Center for Advanced Multimodal Mobility Solutions and Education

USDOT Tier 1 University Transportation Center
Semi-Annual Progress Report #4

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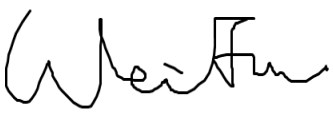
Signature of Submitting Official:	

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1. ACCOMPLISHMENTS

1.1. What are the major goals and objectives of the program?

The major goals and objectives of the program as outlined in the proposal include the following categories.

Research

CAMMSE will 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. CAMMSE is motivated by the recent advances in computing, smartphones and communication technologies, and ubiquitous data to create sustainable, efficient, and growth-enabling multimodal transportation systems. Cutting edge analytical methods and models will enhance the effectiveness, efficiency, and reliability of these systems accordingly. Recent technological advancements enable new perspectives and holistic approaches to address the well-known challenges in multimodal transportation systems planning, design, operations, and maintenance. In particular, the following research topic areas will be 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.

Leadership

The CAMMSE team is nationally and internationally recognized for its contributions to the field of transportation research, and for its deployment of successful solutions to critical, real-world transportation challenges. In addition, team members are committed advocates and longstanding leaders within the multimodal transportation community and the UTC system itself. Through this UTC grant, the Consortium plans to build on its demonstrated experience to mentor future leaders in the field of transportation. CAMMSE plans to nurture students through skill building and professional development activities that promote notable research scholarships and successful transportation careers.

Education and Workforce Development

With years of collective education, research, and UTC experience, CAMMSE will provide a transportation education program through its partner universities. The program will promote creative and multidisciplinary problem-solving and exposure to a myriad of educational and workforce development experiences. The program will serve to attract, educate, and train future and existing transportation professionals with the know-how to undertake and implement innovative projects being or to be conducted.

The workforce development program will leverage the existing training skills and delivery resources available within partner universities. On-line webinars will be designed and delivered using available technical resources, which could provide Continuing Education Credits (CEUs) to interested course participants. In addition, UTC funds will be used to support and host the monthly transportation seminar series, particularly while classes are in session. The target audience is current students and the local

university community. UTC funds will also enhance our ability to host nationally and internationally recognized speakers. The target audience is local and regional (onsite), and national when recording and posting talks online.

CAMMSE will support career-building activities that facilitate student transition from school to the workplace by offering enhanced student research opportunities, research seminars, guest speakers, professional conference travel and other professional networking opportunities. In addition, outreach programs at the pre-collegiate level (elementary to high school) will be designed to spark interest in transportation issues and to encourage youth to consider transportation academic programs and careers. The outreach initiatives will particularly focus on recruiting underrepresented minorities into transportation and other STEM fields.

Technology Transfer

The technology transfer program at CAMMSE is designed to support the USDOT in its objective of "expanding technology transfer to partners and stakeholders" by sharing research results quickly and to the widest possible audience. CAMMSE has demonstrated ability to disseminate research results, spur implementations, and conduct continuing education programs. The technology transfer program is a direct extension of the Center's research and education programs; in other words, these activities are designed to increase the scope and effectiveness of research accomplishments and education initiatives. General objectives within the technology transfer area in CAMMSE will be to:

- Increase the national visibility of CAMMSE research and education activities.
- Increase the availability and speed at which CAMMSE research results are disseminated.
- Provide technical assistance based on CAMMSE research and development.

Collaboration

CAMMSE has an extensive history of forming collaborative relationships at a variety of technical, fiscal and administrative levels. Across all its activities, from conducting pooled fund studies to hosting tech transfer events, CAMMSE will seek to work with collaborators from all sectors.

Diversity

In order for the transportation workforce to reflect the diversity of the national workforce pool, CAMMSE will continue to pursue the development of innovative programs to encourage new entrants, particularly those from groups currently underrepresented in the field. CAMMSE will actively participate in a number of committed activities through which the CAMMSE will increase interest in STEM disciplines and raise awareness of transportation-related careers amongst underrepresented groups.

1.2. What was accomplished under these goals?

Research

CAMMSE was funded by USDOT in November 2016 under the FAST act. Year 1 research projects have been completed, though year 2 and year 3 projects are still ongoing during this reporting period. CAMMSE research results have been published in multiple journals, including *ASCE Journal of Transportation Engineering, Part A: Systems*, *International Journal of Transportation Science and Technology*, *Journal of Transport Geography, Journal of Transportation Safety & Security, Transportation Research Record: Journal of Transportation Research Board*, and *World Wide Web.*

CAMMSE research results were also presented at many conferences on different occasions, which include the 6th Annual UTC Conference for the Southeastern Region, Swiss Transportation Research Council 2018, FHWA Transportation Policy Symposium 2018, North Carolina Section of the Institute of

Transportation Engineers (NCSITE) 2018 Annual Meeting, 21st International Conference on Intelligent Transportation Systems (2018), 2018 Annual Meeting of the Institute of Operations Research and Management Sciences (INFORMS), 3rd Simpson Strong-Tie Annual Building Connections Student Symposium (2018), 37th IEEE International Performance Computing and Communications Conference (IPCCC 2018), IEEE 38th Conference on Computer Communications (INFOCOM 2019), Transportation Research Board 98th Annual Meeting (TRB 2019), and the 2019 Chinese Overseas Transportation Association (COTA) 21st Annual Winter Symposium.

Leadership

Representing the CAMMSE, Center Director Dr. Wei Fan used his expertise to serve on the NCHRP Synthesis 20-05 Topic 50-10 Panel "Availability of Pedestrian Infrastructure Data for Routing and Network Analysis" on October 16, 2018 at the Keck Center of the National Academies of Sciences, Engineering, and Medicine located at 500 Fifth Street, NW Washington, DC. On October 24 2018, Dr. Wei Fan attended and presented a paper at the 6th Annual UTC Conference for the Southeastern Region that was held at the Clemson University, Clemson, South Carolina. On December 17, 2018, Dr. Wei Fan was appointed as the Co-Chair of the Connected Autonomous Vehicles Section for the World Transport Convention. On January 13, 2019, Dr. Wei Fan served as the Chair of Session of “Connected and Autonomous Vehicles” in the 22nd COTA Winter Symposium at Washington D.C.

CAMMSE Center Director and Associate Directors have been actively serving on many editorial boards (e.g., Associate Editor of the *ASCE Journal of Transportation Engineering, Part A: Systems*, *IEEE Transactions on Intelligent Transportation Systems*, *International Journal of Transportation Science and Technology*, and *Journal of Transportation of the Institute of Transportation Engineers,* Editorial board of the *Asian Transport Studies, Institute of Transportation Engineers, Journal of Infrastructure Preservation and Resilience Journal of Transportation Research Part D, Transportation Letters,* and *Transportmetrica A: Transport Science*) and many professional committees (e.g., member of the ASCE Advanced Technologies Committee, ASCE Connected & Autonomous Vehicles Impacts Committee, ASCE Public Transport Committee, ASCE Rail Transportation Committees; member of the TRB Standing Committees (AHB60, AHD60, AP025, ADB10, ABR10, ABJ70, AFN30, ADC20, ADC60, and AFP40), session chair of the INFORMS, and at large member of PENC state board) as well as proposal, book review committees (e.g., NCHRP), the dissertation award committee of the Hong Kong Society of Transportation Studies, Outreach subcommittee of the Lone Star Harbor Safety Committee (LSHSC), Co-General Chair of the 6th International Workshop on Crowd Assisted Sensing, Pervasive Systems and Communications (CASPer 2019), March 2019, and Co-General Chair of the IEEE 38th International Performance Computing and Communications Conference (IPCCC 2019), London, UK, October 2019.

Education and Workforce Development

CAMMSE has been working with Institute of Transportation Engineers (ITE) Student Chapter at UNCC in supporting and hosting the bi-weekly transportation seminar series in which guest speakers are invited to University of North Carolina at Charlotte (UNCC) to present their current project activities while classes are in session. The target audience is current students and the local university community. Dr. Fan’s transportation research group has also been conducting graduate student seminars on a weekly basis.

CAMMSE Center Staff (Drs. Wei Fan, Miguel Pando, David Weggel, Martin Kane, and Yu Wang) has been meeting on a regular basis. Topics discussed among these important regular meetings include, but are not limited to, the second annual research symposium, annual transportation summer camp at UNCC, research, education and outreach as well as technology transfer activities. In particular, on March 21, 2019, Dr. Miguel Pando, CAMMSE Assistant Director of Education and Outreach, and Dr. David Weggel gave presentation, “An Introduction to Transportation: Uses, Modes, Energy, and the Environment”, to two 9th-grade class blocks (20 students and 21 students, respectively) at Central Cabarrus High School, Concord, North Carolina. Through events like “An Introduction to Transportation: Uses, Modes, Energy, and the Environment”, CAMMSE has provided a medium for sponsored students to develop important soft skills. All these events required that students interact with the local community and think of creative

ways to portray complicated concepts in a simple and easy to understand way. Students also had to use creativity to think of an interesting way to capture young children's attention and keep them engaged. The CAMMSE has had impacted both the local community and the sponsored students by encouraging creativity and fostering human-to-human connections.

During the 2018 Fall Semester at UNCC, Dr. Wei Fan developed and taught a new course entitled "Connected and Autonomous Vehicles" to several graduate students. Dr. Yu Wang, integrated research results from CAMMSE on vehicular networking and urban sensing into three Computer Science graduate level courses (ITCS 6132, ITCS 6167, and ITCS 6168). One Ph.D. student, Dr. Miao Yu graduated in December 2018 and won the Outstanding Graduate Ph.D. Student Award. He is currently employed as an Associate Professor by Hohai University, Nanjing City, JiangSu Province, P.R.China. Ms. Zijing Lin won the Women's Transportation Seminar (WTS) Charlotte Metro Chapter Mary N. Clayton Honorary Scholarship in January 2019. From February 22-24, 2019, Mr. Zhen Chen, Mr. Yang Li and Ms. Zijing Lin attended the First Southern District ITE Student Leadership Summit that was held at Clemson University, SC. From March to July 2019, Mr. Yu Pan, a visiting scholar from Wuhan University of Science and Technology will be joining and collaborating with CAMMSE research group at UNCC on research.

At Washington State University (WSU), the Ph.D. student Yan Zhang won the 2018 Outstanding Student Award (3rd Place), selected by the International Association of Chinese Infrastructure Professionals (IACIP). The Ph.D. student Jialuo He won the Best Poster Award (1st Place), the 2019 Annual Workshop of IACIP, Washington, D.C. Michelle Akin provided a table with activities and demonstrations at the 9th Annual Nez Perce STEM Fair on Dec. 6, 2018 that included wind-up cars, balloon cars, alternate fuels display and a steam-powered boat. Michelle Akin was also involved in the STEAM Coalition through which she conducted a lot of elementary-age outreach.

At Texas Southern University (TSU), there were three undergraduate and nine graduate transportation related courses offered by faculty. Two master theses were directly supported by CAMMSE, i.e., "Evaluation of Driver's Compliance to Temporary Speed Limits While Approaching Work Zones on Two-lane Highways", and "Investigating the Impact of Built Environment and Temporal Attributes on Bike Share Usage in Houston".

At University of Connecticut (UConn), the Transportation Undergraduate Research Fellowship (TURF) has supported over two dozen students. Student-led research projects were conducted under the supervision of CAMMSE faculty. TURF fellows presented the results of their research at a seminar in the fall. CAMMSE Researchers at UConn hosted a conference: "Putting Humans in the AV Driver's Seat" which presented intellectual leaders from across the United States and beyond whose work focused on societal impacts of AVs. The event culminated in an interactive Town Hall session moderated by WNPR's Lucy Nalpathanchil, the host of "Where We Live".

At the University of Texas at Austin (UT Austin), events such as "Introduce a Girl to Engineering Day" and "Interacting with the local community" were held as interacting with the local community thinking of creative ways to portray complicated concepts in a simple and easy to understand way. Two graduate students, Mr. Mengyu Fu and Mr. Scott Kilgore were supported by CAMMSE projects during the reporting period.

Technology Transfer

CAMMSE faculty, staff, researchers and students have been making presentations at different meetings including the 6th Annual UTC Conference for the Southeastern Region, 2018North Carolina Section of the Institute of Transportation Engineers (NCSITE) Annual Meeting, Swiss Transportation Research Council, Central Connecticut State University Sustainability Forum, FHWA Transportation Policy Symposium 2018, Transportation Research Board 98th Annual Meeting, and Chinese Overseas Transportation Association (COTA) 21st Annual Winter Symposium.

At UT Austin, in particular, one of the best technology transfer tools are the students that work on these CAMMSE research projects. At present, UT Austin has a total of four active projects sponsoring 2 master's students, 6 PhD students, 3 principal investigators, and 1 researcher. These UT Austin students are key to the technology development and have both gone to work in the Transportation Engineering industry. They will carry the new technology with them and use it in their new jobs, teach peers how to use the technology, thereby implementing the technology. Most importantly, these new techniques will continue to grow and improve as they are used. The professors at UT Austin have also used their classes to teach the new techniques developed through the CAMMSE UTC, therefore planting the new technology in students that are not directly supported by the UTC. In addition, information developed through UT Austin's research is being shared with the City of Austin as the City functions as a partner in the research efforts. UT students are invited to spend time in the City Traffic Control Center representing a valuable learning environment, but the learning is really two-way as the City engineers and students learn from each other. It is also important to note that the results from UT-Austin's 2018 Project 06 Characterization of Bicycle Rider Behavior among Various Street Environments can be applied to Human Behavioral/Social Science and Urban Planning disciplines.

The CAMMSE-supported students that have graduated during this reporting period will carry the new technology that they have helped develop with them for the rest of their careers. This new technology will be used their new jobs, and they will teach peers how to use the technology, thereby implementing the technology. Most importantly, these new techniques will continue to grow and improve as they are used.

Collaboration

CAMMSE created a diverse collaboration network with different state and local government agencies, and educational and professional organizations, as well as community practitioners. CAMMSE also worked to build collaborative relations with international transportation centers and universities.

During the reporting period, CAMMSE Center Director Dr. Wei Fan has been actively working with other UTCs. For example, he has been reviewing proposals for the USDOT Region 10 The Pacific Northwest Transportation Consortium (PacTrans), USDOT Tier 1 University Transportation Center - Freight Mobility Research Institute (FMRI), and USDOT Tier-I Connected Cities for Smart Mobility toward Accessible and Resilient Transportation (C2SMART). Dr. Fan also collaborated with several other universities across the country and abroad (e.g., Florida State University and Tongji University), co-writing proposals and papers. Dr. Yu Wang collaborated with Dr. Fan Li's group in Beijing Institute of Technology on vehicular networks and smart sensing.

UT Austin collaborated with the City of Austin and Capital Metropolitan Transportation Authority. UT Austin also partnered with the Women in Transportation Seminar Heart of Texas (WTS-HOT) Student Chapter and the Institute of Transportation Engineers (ITE)/ Intelligent Transportation Systems (ITS) Student Chapter.

At WSU, during this time period, Dr. Xianming Shi (WSU) served as a visiting professor at Wuhan Polytechnic University, China. Dr. Shi also hosted one visiting scholar from Harbin Institute of Technology and another one from Central South University of Forestry & Technology, China. Michelle Akin is an active member of the Palouse STEAM Coalition, coordinating quarterly forums with keynote speakers and professional development hours for in-service teachers.

TSU collaborated with other universities, such as Beijing Jiaotong University, University of Technology, on researches. TSU collaborated with Houston-Galveston Area Council (HGAC) to provide internship positions to graduate students and collaborated with WTS Houston to establish a student chapter in TSU.

Diversity

Several Ph.D. students from underrepresented groups have been hired to conduct CAMMSE's research during this reporting period. For example, at UNCC, five international graduate students (Mr. Zhen Chen,

Mr. Yang Li, Ms. Zijing Lin, Mr. Pengfei Liu and Mr. Bo Qiu all from P.R.China) joined the INES Ph.D. program and they have been working as CAMMSE research assistants. A master student, Mr. Kiavash Riahipour, from Iran, is currently advised by Dr. Wei Fan to write his thesis. Dr. Wei Fan also served as a Ph.D. committee member for Ms. Yueqi Hu, who recently graduated with a Ph.D. degree from Computer Science at UNCC. UT Austin students sponsored by CAMMSE come from all sorts of diverse backgrounds, including female and international students. Specifically, UT Austin supported students include three females (Ms. Zenia, Ms. Jennifer, and Ms. Amelia) and five males (Mr.Hao, Mr. Mengyu, Mr. Abdullah, Mr. Cesar, and Mr. Santhosh) through CAMMSE. One female research engineer (Michelle Akin, P.E. at WSU) has been actively involved in the CAMMSE 2018 Project 17. One female minority undergraduate civil engineering student (Nicole Kim at WSU), has been involved in CAMMSE 2019 Project 15.

1.3. What opportunities for training and professional development has the program provided?

The bi-weekly seminars at UNCC are open to the general public, particularly to the local and state transportation agencies, as well as the industry practitioners.

1.4. How have the results been disseminated?

News items and information about graduate seminars have been regularly posted on the website at https://cammse.uncc.edu/news-events/graduate-seminars.

In particular, as mentioned before, UNCC has made many presentations both nationally and internationally. UT Austin has presented the results through conference proceedings, technical reports, and technical presentations.

1.5. What do you plan to do during the next reporting period to accomplish the goals and objectives?

The following tasks are planned in order to accomplish the goals and objectives of CAMMSE.

(1) CAMMSE Center Director Dr. Wei Fan plans to attend and present at the Second Annual National Mobility Summit of US DOT University Transportation Centers, April 11, 2019, Washington, D.C.
(2) CAMMSE will conduct outreach activities in the NC Science Expo Festival on April 28, 2019 on the campus of UNCC.
(3) CAMMSE will attend NCDOT Research Summit on May 7, 2019 at NCA&T, Greensboro, NC to present papers based on research.
(4) CAMMSE will hold the Third CAMMSE Transportation Summer Camp from June 10-14, 2019. The camp will include 1 day of field trip (Traffic control center, transportation museum, and Light Rail UNCC station).
(5) CAMMSE will issue the RFPs for the year of 2019-2020, conduct rigorous peer-reviews, select funded projects and issue contracts. For all research projects that will be selected for funding in 2019-2020 year 4, the CAMMSE project information forms will be posted and updated on the CAMMSE website as well as on RiP once the subcontracts are officially signed.
(6) All final project reports that have been completed for year 2 (2017-2019) will be provided to the Transportation Research Board (Transport Research International Documentation database), the National Transportation Library, the U.S. DOT's Research Hub, the Transportation Library, the Volpe National Transportation Systems Center, FHWA's Research Library, and the U.S. Department of Commerce as required by OST-R.
(7) Attend North Carolina Section Institute of Transportation Engineers (NCSITE) Annual Meeting in November 2019 to present papers based on research.

2. PARTICIPANTS AND COLLABORATING ORGANIZATIONS

2.1. Who has worked on the program?

The members of CAMMSE UTC include the University of North Carolina at Charlotte (UNCC); the University of Texas at Austin (UT Austin); the University of Connecticut (UConn); Washington State University – Pullman (WSU); and Texas Southern University (TSU). Table 1 lists the leadership team members who have worked on the program during this reporting period.

Table 1. CAMMSE Staff Working on the Program

Name	Wei Fan	Randy Machemehl	Nicholas Lownes	Xianming Shi	Yi Qi
Program/Project Role	Center Director	Associate Director at UT Austin	Associate Director at UConn	Associate Director at WSU	Associate Director at TSU
Contribution to Program/Project	Oversees overall operations of the program. Responsible for coordinating with stakeholders and developing and implementing the CAMMSE strategic plan	Serves as liaison between CAMMSE and UT Austin	Serves as liaison between CAMMSE and UConn	Serves as liaison between CAMMSE and WSU	Serves as liaison between CAMMSE and TSU
Funding Support	UNCC	UT Austin	UConn	WSU	TSU
Collaborated with Individual(s) in Foreign Country(ies)	Yes	No	Yes	Yes	Yes
Country(ies) of Foreign Collaborator(s)	P.R.China	No	Australia	P.R.China	P.R.China
Traveled to Foreign Country(ies)	No	N/A	N/A	N/A	N/A
If traveled to foreign country(ies), duration of stay	N/A	N/A	N/A	N/A	N/A

2.2. What organizations have been involved as partners?

Table 2 provides a list of the organizations that have partnerships with CAMMSE.

Table 2. A List of Organizations Creating Partnerships with CAMMSE

Organization Name	Type / Location	Partners Contribution to Project				
		Financial Support	In-kind Support	Facilities	Collaborative Research	Personal Exchanges
Capital Metro – Austin Public Transit	Government /TX		X	X		
Centralina Council of Governments	MPO/NC		X			
Charlotte Area Transit System	Government /NC		X			
City of Austin	Government /TX		X	X		
City of Charlotte	Government /NC		X			
Connecticut Department of Transportation	Government /CT				X	
CTTransit	Transit Operator				X	X
Houston Bike Share	Non-profit/ TX				X	
Houston-Galveston Area Council					X	
North Carolina Department of Transportation	Government /NC		X			
North Carolina Turnpike Authority Automated Vehicle Proving Ground (NCTA-AVPG)	Government /NC				X	
Northeast Forestry University	University /China				X	
Propeller Club Port of Houston					X	
Qilu University of Technology					X	X
Texas Department of Transportation	Government /TX		X	X		
Texas Southern University	University /TX	X	X	X		
Tongji University	University /China				X	
University of Arizona	University /AZ				X	
University of Houston	University /TX				X	
University of Connecticut	University /CT	X	X	X		
University of North Carolina at Charlotte	University /NC	X	X	X		
University of Texas at Austin	University /TX	X	X	X		
Washington Department of Transportation	Government /WA				X	
Washington State University	University /WA	X	X	X		

Our CAMMSE UTC has successfully established an external advisory board which contains members from universities and government agencies. The detailed information about all five advisory board members is provided below:

- Dr. Michael Accorsi, Professor and Senior Associate Dean, School of Engineering, University of Connecticut.
  Email: michael.accorsi@uconn.edu
- Dr. Amit Bhasin, Director, Center for Transportation Research, Associate Professor, Transportation Engineering, The University of Texas at Austin.
  Email: a-bhasin@mail.utexas.edu
- Elizabeth Robbins, Planning Policy & Partnerships Manager, Multimodal Planning Division, Washington State Department of Transportation.
  Email: robbins@wsdot.wa.gov
- Neil Mastin, Research and Development Manager, North Carolina Department of Transportation.
  Email: jmastin@ncdot.gov
- Wade Odell, Research Engineer, Texas Department of Transportation.
  Email: Wade.Odell@txdot

2.3. Have other collaborators or contacts been involved?

Dr. Wei Fan, CAMMSE Director, has been making presentations, working, co-writing and publishing papers with faculty and researchers from the Key Laboratory of Road and Traffic Engineering, Ministry of Education and College of Transportation Engineering at Tongji University in Shanghai, P.R.China. A collaborative relationship has been successfully developed between two universities. Dr. Fan was also invited to give presentations at several other universities in China (e.g., Shijiazhuang Tiedao University, Shanghai Maritime University, Wuhan University of Science and Technology, and Dalian University of Technology) and is currently building a collaborative relationship with these universities.

TSU established a collaboration with Houston Bike Share, a 501(c)(3) non-profit organization the bike share program (Houston BCycle) in Houston. Dr. Mehdi Azimi talked to a member of the board of directors and also the Executive Director. Houston Bike Share shared the ridership data including trip start time and date, trip end time and date, trip duration, start station, end station, number of docks per station, bicycle id, etc. to be used in CAMMSE's research project.

3. OUTPUTS

3.1. Journal publications, conference papers, and presentations

Journal publications

[1] Lin, Z. and Fan, W., Modeling Bicyclist Injury Severity in Bicycle-Motor Vehicle Crashes Occurred in Both Urban and Rural Areas: A Mixed Logit Analysis, Accepted for Publication, *Canadian Journal of Civil Engineering*, March 2019.

[2] Li, Y. and Fan, W., Pedestrian-Injury Severities in Pedestrian-Vehicle Crashes and the Partial Proportional Odds Logit Model: Accounting for Age Difference, *Transportation Research Record – Journal of Transportation Research Board*, https://doi.org/10.1177/0361198119842828, pp. 1-16, Paper 19-02385, 2019.

[3] Chen, Z. and Fan, W., Modeling Pedestrian-Vehicle Crash Severity in Rural and Urban Areas: Mixed Logit Model Approach, *Transportation Research Record – Journal of Transportation Research Board*, https://doi.org/10.1177/0361198119842825, pp. 1-12, Paper 19-02356, 2019.

[4] Yu, M. and Fan, W., Optimal Variable Speed Limit Control in Connected Autonomous Vehicle Environment for Relieving Freeway Congestion, *ASCE Journal of Transportation Engineering, Part A: Systems*, 145(4): 04019007, http://doi.org/10.1061/JTEPBS.0000227, April, 2019.

[5] Liu, P. and Fan, W., Modeling Head-On Crash Severity on NCDOT Freeways: A Mixed Logit Model Approach, *Canadian Journal of Civil Engineering,* https://doi.org/10.1139/cjce-2018-0262, Vol. 46, No. 4, pp. 322-328, 2019.

[6] Huang, Z.Y., Xu, R.H., Fan, W., Zhou, F. and Liu, W., Service-Oriented Load Balancing Approach to Alleviating Peak-Hour Congestion in Metro Network Based on Multi-Path Accessibility, *Sustainability*, 11, 1293, http://doi.org/10.3390/su11051293, 2019.

[7] Chen, Z. and Fan, W., A Multinomial Logit Model of Pedestrian-Vehicle Crash Severity in North Carolina, *International Journal of Transportation Science and Technology*, Volume 8, Issue 1, pp. 43-52, 2019.

[8] Jiang, Z.B., Gu, J.J., Fan, W., Liu, W. and Zhu, B.Q. Q-Learning Approach to Coordinated Optimization of Passenger Inflow Control with Train Skip-stopping on an Urban Rail Transit Line, *Computers & Industrial Engineering*, Volume 127, pp. 1131-1142, 2019.

[9] Li, Y. and Fan, W., Modelling the Severity of Pedestrian-Injury in Pedestrian-Vehicle Crashes in North Carolina: A Partial Proportional Odds Logit Model Approach, *Journal of Transportation Safety & Security*, https://doi.org/10.1080/19439962.2018.1483989, 2018.

[10] Yu, M. and Fan, W., Accessibility Impact of Future High Speed Rail Corridor on the Piedmont Atlantic Megaregion, *Journal of Transport Geography*, Volume 73, pp. 1-12, 2018.

[11] Jiang, Z., Gu, J.J., Han, Y.Z., Fan, W. and Chen, J.J., Modeling Actual Dwell Time for Rail Transit Using Data Analytics and Support Vector Regression, *ASCE Journal of Transportation Engineering, Part A: Systems*, Volume 144 Issue 11, 04018071, 2018.

[12] Yu, M. and Fan, W., Optimal Variable Speed Limit Control at a Lane Drop Bottleneck: Genetic Algorithm Approach, *ASCE Journal of Computing in Civil Engineering*, Volume 32 Issue 6, 04018049, pp. 1-17, 2018.

[13] Enam, A., and Konduri, K.C. (2017). Day Pattern Generation System for Jointly Modeling Tours and Stops: Bi-Level Multiple Discrete Continuous Probit Model. *Transportation Research Record, Journal of the Transportation Research Board*, 2665, pp. 69-79.

[14] Atkinson-Palombo, C., Varone, L., Garrick, N. W. Understanding the Surprising and Oversized Use of Ridesourcing Services in Poorer Neighborhoods in NYC. *Transportation Research Record, Journal of the Transportation Research Board*, 2019.
[15] Clark, A., Atkinson-Palombo, C., Garrick, N.W. The Rise and Fall of the Segway. *Transfers*. 2019.
[16] Zang, J., G. Song, R. E, J. Sun, X. Zhang, L. Yu. Experimental Findings of Wide Moving Jam: A case study in Beijing. Accepted for Publication, *ASCE Journal of Transportation Engineering, Part A: Systems*, 2018.

Conference papers

[1] Liu, P. and Fan, W., Exploring the Impact of Connected and Autonomous Vehicles on Freeway Capacity Using Microscopic Traffic Simulation, Paper 19-05196, The 98th Annual Meeting of the *Transportation Research Board*, January 13-17, 2019, Washington, DC.
[2] Li, Y and Fan, W., Pedestrian-Injury Severities in Pedestrian-Vehicle Crashes and the Partial Proportional Odds Logit Model: Accounting for Age Difference, Paper 19-02385, The 98th Annual Meeting of the *Transportation Research Board*, January 13-17, 2019, Washington, DC.
[3] Chen, Z. and Fan, W., Modeling Pedestrian-Vehicle Crash Severity in Rural and Urban Areas: Mixed Logit Model Approach, Paper 19-02356, The 98th Annual Meeting of the *Transportation Research Board*, January 13-17, 2019, Washington, DC.
[4] Tajalli, M., Mirheli, A., Hajbabaie, A., Hajibabai, L. and Fan, W., Utilization Measurement of Highway Fleet Equipment: Dump Trucks, Paper 19-02690, The 98th Annual Meeting of the *Transportation Research Board*, January 13-17, 2019, Washington, DC.
[5] Hu, M.B., Simoni, M.D., Claudel, C.G. (2018). Modeling bus bunching: A comprehensive approach accounting for transit demand and traffic flows, Proceedings of the 21st International Conference on Intelligent Transportation Systems, November 2018.
[6] Lei, T., Claudel, C.G. (2018). Inertial Measurement Units-based probe vehicles: Path reconstruction and map matching. Proceedings of the 21st International Conference on Intelligent Transportation Systems, November 2018.
[7] Yahia, C. N., C. Gokalp, P. Venkatraman, and S. D. Boyles. (2018) Information Based Drone Assisted Parcel Delivery in Urban Environments. Presented at the Annual Meeting of the Institute of Operations Research and Management Sciences, Phoenix, AZ.
[8] Liu, H., Chen, A., & Machemehl, R. B. (2019). An Adaptive Signal Control Method Using Cell Transmission Model and Mixed Integer Linear Programming (No. 19-05850).
[9] Varone, L., Atkinson-Palombo, C., Garrick, N. W. Tracking the Evolving Role of Ridesourcing Services Within Unique Neighborhood Types in NYC. Transportation Research Board Annual Meeting, 2019.

Presentations

[1] Fan, W., CAMMSE: Past and Ongoing Research Projects, and Future Opportunities, Department of Civil Engineering, The University of Texas at Arlington (UT Arlington), February 28, 2019.
[2] Fan, W., Integrated Connected Autonomous Vehicles Platooning and Optimal Variable Speed Limit Control on Freeways, The Chinese Overseas Transportation Association (COTA) 21st Annual Winter Symposium, Chinatown (M3), Marriott Marquis, Washington DC, Sunday, January 13, 2019.
[3] Liu, P. and Fan, W., Exploring the Impact of Connected and Autonomous Vehicles on Freeway Capacity Using Microscopic Traffic Simulation, Paper 19-05196, The 98th Annual Meeting of the Transportation Research Board, January 13-17, 2019, Washington, DC.

[4] Li, Y and Fan, W., Pedestrian-Injury Severities in Pedestrian-Vehicle Crashes and the Partial Proportional Odds Logit Model: Accounting for Age Difference, Paper 19-02385, The 98th Annual Meeting of the Transportation Research Board, January 13-17, 2019, Washington, DC.
[5] Chen, Z. and Fan, W., Modeling Pedestrian-Vehicle Crash Severity in Rural and Urban Areas: Mixed Logit Model Approach, Paper 19-02356, The 98th Annual Meeting of the Transportation Research Board, January 13-17, 2019, Washington, DC.
[6] Tajalli, M., Mirheli, A., Hajbabaie, A., Hajibabai, L. and Fan, W., Utilization Measurement of Highway Fleet Equipment: Dump Trucks, Paper 19-02690, The 98th Annual Meeting of the Transportation Research Board, January 13-17, 2019, Washington, DC.
[7] Lin, Z. and Fan, W., Evaluating the Potential Use of Crowdsourced Bicycle Data in the City of Charlotte, North Carolina Section of the Institute of Transportation Engineers (NCSITE) Annual Meeting, McKimmon Center, North Carolina State University, Raleigh, North Carolina, Thursday, November 15, 2018.
[8] Liu, P. and Fan, W., Impact of Connected and Automated Vehicles on Freeway Capacity, NCSITE Annual Meeting, McKimmon Center, North Carolina State University, Raleigh, North Carolina, Thursday, November 15, 2018.
[9] Yu, M. and Fan, W., Development of a Variable Speed Limit Strategy to Relieve Freeway Congestion in a Connected Autonomous Vehicle Environment, NCSITE Annual Meeting, McKimmon Center, North Carolina State University, Raleigh, North Carolina, Thursday, November 15, 2018.
[10] Li, Y. and Fan, W., Using General Transit Feed Specification (GTFS) Data as a Basis for Evaluating and Improving Public Transit Equity, NCSITE Annual Meeting, McKimmon Center, North Carolina State University, Raleigh, North Carolina, Thursday, November 15, 2018.
[11] Chen, Z. and Fan, W., Use of Multisensor Data in Modeling Freeway Travel Time Reliability, NCSITE Annual Meeting, McKimmon Center, North Carolina State University, Raleigh, North Carolina, Thursday, November 15, 2018.
[12] Fan, W. and Yu, M. Integrated Connected Autonomous Vehicles Platooning and Optimal Variable Speed Limit Control on Freeways, The 6th Annual UTC Conference for the Southeastern Region, Clemson University, Clemson, South Carolina, Wednesday, October 24, 2018.
[13] Hu, M.B., Simoni, M.D., Claudel, C.G. (2018). Modeling bus bunching: A comprehensive approach accounting for transit demand and traffic flows, Proceedings of the 21st International Conference on Intelligent Transportation Systems, November 2018.
[14] Lei, T., Claudel, C.G. (2018). Inertial Measurement Units-based probe vehicles: Path reconstruction and map matching. Proceedings of the 21st International Conference on Intelligent Transportation Systems, November 2018.
[15] Yahia, C. N., C. Gokalp, P. Venkatraman, and S. D. Boyles. (2018) Information Based Drone Assisted Parcel Delivery in Urban Environments. Presented at the Annual Meeting of the Institute of Operations Research and Management Sciences, Phoenix, AZ, November 2018.
[16] Atkinson-Palombo, C., Varone, L., Garrick, N. W. Understanding the Surprising and Oversized Use of Ridesourcing Services in Poorer Neighborhoods in NYC. Transportation Research Board Annual Meeting, 2019.
[17] Varone, L., Atkinson-Palombo, C., Garrick, N. W. Tracking the Evolving Role of Ridesourcing Services Within Unique Neighborhood Types in NYC. Transportation Research Board Annual Meeting, 2019.
[18] Garrick, N. W., Varone, L., Atkinson-Palombo, C. Growth Pattern of Ridesourcing Services in NYC. Swiss Transportation Research Council, Ascona, Switzerland, 2018.
[19] Gosselin, K. How Ridesourcing is Used on College Campuses in New England. Central Connecticut State University Sustainability Forum, 2019.

[20] Atkinson-Palombo, C., The Importance of Public Perceptions and the AV Transition, Arizona State University, CAV101 Seminars, March 2019. https://cav101seminars.jimdofree.com/register-to-attend-the-arizona-cav-101-conference/
[21] Atkinson-Palombo, C., Social Adoption of Emerging Transportation Technologies, ROBOTICA Autonomous Vehicle Summit, Draper Technologies, Cambridge, MA, April 2019.
[22] Lownes, Nicholas E.; Charles Patton; Kelly Bertolaccini; Natalia Vorotynseva; Debarcana Ghosh (2017) Linking Transit Access and Affordable Housing, *2017 State of the Region Conference*, Springfield, MA, October 18, 2017.
[23] Cohen, Jeffrey P. "Introductory Remarks", presentation, Session 3: Transportation and Land Use, FHWA Transportation Policy Symposium, December 6, 2018, Arlington, VA.
[24] He, Y., Akin, M., Shi, X. Multimodal Connected Vehicle Technology for Improved Winter Travel. A poster presentation at the 98th TRB Annual Meeting, Jan. 14, 2019, Washington, D.C.
[25] Shi, X. Smart and Green Infrastructure Enabled by Materials. Presentation for the 3rd Simpson Strong-Tie Annual Building Connections Student Symposium, October 6, 2018, Pullman, WA.

3.2. Website(s) or other internet site(s)

The CAMMSE website is located at http://cammse.uncc.edu/. This website has been used to disseminate any information related to the program.

3.3. Technologies or techniques

Nothing to report.

3.4. Inventions, patent applications, and/or licenses

Nothing to report.

3.5. Other outputs

CAMMSE Graduate Seminar Series @ UNCC, Sponsored by CAMMSE

[1] "Integrated Connected Autonomous Vehicles Platooning and Optimal Variable Speed Limit Control on Freeways", Presented by Mr. Miao Yu (CAMMSE INES Ph.D. research assistant), 9-10am, October 03, 2018 EPIC CEE Conference Room 3344.
[2] "Travel Time Reliability Prediction", Presented by Mr. Zhen Chen (CAMMSE INES Ph.D. research assistant), 9-10am, October 10, 2018 EPIC CEE Conference Room 3344.
[3] "Impact of Connected and Automated Vehicles on Freeway Capacity — Calibration", Presented by Mr. Pengfei Liu (CAMMSE INES Ph.D. research assistant), 9-10am, October 17, 2018, EPIC CEE Conference Room 3344.
[4] "Modeling Strava Users' Cycling Route Segment Choice", Presented by Ms. Zijing Lin (CAMMSE INES Ph.D. research assistant), 9-10am, October 31, 2018, EPIC CEE Conference Room 3366.
[5] "Using General Transit Feed Specification (GTFS) Data as a Basis for Evaluating and Improving Public Transit Equity", Presented by Mr. Yang Li (CAMMSE INES Ph.D. research assistant), 9-10am, November 7, 2018, EPIC CEE Conference Room 3344.
[6] "Research on the Impacts of Connected and Autonomous Vehicles (CAVs) on Traffic Flow", Presented by Mr. Miao Yu (CAMMSE INES Ph.D. research assistant), 9-10am, November 14, 2018, EPIC CEE Conference Room 3366.

[7] “Latent Class Model for Crash Severity Analysis”, Presented by Mr. Zhen Chen (CAMMSE INES Ph.D. research assistant), 9-10am, November 28, 2018, EPIC CEE Conference Room 3344.
[8] “Fitting a Partial Proportional Odds Model Using SAS”, Presented by Mr. Pengfei Liu (CAMMSE INES Ph.D. research assistant), 9-10am, December 5, 2018, EPIC CEE Conference Room 3344.
[9] “Bicyclist Injury Severity Analysis: Model comparison”, Presented by Ms. Zijing Lin (CAMMSE INES Ph.D. research assistant), 9-10am, December 12, 2018, EPIC CEE Conference Room 3344.
[10] “A Brief Overview of Next Generation Simulation (NGSIM) Vehicle Trajectories and Supporting Data”, Presented by Mr. Yang Li (CAMMSE INES Ph.D. research assistant), 9-10am, January 23, 2019, EPIC CEE Conference Room 3344.
[11] “Simple Machine Learning and K-NN Algorithm”, Presented by Mr. Zhen Chen (CAMMSE INES Ph.D. research assistant), 9-10am, January 30, 2019, EPIC CEE Conference Room 3344.
[12] “Deep Leaning”, Presented by Mr. Pengfei Liu (CAMMSE INES Ph.D. research assistant), 9-10am, February 6, 2019, EPIC CEE Conference Room 3344.
[13] “Geospatial and Machine Learning Techniques for Wicked Social Science Problems: Analysis of Crash Severity on a Regional Highway Corridor”, Presented by Ms. Zijing Lin (CAMMSE INES Ph.D. research assistant), 9-10am, February 13, 2019, EPIC CEE Conference Room 3344.
[14] “Artificial neural network (ANN) and traffic crash Analysis”, Presented by Mr. Yang Li (CAMMSE INES Ph.D. research assistant), 9-10am, February 20, 2019, EPIC CEE Conference Room 3344.
[15] “Introduction to tree-based machine learing methods”, Presented by Mr. Bo Qiu (CAMMSE INES Ph.D. research assistant), 9-10am, February 27, 2019, EPIC CEE Conference Room 3344.
[16] “Machine Learning methodology: Extreme gradient boosting (XGBoost)”, Presented by Mr. Zhen Chen (CAMMSE INES Ph.D. research assistant), 9-10am, March 13, 2019, EPIC CEE Conference Room 3344.
[17] “Dimensionality Reduction Algorithms”, Presented by Mr. Pengfei Liu (CAMMSE INES Ph.D. research assistant), 9-10am, March 20, 2019, EPIC CEE Conference Room 3344.
[18] “Generalized Ordered Outcome Models for Crash Injury Severity Analysis”, Presented by Ms. Zijing Lin (CAMMSE INES Ph.D. research assistant), 9-10am, March 27, 2019, EPIC CEE Conference Room 3344.

ITE Seminar Series @ UNCC, Co-organized and sponsored by UNCC ITE Student Chapter and CAMMSE

[1] “Resume Building” by Mr. Patrick Madsen from UNCC Career Center. Location: EPIC 3226, October 10, 2018.
[2] The Young Member Committee from NCSITE came to UNCC for networking and the meeting was co-hosted by UNCC ITE Student Chapter and CAMMSE. Location: EPIC 3226, October 24, 2018.
[3] Presentation by Mr. Justin T. Carroll, the current engineering director from STV. Location: EPIC 3336, February 12, 2019.
[4] Presentation by Mr. Michael Bywaletz, Charlotte region leader of Ramey Kemp & Associates. Location: EPIC 3226, March 13, 2019.

Technical Reports

[1] Fan, W. and Chen, Z, *Estimation of Origin-Destination Matrix and Identification of User Activities Using Public Transit Smart Card Data*, Technical Report for CAMMSE Research 2017 Project 01. September 2018.
[2] Fan, W. and Yu, M, *Improving the Movements of People and Freight: A Case Study of the Piedmont Atlantic Megaregion*, Technical Report for CAMMSE Research 2017 Project 02. September 2018.
[3] Kilgore, S. and Machemehl, R., *Forecasting Ridership for Commuter Rail in Austin*, Technical Report for CAMMSE Research 2017 Project 03. September 2018.
[4] Liu, H. and Machemehl, R., *Corridor Level Adaptive Signal Control*, Interim Technical Report for CAMMSE Research 2017 Project 04. September 2018.

[5] Konduri, K. and Mondal, A. *Stochastic Multimodal Network Modeling: Hidden Markov Model Based Synthetic Population Generation for Use in Microsimulation Models of Transit Systems*, Technical Report for CAMMSE Research 2017 Project 05. September 2018.
[6] Lownes, N., *Robust Routing, Assignment, and Simulation of Transit Systems*, Technical Report for CAMMSE Research 2017 Project 06. September 2018.
[7] Mehdi Azimi *et al., Use of Vessel Automatic Information System Data to Improve Multi-modal Transportation in and around the Ports*, Technical Report for CAMMSE Research 2017 Project 07. September 2018.
[8] Qi, Y. *et al., Use of Innovative Intersection Designs for Roadway Traffic Congestion Mitigation*, Technical Report for CAMMSE Research 2017 Project 08. September 2018.
[9] Akin, M., He, Y. and Shi, X., *The Use of Connected Vehicle Technology to Facilitate Multimodal Winter Travel*, Technical Report for CAMMSE Research 2017 Project 09. September 2018.
[10] Yan, J., *The Effect of Competition of Transport Modes on Mobility*, Technical Report for CAMMSE Research 2017 Project 10. September 2018.
[11] Fan, W. and Yu, M, *Optimal Variable Speed Limit Control for the Mixed Traffic Flows in a Connected and Autonomous Vehicle Environment*, Technical Report for CAMMSE Research 2018 Project 05. September 2018.
[12] Fu, M. and Machemehl, R., *Characterization of Bicycle Rider Behavior among Various Street Environments*, Technical Report for CAMMSE Research 2018 Project 06. September 2018.
[13] Akin, M., Zhang, Y., Shi, X. *Developing Friction Data to Support the Optimal Use of Pre-Wet Deicing Salt for Enhanced Winter Mobility*. Technical Report for CAMMSE Research 2018 Project 16. September 2018.
[14] Mohamed A. A., Claudel, C., *IEA: Inner Ensemble Average within a convolutional neural network*. arXiv preprint arXiv:1808.10350.
[15] Mohamed A. A., Claudel, C. *MCRM: Mother Compact Recurrent Memory A Biologically Inspired Recurrent Neural Network Architecture*. arXiv preprint arXiv:1808.02016.

4. OUTCOMES

4.1. Increased understanding and awareness of transportation issues

The direct impact of UT Austin's projects is a better understanding of how to improve multi-modal mobility (i.e., vehicles, cyclists) and safety (i.e., the interaction between cyclists and motorists).

4.2. Passage of new policies, regulation, rulemaking, or legislation

Nothing to report.

4.3. Increases in the body of knowledge

Results from UT-Austin's 2018 Project 06, Characterization of Bicycle Rider Behavior among Various Street Environments may provide a basis for changes in traffic control device application to bicycle traffic. The study used field observations of bicycle riders to measure their responses to control devices across a variety of situations ranging from control device rich environments to those with no bicycle control devices. Rider compliance varied inversely with the richness of the control device environment indicating, at least in some cases, more control devices may not be better.

4.4. Improvement of existing techniques, practices, technologies

From the Adaptive Signal Control Project that was conducted by UT-Austin, we have improved existing technologies that will allow people to have less delay, resulting in decreased emissions and better quality of life. In addition, CAMMSE research results in enhancements to existing open-source software projects including:

[1] PopGen: see https://github.com/foss-transportationmodeling/popgen/releases, and
[2] DaySim: see https://github.com/RSGInc/DaySim/releases.

4.5. Enlargement of the pool of trained transportation professionals

During this reporting period, several graduates' students from UNCC, UT Austin and TSU that were sponsored through UTC projects have graduated. These students are key in the technology development and have gone to work in the university and transportation engineering industry.

4.6. Incorporation of new techniques, practices, technologies

Nothing to report.

5. IMPACTS

The CAMMSE is currently conducting a variety of research, education and outreach, technology transfer, and diversity activities and as such, the impact of this program cannot be measured during this reporting period.

5.1. What is the impact on the effectiveness of the transportation system?

Nothing to report.

5.2. What is the impact of technology transfer on industry and government entities, on the adoption of new practices, or on research outcomes which have led to initiating a start-up company?

Nothing to report.

5.3. What is the impact on the body of scientific knowledge?

Nothing to report.

5.4. What is the impact on transportation workforce development?

Nothing to report.

6. CHANGES AND PROBLEMS

6.1. Changes in approach and reasons for change

Nothing to report.

6.2. Actual or anticipated problems or delays and actions or plans to resolve them

Due to some reasons, a few CAMMSE Year 2 research projects have been experiencing some delays. For example, due to the award timing and the contracting issues and primarily due to the lack of time to recruit students for the projects, the three Year 2 research projects at the University of Connecticut (UCONN) were not able to get off the ground. As such, a no-cost extension for these projects was needed through September 30, 2019, which would give researchers at UCONN more time to complete all research projects and submit final reports and participate in the Annual CAMMSE Research Symposium in November 2019. To resolve them, Dr. Nicholas Lownes, the Associate Director of CAMMSE at UCONN has been actively working with his grant management staff so that when Year 3 funds come in, if 75% of their total grant has not be expended, the new projects can get off the ground right away.

Other consortium members, including UT Austin, Texas Southern University and Washington State University, also experienced similar situations due to the award timing and the contracting issues and primarily due to the lack of time to recruit students for the projects. As such, a no-cost extension for most of their Year 2 research projects was also needed through September 30, 2019. Currently, all partner institutions have been working extremely hard to address these issues in order to accomplish the project objectives. Regarding their research and technology transfer contributions, the relatively poor performance of the Washington State University consortium member has also been noted by the executive leadership committee at UNCC. This problem can be resolved by making a change in the leadership there and having another professor at WSU take over as its associate director, or making an center-wide objective performance-based budget adjustment to the award allocation.

6.3. Changes that have a significant impact on expenditures

Nothing to report.

6.4. Significant change in use or care of animals, human subjects, and/or biohazards

Nothing to report.

6.5. Changes of primary performance site location from that originally proposed

Nothing to report.

6.6. Additional information regarding products and impacts

Nothing to report.

7. SPECIAL REPORTING REQUIREMENTS

(1) **External Advisory Board:** Available on the program website: https://cammse.uncc.edu/directory/external-advisory-board

(2) **Financial and Annual Recipient Share Reports:** The SF 425 requirements will be met by separate reports.

APPENDIX

CAMMSE @ UNC Charlotte Funded Projects, 2016-2018 (Year 1), All Completed

University	Principle Investigator	Category	Title of the Funded Project
University of North Carolina at Charlotte	Wei Fan	Advanced Research	Estimation of Origin-Destination Matrix and Identification of User Activities Using Public Transit Smart Card Data
	Wei Fan	Applied Research	Improving the Movements of People and Freight: A Case Study of the Piedmont Atlantic Megaregion
University of Texas at Austin	Randy Machemehl	Applied Research	Forecasting Ridership for Commuter Rail in Austin
	Randy Machemehl	Advanced Research	Corridor Level Adaptive Signal Control
University of Connecticut	Nicholas Lownes	Basic Research	Stochastic Multimodal Network Modeling
	Nicholas Lownes	Basic Research	Robust Routing, Assignment, and Simulation of Transit Systems
Washington State University	Xianming Shi	Applied Research	The Use of Connected Vehicle Technology to Facilitate Multimodal Winter Travel
	Jia Yan	Applied Research	The Effect of Competition of Transport Modes on Mobility
Texas Southern University	Mehdi Azimi Yi Qi	Applied Research	Use of Vessel Automatic Information System Data to Improve Multi-modal Transportation in and around the Ports
	Yi Qi	Applied Research	Use of Innovative Intersection Designs for Improving Mobility and Reducing Roadway Traffic Congestion

CAMMSE @ UNC Charlotte Funded Projects, 2017-2019 (Year 2), Ongoing

University	Principle Investigator(s)	Category	Title of the Funded Project
University of North Carolina at Charlotte	Wei Fan	Advanced Research	Use of Multisensor Data in Modeling Freeway Travel Time Reliability
	Wei Fan Martin Kane	Applied Research	Using General Transit Feed Specification (GTFS) Data as a Basis for Evaluating and Improving Public Transit Equity
	Wei Fan Yu Wang	Applied Research	Evaluating the Potential Use of Crowdsourced Bicycle Data in North Carolina
	Wei Fan	Advanced Research	Impact of Connected and Automated Vehicles (CAVs) on Freeway Capacity
	Wei Fan	Advanced Research	Optimal Variable Speed Limit Control for the Mixed Traffic Flows in a Connected and Autonomous Vehicle Environment
University of Texas at Austin	Randy Machemehl	Applied Research	Characterization of Bicycle Rider Behavior among Various Street Environments
	Randy Machemehl	Applied Research	Evolution of Advanced Transit Signal Priority with Gap-Based Signal Recovery Strategy
	Stephen Boyles	Applied Research	Assessment of Parcel Delivery Systems Using Unmanned Aerial Vehicles
	Christian Claudel	Advanced Research	Deep-learning Based Trajectory Forecast for Safety of Intersections with Multimodal Traffic
University of Connecticut	Nicholas Lownes Charles Patton Kelly Bertolaccini	Applied Research	Investigating the Linkage between Transit Access to Services and Affordable Housing Availability
	Karthik Charan Konduri	Advanced Research	Development of Continuous Time, Temporally Constrained and Behaviorally Consistent Tour Pattern Generation System for Modeling the Impacts of Autonomous Vehicle Future
	Norman Garrick Carol Atkinson - Palombo	Applied Research	What Do We Want from Autonomous Vehicles (AVs)? Using Participatory Planning and Scenario Analysis of Alternative Futures to Identify Stakeholders' Desired Outcomes from the Strategic Deployment of Emerging Transportation Technology
Washington State University	Xianming Shi	Applied Research	Developing Friction Data to Support the Optimal Use of Pre-wet Deicing Salt for Enhanced Winter Mobility
	Xianming Shi	Applied Research	Modeling the Macroscopic Effects of Winter Maintenance Operations on Traffic Mobility on Washington Highways
Texas Southern University	Yi Qi Mehdi Azimi Qun Zhao	Applied Research	Determination of Freeway Acceleration Lane Length for Smooth ad Safe Truck Merging
	Yi Qi Mehdi Azimi Qun Zhao	Applied Research	Innovative Countermeasures for Reducing the Truck Waiting Time at Marine Terminals

	Mehdi Azimi Yi Qi Qun Zhao	Applied Research	Investigating the Impact of Different Attributes on Bicycling Mode Share as A Multimodal Connectivity Strategy in Large Cities: A Case Study in Houston

CAMMSE @ UNC Charlotte Funded Projects, 2018-2020 (Year 3), Ongoing

University	Principle Investigator(s)	Category	Title of the Funded Project
University of North Carolina at Charlotte	Wei Fan	Applied Research	Predicting Travel Time on Freeway Corridors: Machine Learning Approach
	Wei Fan Martin Kane	Applied Research	Optimizing Transit Equity and Accessibility by Integrating Relevant GTFS Data Performance Metrics
	Wei Fan Yu Wang	Applied Research	Analyzing Cycling Behavior during Different Time Periods Using Crowdsourced Bicycle Data
	Wei Fan	Applied Research	Trajectory Optimization of Connected and Autonomous Vehicles (CAVs) at Signalized Intersections
University of Texas at Austin	Randy Machemehl	Applied Research	Forecasting Bicycle Facility Demand to Estimate Societal Impacts
	Randy Machemehl	Applied Research	Corridor Level Adaptive Signal Control (Phase II)
	Stephen Boyles	Applied Research	Assessment of Parcel Delivery Systems Using Unmanned Aerial Vehicles (Phase II)
	Christian Claudel	Advanced Research	Deep-learning Based Trajectory Forecast for Safety of Intersections with Multimodal Traffic (Phase II)
University of Connecticut	Jeffrey Cohen Nicholas Lownes	Applied Research	Highways and Wealth Distribution: A Geospatial Analysis
	Karthik Konduri Nalini Ravishanker	Applied Research	Are Transportation Network Companies Synergistic with Other Shared Ride Mode Offerings? An Exploratory Analysis of Demand Data from NYC Utilizing High Resolution Spatiotemporal Models
	Norman Garrick Carol Atkinson - Palombo	Applied Research	Understanding the Surprising and Oversized Use of Ridesourcing Services in Poorer Neighborhoods in NYC
Washington State University	Michelle Akin Xianming Shi	Educational Research	Multimodal Transportation Engineering Curriculum for Middle and High School Students
	Xianming Shi	Applied Research	Effects of Incorporating Connected Vehicle Technologies into No-Notice Emergency Evacuation during Winter Weather
	Ali Hajbabaie	Applied Research	Dynamic Speed Harmonization in Connected Urban Street Networks: Improving Mobility
Texas Southern University	Yi Qi Mehdi Azimi Qun Zhao	Applied Research	Development of Guidelines for Implementation of Contraflow Left-Turn Lanes at Signalized Intersections
	Yi Qi Qun Zhao Mehdi Azimi	Applied Research	Signal Timing Strategy for Displaced Left Turn Intersections
	Mehdi Azimi Yi Qi	Applied Research	Impacts of Bicycling Corridor Improvements on Users' Behaviors in Large Cities

Center for Advanced Multimodal Mobility Solutions and Education