department of Transportation, Federal Highway Administration, Federal Transit Administration, The Texas Department of Transportation, and The Texas Governor's Office, but he is most passionate about teaching and mentoring students.

TECHNICAL SESSIONS & ABSTRACTS FOR FACULTY PRESENTATIONS:

Technical Session #1: (Lecture Hall, UNCC Center City) - 10:30-11:45AM

Advancing Transportation Operations and Management: Emerging Technologies and Advanced Algorithms

10:30 – 10:55 AM:

The Potential Impacts of Connected Vehicle Technology in Improving Multimodal Winter Travel
Speaker: Xianming Shi, Ph.D., P.E, Washington State University

Abstract Page 10

10:55 – 11:20 AM:

Tabu Search Strategies for Variable Speed Limit Control at a Lane Drop Bottleneck
Speaker: Wei (David) Fan, Ph.D., P.E., University of North Carolina at Charlotte

Abstract Page 11

11:20 – 11:45 AM:

Optimization of Last Mile Vehicle Deliveries in Cities Using the Fast Lax Hopf Algorithm
Speaker: Claudel Christian, Ph.D., University of Texas at Austin

Abstract Page 12

Technical Session #2: (Lecture Hall, UNCC Center City) - 3:00-4:15PM

Improving Multimodal Mobility

3:00 – 3:25 PM:

Impacts of CTfastrak on Real Estate and Urban Economic Development: Phase 1
Speaker: Jeffrey P. Cohen, Ph.D., University of Connecticut

Abstract Page 13

3:25 – 3:50 PM:

Safety Performance of Displaced Left Turn Intersections: Case Studies in San Marcos, Texas
Speaker: Yi Qi, Ph.D., Texas Southern University

Abstract Page 14

3:50 – 4:15 PM:

Determining the Accuracy of Vessels' Estimated Time of Arrival (ETA) in a Multimodal System
Speaker: Mehdi Azimi, Ph.D., P.E., Texas Southern University

Abstract Page 15

The Potential Impacts of Connected Vehicle Technology in Improving Multimodal Winter Travel

Technical Session #1: Advancing Transportation Operations and Management: Emerging Technologies and Advanced Algorithms

10:30 – 10:55 AM - Speaker: Xianming Shi, Ph.D., P.E, Washington State University

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Abstract:

Winter maintenance has advanced significantly by adopting technologies related to weather, forecasting, location-specific material use, automated spreaders, optimization software, and traveler information. The imminent and much-anticipated deployment of connected vehicles (CV) is expected to provide significant benefits to transportation safety and mobility year-round. During this research specific scenarios related to improved mobility with CV during winter storms have been explored.

This presentation will cover the use of CV data for improved decision-making for roadway operations during winter weather events and enhance situational awareness of vehicles. The research covers CV interface with fleet vehicles, public transit systems, and bicycles to provide balanced transportation options. The concept of operations for such a system has been developed and includes users, systems, scenarios, operational policies and constraints, and impacts.

Tabu Search Strategies for Variable Speed Limit Control at a Lane Drop Bottleneck

Technical Session #1: Advancing Transportation Operations and Management: Emerging Technologies and Advanced Algorithms

10:55 – 11:20 AM - Speaker: Wei (David) Fan, Ph.D., P.E., University of North Carolina at Charlotte

Authors:

Miao Yu

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Abstract:

Traffic congestion and freeway bottlenecks continue to challenge existing transportation networks. This study presents a systematic method to evaluate freeway performance and locate and rank freeway bottlenecks while accounting for both intensity and reliability dimensions of traffic congestion. A data-driven approach is used to determine a local range of the weighting factor. Based on the vehicle probe data collected on four interstate freeways in Mecklenburg County, North Carolina, a case study is conducted to illustrate this new method. Numerical results clearly indicate that although two freeway segments have nearly identical reliability values, their intensity levels can be significantly different, and vice versa. Hence, quantifying both dimensions of traffic congestion in freeway bottleneck studies is necessary. The research results can provide insightful and objective information for decision makers and transportation professionals to systematically assess traffic conditions along freeway segments and objectively locate and rank freeway bottlenecks, competently develop congestion mitigation strategies, and thus allocate limited transportation funding in a more effective and efficient manner.

Optimization of Last Mile Vehicle Deliveries in Cities Using the Fast Lax Hopf Algorithm

Technical Session #1: Advancing Transportation Operations and Management: Emerging Technologies and Advanced Algorithms

11:20 – 11:45 AM - Speaker: Claudel Christian, Ph.D., University of Texas at Austin

Authors:

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Abstract:

This talk deals with a traffic simulation framework to reproduce urban freight movements, in particular double-parked delivery operations. The simulation framework is based on the classical Lighthill-Whitham-Richards (LWR) macroscopic model and on the theory of fixed and moving bottlenecks. An alternate Hamilton-Jacobi formulation of the LWR model is used to derive a Fast Lax Hopf (FLH) algorithm that enables the computation of exact solutions of the model over networks, considering the impact of the fixed bottlenecks created by the delivery vehicles.

The traffic component of the model is then coupled with a probabilistic parking model to enable very fast computations of forward solutions associated with given initial conditions, boundary network demand and supply patterns, and a finite number of delivery vehicles attempting to deliver items according to a schedule, but for which trajectories are initially unknown. Being very fast, this framework is particularly suitable for simulations of large scale delivery scenarios, for the evaluation of City Logistics measures to tackle the last-mile problem, and for real time optimization of deliveries within a city. The framework is validated on a subset of the Austin road network, on a scenario involving tens of delivery vehicles, which is solved in real time on a conventional computer.

Impacts of CTfastrak on Real Estate and Urban Economic Development: Phase 1

Technical Session #2: Improving Multimodal Mobility

3:00 – 3:25 PM - Speaker: Jeffrey P. Cohen, Ph.D., University of Connecticut

Authors:

Jeffrey P. Cohen, Ph.D., **(Corresponding Author)**

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Abstract:

CTfastrak, a bus rapid transit service connecting four municipalities (Hartford, West Hartford, Newington, and New Britain) in Central Connecticut (CT), received final funding approval in 2011 and opened for service in March 2015. This new service may be encouraging transit-oriented development (TOD) along the busway, including new retail stores, restaurants, office space and housing. These potential impacts of CTfastrak are expected to affect property values. But, a priori, the magnitude of the impact is unknown. The overall aim of this study is to measure the impact of CTfastrak on real estate and urban economic development in these four municipalities. The change in property values and economic development will be analyzed before and after two crucial dates: the announcement of the funding commitment for the project in 2011 and the commencement of service in 2015. The first phase of this project – the focus of this report – involves collecting the necessary data for the second phase, which could encompass a data analysis study on the potential impacts on residential property values, businesses, residents, and towns in the areas surrounding CTfastrak stations over approximately the next five years.

Safety Performance of Displaced Left Turn Intersections: Case Studies in San Marcos, Texas

Technical Session #2: Improving Multimodal Mobility

3:25 – 3:50 PM - Speaker: Yi Qi, Ph.D., Texas Southern University

Authors:

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Abstract:

Displaced left turn (DLT) is an innovative intersection designed to increase the mobility of an intersection by relocating its left turn lane (lanes) to the far-left side of the road at upstream location of the main signalized intersection. Since DLT is a relative new design and there are very limited crash data available, previous studies mainly focused on its operational performance analysis rather than its safety performance analysis. To fill the gap, this study investigated the safety performance of two DLT intersections located in San Marcos, Texas. Nearly 8 years' crash data from 2011 to April 2018 were extracted from TxDOT Crash Record Information System (CRIS) and analyzed. Two different approaches, 1) crash data statistical analysis and 2) collision diagram based "before and after analysis", were used. The results of this study indicate that the displaced left turn design has significantly reduced the certain types of conflicts. Meanwhile, some safety problems associate with the traffic signage, geometric design and access management of the DLT design were also identified. Finally, recommendations were provided for safe implementation of displaced left turn design in the future.

Determining the Accuracy of Vessels' Estimated Time of Arrival (ETA) in a Multimodal System

Technical Session #2: Improving Multimodal Mobility

3:50 – 4:15 PM - Speaker: Mehdi Azimi, Ph.D., P.E., Texas Southern University

Authors:

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Abstract:

Accuracy in estimated time of arrival (ETA) of vessels at port of call has received a lot of attention in recent years. A hand full of research works has focused on the use of statistical tools and machine learning algorithms. These methods have leveraged on the information obtainable from historical Automatic Identification System (AIS) data. Although encouraging results have been presented in some of these methods, none of the previous works have addressed this process in a multimodal system neither have they holistically approached the problem with interconnectivity of the different modes of transportation in mind. Therefore, it becomes imperative to look at methods that can be employed to improve alignment in planning the arrival and departure of different modes of transportation in play.

Machine learning techniques are techniques that are capable of capturing complex nonlinear relationships between influencing factors (inputs) and the item to be predicted (output). This study applied machine learning methods in estimating a better accurate arrival time of vessels. In achieving this, the factors that could be responsible for delays in vessel arrival at both the pilot point and the container terminals were identified. Data from Automatic Identification System (AIS) over a period of time was collected and analyzed. The relevant data used are; latitude, longitude, distance to be covered, current speed of the vessel, change in speed over the last three hours, average speed based on the last 12 hours, time used for calculating the average speed, length of the ship, breadth of the ship, and ETA of the ship's agent (acquired from AIS). Other quantifiable characteristics of the Port of Houston that are critical to the project were identified and put into consideration. Data specific to the Bayport and Barbours Cut container terminals were also identified and incorporated into the system to improve the accuracy of the result obtained. The relationship and influence of these factors on the time of arrival of vessels were linked using machine learning algorithms. For further testing and identification of accurate methods, changes were made to some of the parameters before ETA are predicted. ETA generated from the different changes in parameter were compared to determine the parameter with the most accurate ETA prediction.

POSTER SESSION & ABSTRACTS FOR POSTER PRESENTATIONS:

Poster Session: (*Atrium and Mezzanine, UNCC Center City*) - 1:30-3:00PM
(Coordinator: Dr. Miguel Pando)

Posters will be judged by at least 3 judges using posted rubric. People who are interested in serving as a judge are encouraged to contact Dr. Miguel Pando at mpando@uncc.edu.

ID	Authors	Title	Institution
P01	Zhen Chen, and Wei Fan	Estimation of Origin-Destination Matrix and Identification of User Activities Using Public Transit Smart Card Data	University of North Carolina at Charlotte
P02	Miao Yu, and Wei Fan	Accessibility Impact of Future High Speed Rail Corridor on the Piedmont Atlantic Megaregion	University of North Carolina at Charlotte
P03	Amit Mondal, and Karthik C. Kondurl	Synthesizing Household and Person-Level Attributes using Hidden Markov Model	University of Connecticut
P04	Yan Zhang, Lathan Card, Michelle Akin, and Xianming Shi	Optimal Prewet Deicer Performance Determined from Laboratory Tests	Washington State University
P05	Hao Liu, Amber Chen, and Randy Machemehl	An Adaptive Signal Control Method Using the CTM Model and Lighthill-Whitham-Richards Model	The University of Texas Austin
P06	Yi Qi, Qiao Sun, and Qun Zhao	Left-turn Crossover Distance for Displaced Left Turn Intersection Design	Texas Southern University
P07	Randy Machemehl, Scott Kilgore, and Jennifer Zuehlke	Modeling Commuter Rail Riders' Access Mode Decision-Making Using Revealed Preference Data from Austin, Texas	The University of Texas at Austin
P08	Manar Hasan	Effectiveness of Transit Signal Priority – Case Study Austin, TX	The University of Texas at Austin
P09	Mehdi Azimi, Lan Lan, Akintola Aremu, and Yi Qi	Exploring Bike Share Users' Activities and the Impact of Attributes on Bike Share Demand at the Station Level	Texas Southern University

See Abstracts for posters in Pages 17 through 25.

Abstracts for Poster Presentations:

Poster P01:

Estimation of Origin-Destination Matrix and Identification of User Activities Using Public Transit Smart Card Data

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Abstract:

The smart card-based automated fare collection (AFC) system has become the main method for collecting urban bus and rail transit (UBRT) fares in many cities worldwide. Such smart card technologies provide new opportunities for transportation data collection since the transaction data obtained through AFC system contains a significant amount of archived information which can be gathered and leveraged to help estimate public transit Origin-Destination (OD) matrices. Boarding location detection is an important step particularly when there is no AVL (automatic vehicle location) system or GPS information in the database in some cases.

This study presents a systematic approach to illustrating how passenger journey information derived from smart card data can be used to enhance information available for integrated network planning. With the analysis of raw data without AVL information in this study, an algorithm for trip direction detection is built and the directions for any bus in operation can be confirmed. The transaction interval between each adjacent record is also analyzed to detect the boarding clusters for all trips in sequence. Boarding stops then are distributed with the help of route information and operation schedule. With the boarding information, practical solution algorithms are developed for the robust origin-destination matrix estimation. Finally, the feasibility and practicality of the methodology are tested using the bus transit smart card data collected in Guangzhou City, China. The newly generated robust origin-destination matrix for the rail and bus network can help the decision makers for plan, design, operate, and manage a more efficient public transit system.

Poster P02:

Accessibility Impact of Future High Speed Rail Corridor on the Piedmont Atlantic Megaregion

Miao Yu

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Abstract:

The U.S. population is projected to reach 400 million in 2050. The increasing population and the continually expanding metropolitan regions create a new scale of geography which is commonly known as megaregion. As a new geographic unit, megaregion plays an important role in interlocking economic systems, sharing natural resources, and linking people together. Typically, the geographic scale of a megaregion is consistent with its longer distance trips appropriate for High-speed rail (HSR). HSR corridor (and network) can be used to provide a fastest mean of mass ground transportation and alleviate congestion on roadway networks. In addition, HSR can compete with air travel for its faster passenger loading and unloading times. HSR system planning studies at the megaregional level have been carried out by researchers and organizations in the United States.

This study evaluates the accessibility impact of future HSR corridor on the Piedmont Atlantic Megaregion (PAM) in the United States. A geographic information system (GIS) tool is used to conduct the accessibility assessment. The door-to-door approach is adopted to evaluate the multimodal (including roadways and HSR) travel time. Three accessibility indicators are selected, including the weighted average travel time (WATT), daily accessibility (DA), and potential accessibility (PA). The selected accessibility indicators are calculated by using the estimated travel time at the geographical level. The average accessibility scores of the counties in the PAM during peak and off-peak hours are estimated and compared. The results indicate that the building of the HSR corridor within the PAM will improve the accessibility at the megaregional level. However, the coefficient of variation results indicate that the inequality will also increase due to the new HSR corridor. The relationships between megaregional accessibility scores (i.e., WATT) and HSR services (such as headway and speed) are explored. Several policy implications are drawn in terms of enhancing the megaregional accessibility.

Poster P03:

Synthesizing Household and Person-level Attributes using Hidden Markov Model

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Abstract:

Population synthesis plays an important role in describing the socio-economic and demographic attributes of all agents of interest. This is essentially a task of obtaining a full set of agents where each agent is characterized by a combination of variable attributes. This disaggregate level information is one of the basic inputs for microscopic land use and activity-based models. Over the years, different techniques have been explored by the researchers including the fitting based approaches and combinatorial optimization approaches. Fitting based methods make use of a disaggregate sample dataset and attribute marginal distributions to reweigh agents from the sample so that attribute marginals are satisfied. Combinatorial optimization approaches are also based on sample dataset and involve selecting a combination of agents from the sample using an iterative approach to obtain the best goodness of fit. A few sample-free techniques have also been proposed to overcome some common issues of sample-based approach such as sampling bias, costs of data collection and inability to obtain a representative set of agents for the entire population. Recently, there has been a significant development in terms of incorporating machine learning techniques in the realm of population synthesis. Researchers have introduced several methods to better understand the composition of agents so that the synthesized population can be a perfect representation of the actual population in the study area.

In our study, we propose a population synthesis technique using a Hidden Markov Model (HMM) to address the composite characteristics of multi-level agents such as households and persons. A typical HMM operates on the basis of a transition probability matrix which is estimated using a sample dataset. In our case, we introduce a more complex transition structure of household and person level attributes in the transition probability matrix and also a two-step technique for tuning up the cell probabilities so the synthetic totals match closely with attribute marginal distributions. Firstly, the structure of the transition matrix is designed in a way to capture the conditional dependencies of each household and person-level variables. Besides, all person levels attributes are conditional on the corresponding household level attributes so that the variable attributes of the synthetic population is consistent both at household and person level. The study also focuses on simulating multilevel agents maintaining their complex household compositions. In other words, the model can capture different compositions of persons who belong to a particular household. This essentially helps to obtain a synthetic population with more heterogeneity in terms of person composition and their respective variable attributes. Secondly, we incorporate Iterative Proportional Fitting in the transition matrix estimation process using attribute marginals as constraints and PUMA (Public Use Microdata Areas) based sample data as seed. This approach helps address geography based demographic and socioeconomic heterogeneity while synthesizing population for a set of different geographical units. In the scope of this study, we generate a synthetic population for two block groups in Connecticut and perform three case studies where we use three transition matrices with the same structure but different cell probabilities estimated using entire PUMS dataset, selected PUMA sample data containing the block groups and our approach of cell probability estimation. Finally, we include a comprehensive analysis of the synthetic population generated using our synthesis technique and perform a comparative assessment of using our approach for estimating transition probability matrices using both disaggregate sample data and corresponding attribute marginal distributions.

Poster P04:

Optimal Prewet Deicer Performance Determined from Laboratory Tests

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Abstract:

Applying prewet deicers during winter storms is a cost-effective strategy to improve deicer performance. Prewet deicers have a small amount of liquid product applied to solid salt or salt/sand which helps activate the ice melting and penetration and significantly reduces bounce and scatter. Prewetting keeps the product on the road and improves the ability of plows to removed compacted snow and ice. While many agencies use prewet deicers, there is not enough reliable data to determine optimal prewetting rates or product type.

This research presents the results of an in-depth survey of the pacific northwest (Oregon, Washington, Alaska and Idaho) on prewetting practices and laboratory tests that quantified the ice melting, frictional behavior and reduction in snow-pavement bond strength of salt prewet with various liquid deicers and prewetting rates. Ice melting tests are an accepted method to gauge basic chemical performance, but do not adequately predict field performance. More sophisticated laboratory tests on asphalt pavement with realistic snow and representative trafficking motion and forces were conducted. Whereas ice melting tests require unrealistically high application rates (over 1000 pounds per lane mile (lb/lm)), the snow/traffic/friction tests were conducted with reasonable application rates (250 lb/lm). This research has provided realistic data to suggest optimal prewetting practices.

Poster P05:

An Adaptive Signal Control Method Using the CTM Model and Lighthill-Whitham-Richards Model

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Abstract:

Traffic signal control, including both pre-timed control and adaptive signal control, is an effective tool to mitigate congestion in urban networks. Due to its ability to accommodate varying traffic demands, adaptive signal control is considered superior to pre-timed control. Two components constitute the core of the adaptive signal control algorithms: traffic forecasting and an optimization model. In past decades, a large number of adaptive signal control frameworks have proposed using a rolling horizon scheme. The length of the rolling horizon plays an important role on the efficiency of the signal control. Some models use detectors to count vehicles located at upstream intersections to forecast traffic demand at downstream intersections, while others use historical counts from the target intersection. These approaches could lead to a rolling horizon that is too short or inaccurate forecasting results from assuming the past is the same as the future. Another problem is that although the parameters, such as the sequence of phases and phase lengths, have been studied widely, few models have considered the number of times each phase is served per cycle.

This study proposes a new adaptive signal control method under a rolling horizon scheme to overcome the drawbacks mentioned above. The rolling horizon length is the signal cycle length. At the beginning of each horizon, the cell transmission model (CTM) is used to forecast the traffic flow for each phase for this horizon based on the current information from the upstream links and the upstream intersection signal settings. Then, the signal optimization problem is modeled as a mixed integer linear program based on the properties of the analytical solution of the Lighthill-Whitham-Richard (LWR) model. Finally, the effect of the proposed model is validated through the simulation performed by incorporating a microscopic traffic simulator, CORSIM, and MATLAB.

Poster P06:

Left-turn Crossover Distance for Displaced Left Turn Intersection Design

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Abstract:

Displaced left turn (DLT) is an innovative intersection designed to increase the mobility of an intersection by relocating its left turn lane (lanes) to the far-left side of the road at upstream location of the main signalized intersection. Previous research has suggested DLT can significantly increase the efficiency and capacity of the main intersection and improve progression at the corridors. However, since DLT is relatively new, there are few existing guidelines available for the DLT, leaving traffic engineers to rely on engineering judgment for their designs. A critical element in this design is the distance between the left-turn crossover and the main intersection. If the distance is too short, it will result in queue overflow from the turning lanes, which may block the through traffic at the left-turn crossover.

Therefore, the Left-turn crossover distance is a critical issue in the DLT design. Most of the existing guidelines only provide some general recommendations, such as a range of crossover distance, for the DLT design and no specific quantitative methods were proposed for determining the left-turn crossover distance based on the actual traffic volumes, intersection signal timings, geometric conditions, etc.

To fill the gap, this study developed a method for determining the required minimum crossover distance for DLT design under various traffic conditions. The developed method was validated by VISSIM simulation study for evaluating the operational and safety performance of a DLT intersection with different crossover distances. The results of this study showed that the developed method can provide a reasonable estimation for the minimum required left-turn crossover distance, while failing to provide the estimated minimum crossover distance could result in serious traffic congestion and safety problems in the DLT design.

The results of this study will complement the provisions in current roadway design manuals and guidelines in implementing this innovative intersection design.

Poster P07:

Modeling Commuter Rail Riders' Access Mode Decision-Making Using Revealed Preference Data from Austin, Texas

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Abstract:

Growing cities like Austin, Texas continue to see the need for improving commuter rail options to make daily travel easier. A key component of rail demand forecasting is the access mode used by rail passengers to reach stations. Consequently, an on-board survey was conducted with the help of Capital Metro's MetroRail Red Line passengers during late summer of 2017. The survey revealed access modes used, distances traveled, and spatial patterns of trip origins in and around the rail line path. The fundamental purpose of this study is to examine the influence of access modes from a commuter's decision-making process and characterize travelers at each boarding station. With a geographic information system (GIS) perspective of the city, evaluating demographic and socioeconomic data helps to describe the traveler decision process.

This study in particular illustrates a case involving a 32-mile stretch of rail and nine stations where we model the commuters' decision-making process and travel preferences. Data collected based on a passenger's choice of access mode emphasized whether an individual decided to walk, bike, ride a bus, or drive to a park-and-ride facility. Likewise, generalizations were made about individual preferences for these purposeful trips after gathering information on the type of trip carried out and distance traveled by the commuter. In this case, a discrete choice binomial logit model showed benefits in relating whether a rider may choose to access the Red Line specifically by walking or driving to the station. For instance, those boarding in the central business district (CBD) within downtown Austin prefer walking rather than any of the other identified modes considering the proximity to entertainment and social gatherings in an area where finding parking can be difficult. The research suggests that more densely developed areas of the city tend to have more people willing to walk to the boarding stations. However, people boarding at stations further from the CBD often take advantage of available station parking thus their preferred access mode is driving.

Poster P08:

Effectiveness of Transit Signal Priority – Case Study Austin, TX.

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Abstract:

Transit Signal Priority (TSP) strategies have been used by transit agencies to improve reliability of transit service. The concept includes three main components: detection, communication, and decision (algorithm), each of which has many possible implementation strategies within itself. There are studies in particular locations which explore the effectiveness of a certain strategy combination in that area, but not a general overview of the various options and their advantages/disadvantages.

This study presents a thorough background of TSP usage in the United States and beyond, with discussions of many possible combinations of detection-communication-decision. The study also identifies many possible avenues for future research, with the ultimate goal of reaching a planning-assisting toolbox that could determine which combination of detection-communication-decision is most effective in various circumstances. The study explores the current implementation of TSP in Austin, TX, and builds off of that to generate possible improvements that can apply not only to Austin's implementation, but to others as well. This includes a discussion of effective data collection practices as well. A specific improvement, namely a new algorithm which balances out signal timing variations by 'repaying the loan' of green time taken from an approach during cycle A in the following cycle, is tested in a model of Austin to determine effects on the overall transportation system.

Poster P09:

Exploring Bike Share Users' Activities and the Impact of Attributes on Bike Share Demand at the Station Level

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Abstract:

Public bicycle systems have increased from operating in a few European cities to expanding in the United States at an increasing pace. The system intends to increase cycle usage, facilitate the first mile/last mile connection to other transportation modes, and lessen the environment impacts of transportation activities. As a major city in the United States, Houston has operated its bike share program. Houston BCycle was designed to provide an easy, cost-effective transportation option for short trips around the city and to improve multimodal transportation. Along with the growth of Houston BCycle, significant increases have been observed in both rider count and trip count. Bike share riders increased from 700 to more than 50 thousand. There were over 140 thousand trip data generated in 2017. Despite the rapid development of the program, the bike share faces the challenge of bike unavailability and dock shortage at different stations.

This study uses historical trip data collected from Houston BCycle to explore bike share users' activities and examine the potential attributes that impact bike sharing demand. Through compiling various trip data, this study analyzes the distribution of bicycle trips at the station level and the trip volume throughout the different time periods of the day as well as the week. The results of the bike user survey which has been conducted at the two highest volume stations provide insights into the social-demographic characteristics, motivation of usage, and program experience of bike share users. In terms of the potential attributes on bike share demand, trip generated and trip attracted at each station are analyzed using ArcGIS to show the most popular stations and reveal the usefulness of bike share in Houston.

2018 CAMMSE RESEARCH SYMPOSIUM – OTHER USEFUL INFORMATION:

UNC Charlotte Center City (Day 1: August 6, 2018: Research Symposium):

320 E. 9th Street, Charlotte, NC 28202

<http://centercity.uncc.edu>

Walking distance from the Ninth Street Light Rail Station (Blue Line).

Parking requires a UNCC parking pass available for a nominal fee of about \$5/day.

Location: **Point B** in Figure 1, below.

EPIC Building, UNC Charlotte Main Campus (Day 2: August 7, 2018: CAMMSE Executive Meeting):

8700 Phillips Rd., Charlotte, NC 28223

<http://epic.uncc.edu>

Walking distance from the JW Clay Light Rail Station (Blue Line).

Parking requires a UNCC parking pass available for a nominal fee of about \$5/day.

Location: **Point A** in Figure 1, below.

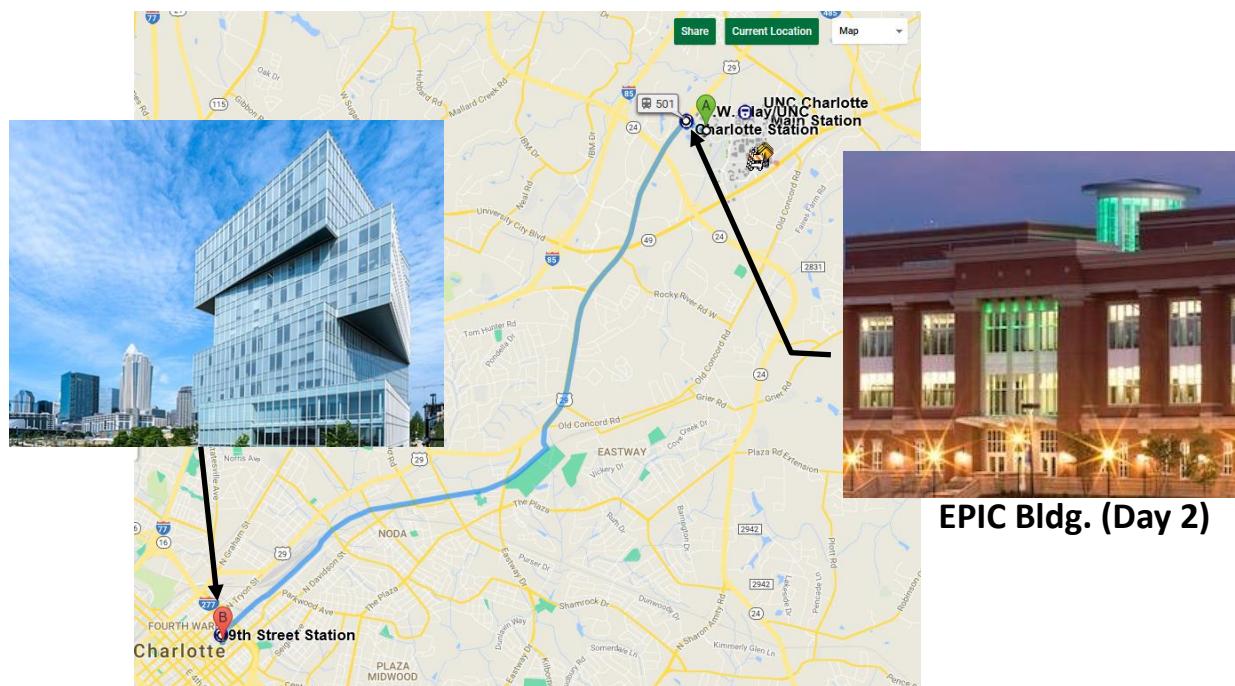


Figure 1 – Venues of CAMMSE Research Symposium