CAMMSE NEWS
October, 2017

LETTER FROM CAMMSE Director

Welcome to our very first USDOT Center for Advanced Multimodal Mobility Solutions and Education (CAMMSE) newsletter. We are extremely honored to have been granted a Tier 1 University Transportation Center by the United States Department of Transportation, which will be headquartered at University of North Carolina at Charlotte (UNC Charlotte).

CAMMSE is a consortium of five universities, led by UNC Charlotte, each with outstanding programs in synergistic research, education, technology transfer and innovation on multimodal transportation planning, design, operations, and maintenance. The Center includes UNC Charlotte, 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 hubs engaging diverse populations and nurturing the success of all students.

CAMMSE will address the FAST Act research priority area of "Improving Mobility of People and Goods" by focusing on developing advanced technology, methods and models for multimodal transportation (including highway, air, rail, freight, public transit, bicycle and pedestrian) as well as educating and developing an effective workforce. A collaborative research, education and outreach partnership will harness advanced (computing, smartphones and communication) technologies and ubiquitous data for creating sustainable, efficient and growth-enabling multimodal transportation systems using cutting edge analytical methods and models.

As a result, research performed by the Center will deliver impactful products to local, regional, and national stakeholders that support economic development, significantly improve mobility of people and goods, reduce congestion, promote safety and social equity, preserve the environment, and preserve the existing transportation system.

Dr. Wei (David) Fan
CAMMSE Director

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MEET OUR ASSOCIATE DIRECTORS

CAMMSE has the support of a team of nationally and internationally recognized professors from our partner institutions acting as our associate directors. They will be actively involved in all aspects of CAMMSE's research, education, outreach, and technology transfer activities. Our CAMMSE team members are committed advocates and longstanding leaders within the multimodal transportation community and the UTC system itself.

Dr. Yi Qi is a Professor and Chair of the Department of Transportation Studies at TSU, which is one of the nation's largest historically black universities located in Houston, Texas. She teaches transportation planning and engineering courses. Her research areas include transportation system performance analysis, roadway geometric design, highway operation, traffic incident management, traffic signal operation, and high speed rails. She has served as a PI on many research projects sponsored by the Department of Homeland Security (DHS), Texas Department of Transportation (TxDOT), Southwest Region Transportation Research Center Project (SWUTC). In these research projects, innovative system performance analysis tools, data management systems, and comprehensive guidelines were developed. The products of these studies are highly applicable and have resulted in numerous research papers in several prestigious transportation engineering journals and conferences. Dr. Qi is a nationally recognized scholar and has served as a member of the Transportation Research Board (TRB) ABR10 Committee "Critical Transportation Infrastructure Protection," and the Transportation Research Board (TRB) ABJ70 Committee "Artificial Intelligence and Advanced Computing Applications" under the National Academies. She got her Ph.D. in Transportation Planning and Engineering from New York University-Polytechnic Institution.

Dr. Nicholas Lownes is an Associate Professor and Associate Head of the Department of Civil and Environmental Engineering at the University of Connecticut. Dr. Lownes' research focuses are public transportation systems modeling, equity and economics. He earned his PhD in August 2007 from The University of Texas at Austin. From 2010-2016 he served as the director of the Center for Transportation and Livable Systems. In 2016 he was named a UTC Professor in Engineering Innovation. Dr. Lownes received the 2009 C.R. Klewin, Inc. Excellence in Teaching Award and the Provost's Award for Excellence in Public Engagement in 2013. He has authored or co-authored over eighty journal articles, refereed conference proceedings and technical reports. He is an active member of several organizations, including TRB, ASCE and INFORMS.
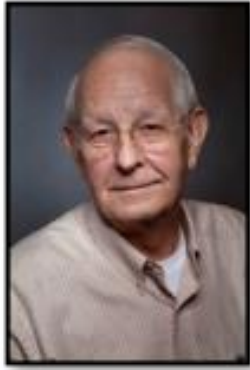
Dr. Dr. Randy Machemehl serves as the Nasser I. Al-Rashid Centennial Professor in Transportation Engineering at The University of Texas and was formerly the Director of the Center for Transportation Research. He is active in many professional organizations, having served in the American Society of Civil Engineers and The Institute of Transportation Engineers at both the state and national levels and recently served as President of the Council of University Transportation Centers. His research activities are numerous, addressing a wide range of transportation topics and modes that are generally concentrated in transportation system operations. Dr. Machemehl has been a principal or co-principal investigator on more than 200 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. Results of his research have been published in over 300 technical reports and papers. His research interests span a wide range of topics, but are concentrated in transportation system operations. Much of his recent work has dealt with transport system safety. He has developed techniques for optimization of large scale transportation systems including urban traffic signal networks and bus transit route networks. He has developed a variety of general and special purpose computer simulators of ground transportation systems. Additionally, he has conducted a series of human factors studies in which he examined vehicle driver responses to traffic control systems using instrumented vehicles and experimental driver monitoring systems. The human factors investigations have examined driver responses to freeway guide signing, arterial street traffic control, work zone traffic control, and rural road delineation and signing.

Dr. Xianming Shi, P.E. is an Associate Professor in the Department of Civil and Environmental Engineering at the Washington State University - Pullman. He also serves as the Department's Geotechnical & Transportation Engineering Group Coordinator. His research focuses on innovative materials and practices for sustainable transportation systems. For this UTC, Dr. Shi brings his decades of research experience in best practices of road weather management and winter mobility as well as his expertise in *Industrial & Management Engineering*. Before joining WSU in 2014, he was a Research Professor at Montana State University and the Manager of Winter Maintenance & Effects Program at the Western Transportation Institute for nine years. He has served as a Principal Investigator or Co-PI of about two dozen research projects related to winter road maintenance best practices and impacts, sponsored by various DOTs and their consortia and the National Science Foundation (totaling ~$9 million).
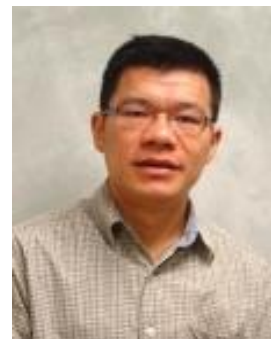
CAMMSE'S TRANSPORTATION ENGINEERING CAMP

This summer camp is a partnership between UNC Charlotte's Civil and Environmental Engineering Department and Camps on Campus and is a grant-supported educational activity with the US DOT University Transportation Center CAMMSE (http://cammse.uncc.edu/). This week-long, day camp was held from July 10, 2017 - July 14, 2017 on the UNC Charlotte campus. Several high-school students were introduced to many aspects of the transportation field. Campers had hands-on lab activities, went on local supervised field trips on the UNC Charlotte campus, and learned about the transportation field directly from transportation and civil engineering professionals and experts. Example Camp Activities Include:

- Topography and map reading exercise
- Introduction to civil engineering
- Basics of road design
- Traffic engineering and traffic signals
- Stop sign field activity
- Seat belt and cell phone study
- Driving simulator
- Tour of UNC Charlotte campus and facilities

Summer Camp Main Instructors are the investigators for the UNC Charlotte CAMMSE. In photo from left to right: Dr. Miguel Pando, Dr. Marty Kane, Dr. Wei Fan, and Dr. David Weggel. The camp will also include guest lectures from faculty of the Civil and Environmental Engineering Department at UNC Charlotte.

TSU Summer Maritime Academy

TSU Department of Transportation Studies hosted Summer Maritime Academy (SMA) in June 2017. Twenty high school students attended this program. The week long non-residential program is designed to introduce students to the Maritime industry and careers in the industry. The program also introduced students to the Maritime Transportation Management and Security degree program and scholarship opportunities at TSU. During the week the topics of logistics, security, and the TSU


Summer Maritime Academy Field Trip

environment (vehicle emissions) were covered and students enjoyed field trips to the Port of Houston Authority and U.S. Coast Guard facility. U.S. Customs and Border Protection Agency officials also visited with students and demonstrated cargo screening techniques to detect contraband items in cargo. Students also learned transferable skills through sessions on Leadership, Dealing with Change, and Effective Communication Strategies.

TSU Summer Internship Program with Elkin High School Engineering Academy

In summer 2017, four students from Elkin High School were selected for TSU summer internship program. They were mentored by Dr. Yi Qi. All students worked on Dr. Yi Qi's newly awarded TxDOT project. This two-week internship program offers high school students the opportunity to work with professors and graduate students in our research labs, enabling them to participate in various research projects and learn about many of the tools and software programs that were used for transportation research purpose.
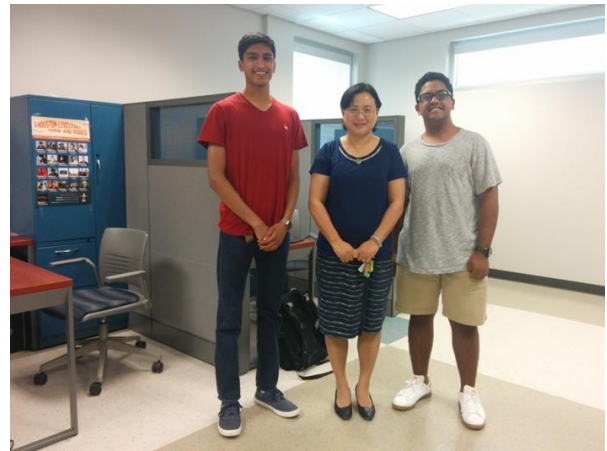

Dr. Yi Qi and the two High School Intern Students in TSU Research Lab

TSU CAMMSE LECTURE

TSU CAMMSE designed and organized "*Transportation Seminar Series*" to both undergraduate students and graduate students. These seminars focus on innovations to improve multi-modal connections, system integration, and security; and cover other transportation mobility related areas. Lectures are offered in two forms: invited speak and Webinar based lectures.

In FY2016, two seminars were organized and widely welcomed by students. One lecture was given by Dr. Liang-Chieh and Dr. Yunpeng Zhang from the University of Houston. The topic of their lecture was "The Future of National Security – Maritime Cybersecurity". Another seminar was "Introducing the Guidelines for Implementing Managed Lanes", offered by *Transportation Research Board (TRB)* Standing Committees on Managed Lanes and Operational Effects of Geometrics.
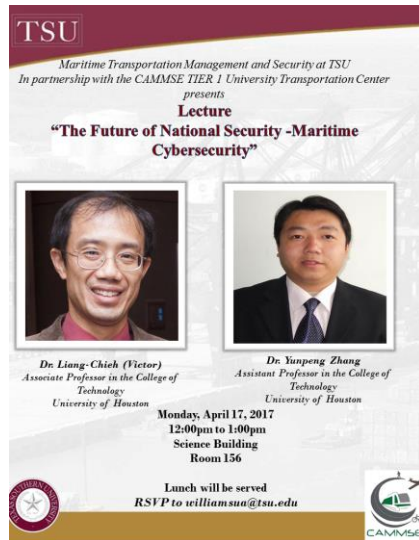
Flyers of TSU Transportation Seminar Series

CAMMSE AT EXPLORE UT

Join us for Explore UT, a campus-wide event at the University of Texas at Austin described as the "Biggest Open House in Texas!" Explore UT invites people of all ages to experience the intellectual life, technological advances and rich resources of a world-class university. The UT-Austin CAMMSE team will have a hands-on exhibit showcasing our latest research and findings. Visitors of all ages will have the opportunity to experience engaging and inspiring activities while learning about CAMMSE's current research and breakthroughs.

ONGOING RESEARCH

Project 01. Estimation of Origin-Destination Matrix and Identification of User Activities Using Public Transit Smart Card Data
PI: Dr. Wei Fan (UNC Charlotte)

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 as the transaction data obtained through AFC system contains a significant amount of archived information. At the same time, basic information about card users can be recorded or inferred by the system. These raw data can potentially help estimate public transit Origin-Destination (O-D) matrices and used

by transit service providers for analysis of both passenger demand and system performance, including demand analysis, travel behavior analysis, operational management, and public transit planning.

The purpose of this project is to develop a systematic approach to illustrating how passenger journey information can be mined from the data derived from the smart card-based automated fare collection (AFC) system. Advanced solution algorithms will be developed for the origin-destination matrix estimation. The analysis of passenger activities will help present passengers' trip characteristics in a transportation planning aspect. The newly generated origin-destination matrix for the bus network can help the decision makers for plan, design, operate, and manage a more efficient public transit system.

Project 02. Improving the Movements of People and Freight: A Case Study of the Piedmont Atlantic Megaregion
PI: Dr. Wei Fan (UNC Charlotte)

As specifically addressed in the 2016 Southeast Rail Forum by Mr. Anthony Foxx, U.S. Secretary of Transportation, a wave of population growth is going to hit the Southeast. Another 13 million people and a significant increase in the movement of freight can be expected by 2045. As such, local and state leaders shall act promptly to develop a comprehensive blueprint for the Region's rail network and establish a Southeast Rail Commission to advance it or risk being stuck in traffic for a very long time. Although the progress over the years has been steady, future work remains. Meanwhile, from Boston to Washington DC to Charlotte to Atlanta, the term, "megaregions", has been used to re-envision the economic and social fabric of America. Mega-regions have been defined as networks of metropolitan areas linked by economic and trade relationships, transportation infrastructure, linked ecosystems, and growth concerns. Megaregions, supported by improved transportation networks, have the potential to evolve as integrated economic units.

The project will consider the Piedmont Atlantic Megaregion with an emphasis on maintaining efficient future people and freight movements and will offer multimodal solutions to moving people and freight to, between, and within the metropolitan economies of the megaregion to 2050. The needs, impacts and benefits of intercity high speed passenger and freight rails will be carefully examined and objectively quantified. The issues and themes that

arise in the mega-region evolution and development context, including regional planning, effective land management, water, energy and air quality issues, and education and social equity issues including health access, will be discussed. The importance of developing a multi-modal transportation system that integrates freight, light rail, commuter rail, buses, and personal vehicles, will also be discussed and emphasized.

Project 03. Forecasting Ridership for Commuter Rail in Austin
PI: Dr. Randy Machemehl (UT Austin)

Austin, Texas is one of the most rapidly growing cities in the United States. Current estimates indicate over 150 people per day are moving to Austin. To deal with the growing transportation needs, Capital Metro is proposing the addition of commuter rail services in several corridors where publically owned rail right of way is available. Forecasting ridership for such services is problematic due to a lack of experience with access modal choices and the potential operational state of the transport system due to rapid growth. The research team has developed dynamic traffic assignment algorithm for such problems, however, it currently estimates time and cost of access in very rudimentary ways. This work aims to develop robust predictive tools for assessing modes used for accessing the proposed commuter rail systems.

The purpose of this project is to develop access mode models using a combination of stated preference survey data and analogies with other cities. The research team has conducted an on-board survey at the end of August and is currently analyzing the results.

Project 04. Corridor Level Adaptive Signal Control
PI: Dr. Randy Machemehl (UT Austin)

Traffic congestion in Austin, Texas is becoming more problematic as the City continues growing rapidly. Current estimates indicate over 150 people per day are moving to Austin. To deal with the growing congestion problem in many travel corridors, the City is proposing adaptive traffic signal systems for several routes. The first pilot test is on a north-south route (Lamar Blvd) that experiences congestion particularly during the AM peak time. Before-after assessments of the proposed timing methodology will be developed from field observations and form the basis for improving the concept. The chosen corridor is an excellent test bed since it features
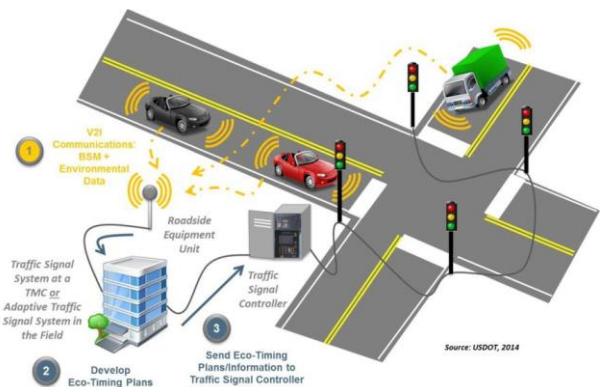
hard-wire connected signal controllers and video surveillance. Street geometry includes two lanes each direction with a continuous two-way left turn lane. The research team has extensive experience with adaptive signal control concepts and this knowledge will be a significant contribution to the effort. Before-after field data combined with micro-simulation will constitute the primary tools. The research team also has a fully calibrated network model and dynamic traffic assignment capabilities to examine the likelihood of travelers changing paths potentially impacting the Lamar corridor signals.

During the first stage of this study, a single intersection testbed controlled by two-phase traffic signal was developed in CORSIM. The first set of runs maintained a constant cycle length of 90 seconds, but changed red/green splits based on the critical flows calculated from the previous cycle. The team is currently analyzing the results to understand whether the average traffic delay and average queue length per vehicle can be decreased significantly by utilizing this type of simple adaptive signal control.

Project 05. Stochastic Multimodal Network Modeling
PI: Dr. Nicholas Lownes (UConn)

A broad range of transit data are available that can be mined beyond performance analysis for the current state of the system. Such data will enhance the current models of transit and multimodal systems, and make possible the application of innovative models in long-term planning of regional networks and in real-time operations management. We are proposing a data-intensive approach to model transit and multimodal systems using existing and new ITS data. It includes stochastic transit network representation, user behavior modeling under uncertainty, reliability-based routing, assignment, and network design, and lastly, application of the models towards long-term planning and operational management.
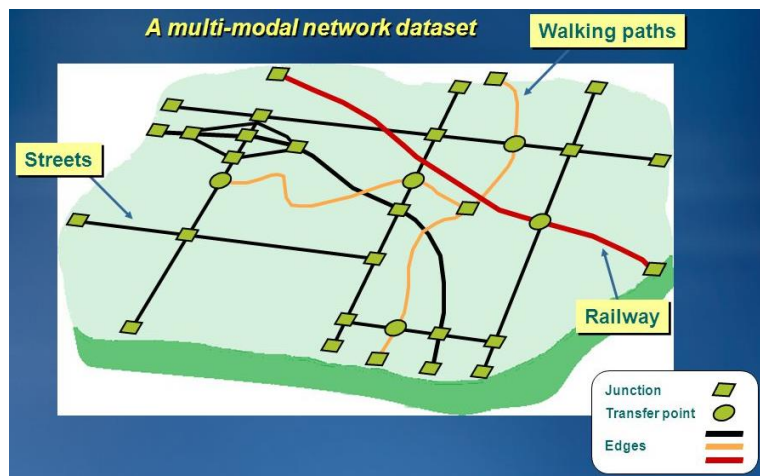

Powerful map-matching algorithms for processing the network data will be the first step taken toward more realistic and detailed modeling of transit and multimodal networks. Moreover, statistical modeling tools will be developed to process historical APC and AVL data and to develop a stochastic transit network. This underlying stochastic network will facilitate system modeling and decision making for the varying levels of reliability over the course of a day, week or year, as opposed to modeling a typical day. Moreover, the impact of external conditions such as weather or incidents on transit performance can be built into the methodological framework, improving existing models and positioning for future applications.

Project 06. Robust Routing, Assignment, and Simulation of Transit Systems
PI: Dr. Nicholas Lownes (UConn)

Transit system complexity is a function not just of the infrastructure but is strongly tied to user behavior, which is driven by perception of the quality of service (in experiencing waiting,

transfers, and travel time variability), which is not always an accurate reflection of the true quality of service. The variability and inconsistency (with reality) of these perceptions can be captured in part by correlating the multiple data sources, observing travel patterns and modeling user behavior under uncertainty.
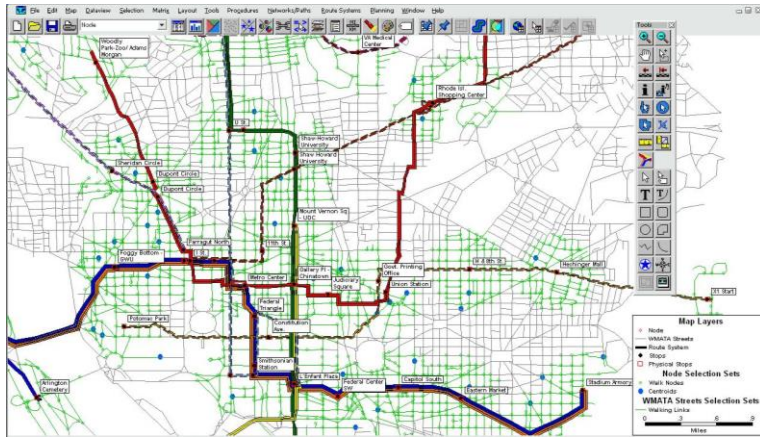
The effect of service reliability and accessibility will be investigated toward development of route choice, stop choice, and departure time choice models. Stochastic multimodal network and user behavior models will be leveraged toward the development of routing, assignment, and simulation models for ridership estimation and performance analysis. Robust analysis tools will be developed that take into account system characteristics that are a function of the performance of the auto network, models passenger flow in the network under stochastic rules and predicts system wide travel patterns. Such models will enhance decisions made by transit agencies when allocating resources toward additional capacity, schedule updates, and stop/station location in the long term; and stop skipping, rerouting, and vehicle holding as real-time operational decision.

Project 07. Use of Vessel Automatic Information System Data to Improve Multi-modal Transportation in and around the Ports
PI: Drs. Mehdi Azimi & Yi Qi (TSU)

One of the major challenges in multi-modal transportation is the alignment in planning the arrival and departure of different modes, e.g. vessels and trucks, such that the containers can be transferred without delays. Although trucking companies may have access to some levels of information in order to track the vessels and cargos, they don't have accurate estimation for the arrivals of those vessels to the port. Automatic Information System provides a means for ships to electronically broadcast ship data at regular intervals including vessel identification, position, course, and speed.

PortVision is a tool that uses the Automatic Information System. By using this tool, the positions of the vessels can be tracked in order to calculate the vessel estimated time of arrivals. It will help the trucking companies to have a better plan for delivering or picking up the containers. If the system detects a deviation from the planned schedule (e.g. a delay in arrival of a vessel), the involved trucking companies are informed pro-actively. Consequently, the related trucks can be re-scheduled at an early stage and waiting times and unsuccessful attempts to deliver or pick up a container can be
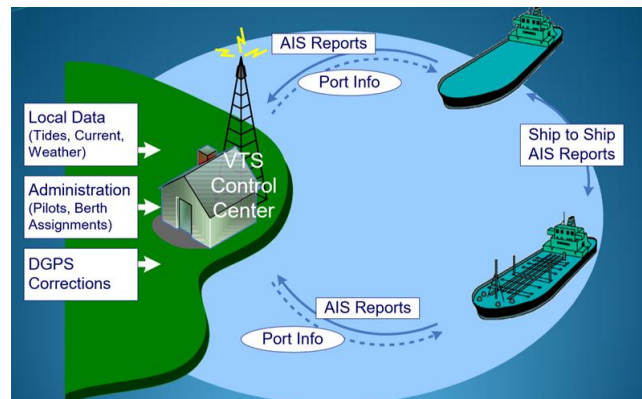
reduced. The outcomes of the project will decrease unproductive waiting time of transportation vehicles and improve the multi-modal connections in ports.

Project 08. Use of Innovative Intersection Designs for Roadway Traffic Congestion Mitigation
PI: Dr. Yi Qi (TSU)

Traffic engineers, their partner agencies, and developers increasingly have to consider the use of innovative intersection designs, including single-point urban interchanges, Michigan U, Super
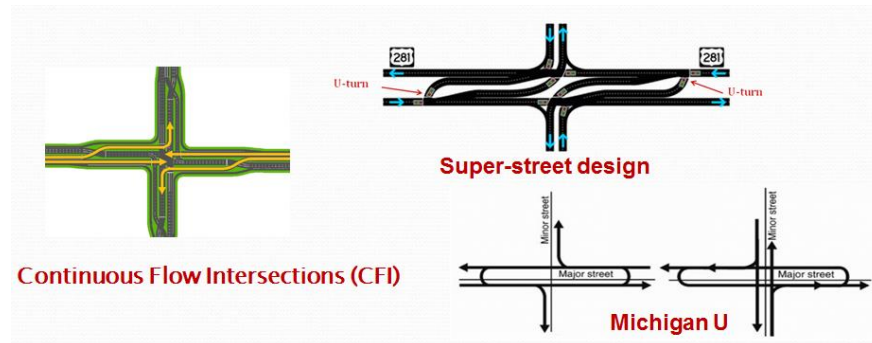
Streets, continuous flow intersections, to mitigate the congestion problems at conventional intersections. An innovative intersection is generally defined as any at-grade design concept that is able to reduce the number of traffic signal phases at the main intersection, thereby increasing the efficiency and capacity of the intersection and improving progression at the corridors.

It is important to understand the applicable conditions for such intersection designs and how they are performing in terms of operations, safety, and their general public acceptance. The proposed research project is to systematically investigate the operational and design issues in the implementation of such innovative designs and to evaluate the operational benefits of these intersection designs. The outcome of the project will provide tools and guidelines for appropriately selecting the right locations and cost-effectively implementing of different types of innovative intersection designs.

Project 09. The Use of Connected Vehicle Technology to Facilitate Multimodal Winter Travel
PI: Dr. Xianming Shi (WSU)

This project aims to investigate how connected vehicle (CV) data could be utilized to improve decision-making for roadway operations subject to inclement winter weather events (e.g., snowstorm, icy roads) and enhance situation awareness of drivers, thus improving the multimodal traveler experience, with the focus on transition from airports to roadways and

intersection of roadways and bicycle lanes. Smart snowplows have been increasingly used as mobile data collection platform for enhanced winter operations, featuring automatic vehicle location (AVL) and other sensors. For winter travel, there are also existing technologies such as road weather information systems (RWIS), dynamic message signs (DMS), and traveler information systems. CV data could be utilized to enhance these strategies by

supplementing or complimenting current roadway sensing components to improve the effectiveness of the system operations to react to changing road weather conditions. The 360° awareness by snowplow operators and increased system reliability are envisioned to reduce the risk of vehicle crashes and enhance the efficiency of system operations. Road weather data collection will be improved by utilizing weather sensors in CVs and by transferring collected data through vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communication, which has been demonstrated in the European WiSafeCar project. The enhanced road weather condition information can be communicated to the general public so that they can slow down, choose a different route, or stay home in light of inclement weather.

Project 10. The Effect of Competition of Transport Modes on Mobility
PI: Dr. Jia Yan (WSU)

Emerging technologies in transportation will have profound impacts on travel both within and between cities in the Unites States. Some examples of these new technologies include Uber,

Zipcar, driverless vehicles, high-speed rail and hyperloop. These new technologies will enhance competition of transport modes and therefore benefit travelers by improving their mobility. Policymakers need rigorous evidence on the effects of the enhanced transport mode competition caused by new technologies on travelers' mobility in order to prioritize transportation policies. In this project we will build transport mode-choice models of travelers both within and between metropolitan areas in the United States and use the models to understand travelers' willingness-to-pay for important transport attributes such as travel time, reliability and safety. Given these parameter estimates, we will quantify the effect of the enhanced competition on travelers' mobility which is measured by both trip allocation and trip generation.

   The project will include two components. 1. Transport mode choice models for within-city travel. Typical transport modes for within-city travel include private driving, public transit, taxi and bicycle. We will study how UBER services affect travelers' mode choices. 2. Transport mode choice models for inter-city travel. We will analyze mode choice behavior among automobile, rail and air and simulate how high-speed railway affect inter-city travel.
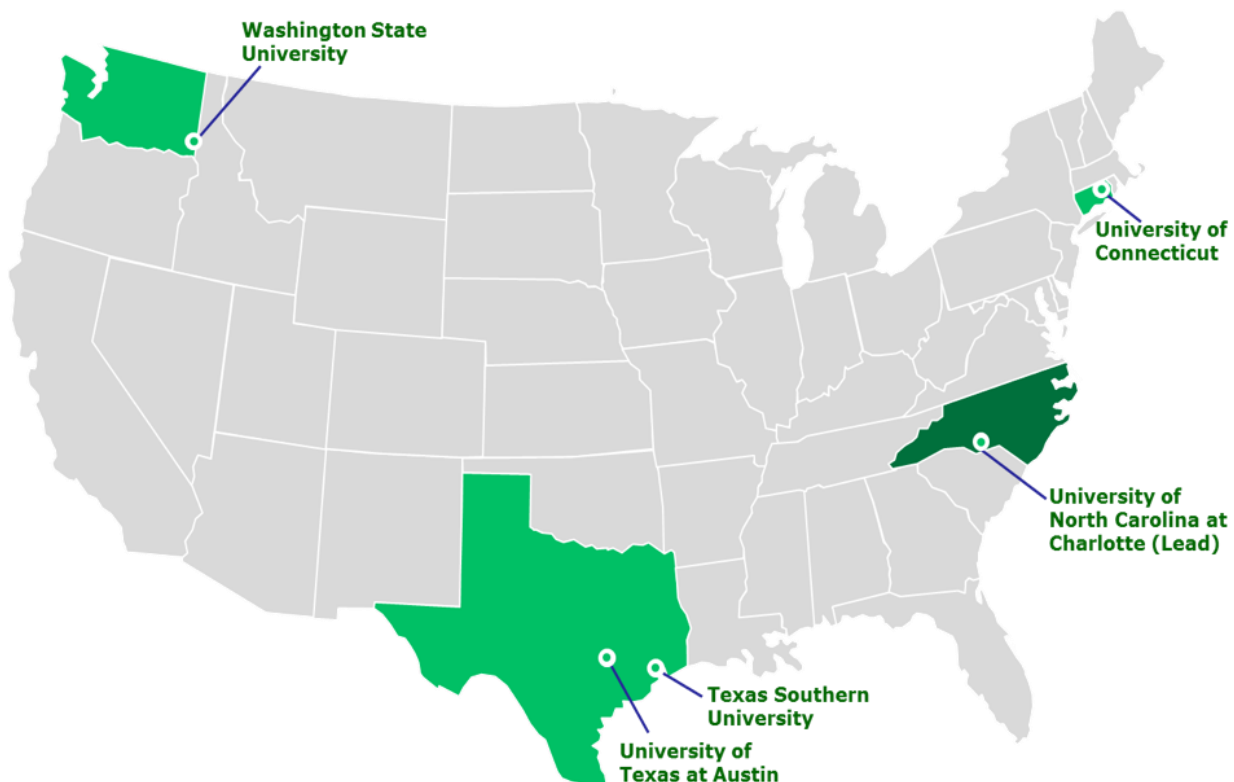
UPCOMING RESEARCH

In July of 2017, CAMMSE sent out Call for Research Proposals (CRP) for 2018 Year 2 to solicit project ideas from researchers at all consortium members. In general, CAMMSE research projects were solicited based on continuing the CAMMSE theme of addressing 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. In particular, the following research thrusts were established to maximize synergy and adaptability across multiple modes and jurisdictions:

- Increase access to opportunities that promote equity in connecting regions and communities, including urban and rural communities;
- Generate innovations in multi-modal planning and modeling for high-growth regions;
- Develop data modeling and analytical tools to optimize passenger and freight movements;
- Innovations to improve multi-modal connections, system integration and security; and
- Smart Cities.

24 research proposals were received on Monday, August 7, 2017. All proposals were sent out for peer-reviews. The CAMMSE research program leadership committee then reviewed all the proposals along with their review comments, and selected 17 proposals for the 2018-2019 CAMMSE research project awards. Funding for all projects was anticipated around October 1, 2017.

Center for Advanced Multimodal Mobility Solutions and Education