



Center for Advanced Multimodal Mobility Solutions and Education



Annual Performance Indicators Report for University Transportation Centers



October 1, 2021 to September 30, 2022

Submitted by
Center for Advanced Multimodal Mobility Solutions and Education

Prepared for
**Office of the Assistant Secretary for Research and Technology (OST-R)
U.S. DEPARTMENT OF TRANSPORTATION**



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

Charlotte, NC 28223
Austin, TX 78712
Storrs, CT 06269
Pullman, WA 99164
Houston, TX 77004



TABLE OF CONTENTS

1. PROGRAM INFORMATION	ii
2. PROGRAM-WIDE INDICATORS	1
3. UTC-SPECIFIC INDICATORS	3
3.1. University of North Carolina at Charlotte	3
3.2. University of Texas at Austin	10
3.3. University of Connecticut	14
3.4. Washington State University – Pullman	17
3.5. Texas Southern University	20





1. PROGRAM INFORMATION

USDOT Tier 1 University Transportation Center Annual Performance Indicators Report

Submitted to: U.S. Department of Transportation
Office of the Assistant Secretary for Research
and Technology (OST-R)

Grant Number: 69A3551747133

Project Title: Center for Advanced Multimodal Mobility Solutions
and Education (CAMMSE)

Center Director: Wei (David) Fan, Ph.D., P.E.
Professor
Department of Civil and Environmental Engineering
University of North Carolina at Charlotte
9201 University City Blvd., Charlotte, NC 28223
wfan7@uncc.edu | 704-687-1222

Submission Date: October 14, 2022

DUNS: 06-630-0096

EIN: 56-0791228

Recipient Organization: University of North Carolina at Charlotte

Project/Grant Period: November 30, 2016 - September 30, 2022

Reporting Period Start Date: October 1, 2021

Reporting Period End Date: September 30, 2022

Report Term or Frequency: Annual Performance Indicators

Signature of Submitting Official:



2. PROGRAM-WIDE INDICATORS

University Transportation Centers Program Performance Indicators

UTC Name:	Center for Advanced Multimodal Mobility Solutions and Education (CAMMSE)
University:	Lead University: <ul style="list-style-type: none"> • University of North Carolina at Charlotte (UNCC) Consortium Member Universities: <ul style="list-style-type: none"> • University of Texas at Austin (UT Austin) • University of Connecticut (UConn) • Washington State University – Pullman (WSU) • Texas Southern University (TSU)
Grant #:	69A3551747133
Reporting Period:	October 1, 2021 - September 30, 2022

Performance Indicators	Total	UNCC	UT Austin	UConn	WSU	TSU
1. Number of transportation-related courses offered during the reporting period that were taught by faculty and/or teaching assistants who are associated with the UTC						
Undergraduate courses	24	4	5	9	1	5
Graduate courses	24	3	3	7	1	10
2. Number of students participating in transportation research projects during the reporting period funded by this grant						
Undergraduate students in research	3	0	1	0	1	1
Graduate students in research	29	10	5	3	3	8
3. Number of transportation-related advanced degree programs that utilize grant funds during the reporting period to support graduate students						
Masters level programs	5	1	1	2	0	1
Doctoral level programs	5	1	1	2	1	0
4. Number of students supported by this grant during the reporting period						
Undergraduate students	3	0	1	0	1	1



Masters students	9	2	1	0	0	6
Doctoral students	20	8	5	3	3	1
5. Number of degrees awarded during the reporting period to students supported by this grant						
Undergraduate degrees	1	0	0	0	1	0
Masters degrees	2	0	1	0	0	1
Doctoral degrees	5	3	1	0	1	0
6. Number and total dollar value of research projects selected for funding during the reporting period using UTC grant funds (Federal and/or Recipient Share) that you consider to be applied research and advanced research						
Number of applied research projects	11	2	2	1	1	5
Dollar value of applied research projects	\$924,287.99	\$180,014.00	\$217,790.00	\$38,807.00	\$62,271.00	\$425,405.99
Number of advanced research projects	8	4	1	2	0	1
Dollar value of advanced research projects	\$768,750.26	\$540,012.00	\$67,790.00	\$77,614.00	-	\$83,334.26

3. UTC-SPECIFIC INDICATORS

3.1. University of North Carolina at Charlotte

Part II – UTC-Specific Performance Indicators		
UTC Name	Center for Advanced Multimodal Mobility Solutions and Education (Cammse)	
University	University of North Carolina at Charlotte	
Grant #	69A3551747133	
Reporting Period	October 1, 2021- September 30, 2022	
Category	Description of indicator	Metric
1. Research Capability	<ul style="list-style-type: none"> Research results published in: <i>IEEE Access, Information Sciences, International Journal of Transportation Science and Technology, Journal of Advanced Transportation, Journal of Safety Research, Transportation Planning and Technology</i> Transportation Research results presented at: the 2021 NCDOT Virtual Research & Innovation Summit, the 4th Annual Cammse Virtual Research Symposium, the 21st COTA International Conference of Transportation Professionals, the 101st Annual Meeting of the Transportation Research Board, the 7th Annual UTC Conference for the Southeast Region, the Battery Complexity, Autonomous Vehicle and Electrification (BATT CAVE) Research Center at UNC Charlotte, the University of Nebraska at Lincoln, UNCC 	<ul style="list-style-type: none"> Number of refereed journal publications (7) <ol style="list-style-type: none"> Hua, C. and Fan, W., Injury Severity Analysis of Time-of-Day Fluctuations and Temporal Volatility in Atypical Sideswipe Collisions: A Random Parameter Model with Heterogeneous Means and Heteroscedastic Variances, Accepted for Publication, <i>Journal of Safety Research</i>, July 2022. Liu, S. and Fan, W., Platooning-Based Trajectory Planning of Connected and Autonomous Vehicles at Superstreets, Accepted for Publication, <i>Transportation Planning and Technology</i>, June 2022. Liu, S. and Fan, W., Evaluating the Performance of Connected and Automated Vehicles in Fixed Signal-Controlled Conventional Intersections and Superstreets with Platooning-Based Trajectory Planning,



	<p>Department of Civil and Environmental Engineering Graduate Research Symposium</p>	<p>Accepted for Publication, <i>Journal of Advanced Transportation</i>, May 2022.</p> <ol style="list-style-type: none"> 4. Gu, J.J., Jiang, Z.B., Fan, W. and Chen, J., Short-Term Trajectory Prediction for Individual Metro Passengers Integrating Diverse Mobility Patterns with Adaptive Location-Awareness, <i>Information Sciences</i>, Volume 599, pp. 25-43, June 2022. 5. Yang, Y., Cui, H., Ma, X., Fan, W., Zhu, M. and Yao, S., Evaluating the Impacts of Optimization Horizon on the Shared Autonomous Vehicle Reservation Request System, <i>Journal of Advanced Transportation</i>, Volume 2022. 6. Song, L. and Fan, W., Traffic Signal Control Under Mixed Traffic with Connected and Automated Vehicles: A Transfer-Based Deep Reinforcement Learning Approach, <i>IEEE Access</i>, Volume 9, pp. 145228-145237, 2021. 7. Liu, S., Li, Y. and Fan, W., Mixed Logit Model Based Diagnostic Analysis of Bicycle-Vehicle Crashes at Daytime and Nighttime, <i>International Journal of Transportation Science and Technology</i>, October 2021. <ul style="list-style-type: none"> • Number of conference papers presented, and other presentations made (17) • Number of technical research reports published (4) <ol style="list-style-type: none"> 1. Fan, W. and Liu, S., <i>Evaluating and Comparing the Impact of Connected and Autonomous Vehicles on Conventional Intersections and Superstreets</i>, Technical Report for CAMMSE Research 2022 Project 01, U.S. Department of
--	--	---





		<p>Transportation, September 2022.</p> <ol style="list-style-type: none"> 2. Fan, W. and Hua, C., <i>Real-Time Freeway Speed Prediction Based on Deep Learning in Connected and Autonomous Vehicles Environment</i>, Technical Report for CAMMSE Research 2022 Project 02, U.S. Department of Transportation, September 2022. 3. Fan, W. and Zhao, Y., <i>Online Cooperative Lane-changing Model of Connected and Autonomous Vehicles</i>, Technical Report for CAMMSE Research 2022 Project 03, U.S. Department of Transportation, September 2022. 4. Fan, W. and Yang, T., <i>Impact of Connected and Autonomous Vehicles on Signalized Intersections with Transit Signal Priority</i>, Technical Report for CAMMSE Research 2022 Project 04, U.S. Department of Transportation, September 2022.
<p>2. Leadership</p>	<ul style="list-style-type: none"> • Handling Editor, <i>TRR Inaugural Editorial Board of Transportation Research Record</i> • Guest Editor, <i>World Electric Vehicle Journal (Special Issue Title: Emerging Technologies in Electrification of Urban Mobility)</i> • Associate Editor, <i>IEEE Transactions on Intelligent Transportation Systems</i>, <i>ASCE Journal of Transportation Engineering, Part A: Systems</i>, <i>International Journal of Transportation Science and Technology</i> • Editorial Board, <i>Journal of World Review of Intermodal Transportation Research</i> • Organization Chair, 2021 CAMMSE Research Symposium 	<ul style="list-style-type: none"> • Handling Editor (1) • Guest Editor (1) • Editorship (4) • Organizing committee chair, secretary, session chair or area editor of conferences (9) • Number of professional committees or board members (12) • Technical Reviewer (9)



	<ul style="list-style-type: none">• Co-Chair, Connected and Autonomous Vehicles Section, World Transport Convention• Secretary, TRB Committee on Light Rail Transit Systems (A0020C, AP075)• Conference Organizer and Moderator, the 24th COTA Winter Symposium, the 20th, 21st and 22nd COTA International Conference of Transportation Professionals• General Secretary, Board of Director, Chinese Overseas Transportation Association (COTA)• Advisory Board Member, ASCE National Artificial Intelligence (AI) Committee• Member, ASCE National Connected & Autonomous Vehicles Impacts Committee, TRB Standing Committees (A0020C, ACP60, AP075, AHB60), WTC Shared Logistics and Transportation Systems Committee, NCDOT Fully Autonomous Vehicle (FAV) Research Working Group Committee, ASCE National Public Transport Committee, ASCE National Rail Transportation Committee, NCSITE Scholarship Committee, PENC State Board• Technical Reviewer, Canada Research Chair Renewal Review - Cooperative Transportation Systems, NCHRP (17-108, 08-157, 17-102), National Defense Science and Engineering Graduate (NDSEG) Scholarship Evaluation Panel, Luxembourg National Research Fund (NSF) Technical Report Review, Independent Research Fund Denmark, USDOT Tier 1 UTC -	
--	---	--





	<p>Freight Mobility Research Institute, National Science Foundation Review Panel</p>	
<p>3. Education and Workforce Development</p>	<ul style="list-style-type: none"> • Four existing undergraduate courses and three existing graduate courses • Ten graduate students in CAMMSE projects • Two degree programs in the Department of Civil and Environmental Engineering, College of Engineering, UNC Charlotte • Three doctoral students graduated • Six UNC Charlotte ITE student chapter seminars and thirty-three UNC Charlotte transportation graduate student weekly seminars • Conducted CLT Airport Seminar, CAMMSE's Transportation Engineering Summer Camp • The 4th CAMMSE Annual Meeting 	<ul style="list-style-type: none"> • Transportation-related courses offered by faculty (7) • Number of students participating in CAMMSE funded projects (10) • Number of transportation-related degree programs with students funded by CAMMSE (2) • Number of graduated students (3) • Number of education and outreach, and workforce development activities (2) • Number of research symposium (1) • Number of transportation seminars (39) • Student scholarships or awards (7) <ol style="list-style-type: none"> 1. Bo Qiu, USDOT Student of the Year Award, CAMMSE UTC, Washington DC, January 8, 2022 2. Yang Zhao, Women's Transportation Seminar (WTS) Charlotte Metro Chapter Mary N. Clayton Honorary Scholarship, January 2022 3. Paul D. Cribbins Cup, Outstanding ITE Student Chapter, North Carolina Section of the Institute of Transportation Engineers, McKimmon Center, North Carolina State University, Raleigh, NC, November 18, 2021 4. Li Song, Don Blackburn Memorial Scholarship, North Carolina Section of the Institute of Transportation Engineers, McKimmon Center, North Carolina State University, Raleigh, NC, November 18, 2021



		<ol style="list-style-type: none"> 5. Shaojie Liu, Roy D. Williams Memorial Scholarship, North Carolina Section of the Institute of Transportation Engineers, McKimmon Center, North Carolina State University, Raleigh, NC, November 18, 2021 6. Bo Qiu, Second Place Award, Graduate Student Presentation Competition, Fourth Annual CMMSE Virtual Research Symposium, UNC Charlotte Center City, Charlotte, NC, November 5, 2021 7. Li Song, Third Place Award, Graduate Student Presentation Competition, Fourth Annual CMMSE Virtual Research Symposium, UNC Charlotte Center City, Charlotte, NC, November 5, 2021
<p>4. Technology Transfer</p>	<ul style="list-style-type: none"> • Two presentations were made at the Department of Civil and Environmental Engineering Graduate Research Symposium at UNC Charlotte • Four presentations at the 4th Annual CMMSE Virtual Research Symposium • Two poster presentations and one presentation at the 2021 NCDOT Research & Innovation Summit at the University of North Carolina at Chapel Hill • One presentation at the 21st COTA International Conference of Transportation Professionals • Three presentations at the 7th Annual UTC Conference for the Southeast Region • One presentation at the University Graduate School Research Symposium at UNC Charlotte • One presentation at the University of Nebraska at Lincoln • One presentation at the Battery 	<ul style="list-style-type: none"> • Presentations given at professional and academic meetings (17) • Number of professionals in the audience (est. 600)



	<p>Complexity, Autonomous Vehicle and Electrification (BATT CAVE) Research Center at UNC Charlotte</p> <ul style="list-style-type: none">• One presentation at the 101st Annual Meeting of the Transportation Research Board at Washington D.C.	
5. Collaboration	<ul style="list-style-type: none">• North Carolina DOT, North Carolina A&T State University, and North Carolina State University in collaborative research and UNC Charlotte in providing cash, in-kind support, facilities, etc.• Research Collaboration with NCSU on NCHRP (13-06)• Collaborated with Charlotte Area Transit System, Charlotte-Douglas Airport, and Michigan State University on the CAMMSE Summer Camp activities• Center personnel: Drs. Wei Fan, Martin Kane, Ms. Kim Wilson	<ul style="list-style-type: none">• Number of collaborative partners (7)• Number of Center personnel involved (3)





3.2. University of Texas at Austin

Part II – UTC-Specific Performance Indicators		
UTC Name	Center for Advanced Multimodal Mobility Solutions and Education (Cammse)	
University	University of Texas at Austin	
Grant #	69A3551747133	
Reporting Period	October 1, 2021 - September 30, 2022	
Category	Description of indicator	Metric
1. Research Capability	<ul style="list-style-type: none"> • Research results published in: <i>IEEE Transactions on Intelligent Transportation Systems, IEEE Transactions on Automatic Control</i> • Transportation Research results presented at: the Transportation Research Board 101st Annual Meeting, the 2021 International Conference on Computer Vision (ICCV), IEEE PerCom CoMoRea 2022 	<ul style="list-style-type: none"> • Number of refereed journal publications (2) <ol style="list-style-type: none"> 1. Nugroho, S.A., Vishnoi, S.C., Taha, A.F., Claudel, C.G. and Banerjee, T, Where Should Traffic Sensors Be Placed on Highways? <i>IEEE Transactions on Intelligent Transportation Systems</i>, October 2021. 2. Du, B., Qian, K., Claudel, C., and Sun, D., Jacobi-Style Iteration for Distributed Submodular Maximization, <i>IEEE Transactions on Automatic Control</i>, Vol. 67, No. 9, pp. 4687-4702, September 2022. • Number of refereed conference proceedings (5) <ol style="list-style-type: none"> 1. Nugroho, S., Vishnoi, S., Taha, A. and Claudel, C., <i>Optimal Sensor Placement on Highway Networks: A Traffic Dynamics Based Approach</i>, Transportation Research Board (TRB) Annual Meeting, January 2022, Washington, D.C. 2. Hall, J., Baumanis, C. and Machemehl, R., <i>Modeling Impacts of COVID-19 on Capital Metro Ridership</i>, Proceedings of the Transportation Research



		<p>Board 101st Annual Meeting, Washington, D.C., January 2022.</p> <ol style="list-style-type: none"> 3. Baumanis, C., Hall, J. and Machemehl, R., <i>A Machine Learning Approach to Predicting Bicycle Demand During the COVID-19 Pandemic</i>, Proceedings of the Transportation Research Board 101st Annual Meeting, Washington, D.C., January 2022. 4. Mohamed, A., Chen, H., Wang, Z. and Claudel, C., <i>Skeleton-Graph: Long-Term 3D Motion Prediction From 2D Observations Using Deep Spatio-Temporal Graph CNNs</i>, proceedings of the 2021 International Conference on Computer Vision (ICCV), Montreal, Canada, October 2021. 5. Mohamed, A., Lejarza, F., Cahail, S., Claudel, C. and Thomaz, E. <i>HAR-GCNN: Deep Graph CNNs for Human Activity Recognition from Highly Unlabeled Mobile Sensor Data</i>, to appear, IEEE PerCom CoMoRea 2022, Pisa, Italy, March 2022. <ul style="list-style-type: none"> • Number of presentations (12) • Number of technical reports (3) <ol style="list-style-type: none"> 1. Hall, J., Baumanis C., and Machemehl, R., <i>Impacts of Dockless Electric Scooter Crashes</i>, Interim Technical Report for CAMMSE Research 2021 Project 01, U.S. Department of Transportation, September 2022. 2. Baumanis, C. and Machemehl, R., <i>Driver Compliance with Pedestrian Crossings at Non-Signalized Intersections</i>, Technical Report for CAMMSE Research 2021 Project 02, U.S. Department of Transportation, September
--	--	--





		<p>2022.</p> <p>3. Mohamed, A., Claudel, C., <i>HAR-GCNN: Deep Graph CNNs for Human Activity Recognition from Highly Unlabeled Mobile Sensor Data</i>, Technical Report for CAMMSE Research 2021 Project 03, U.S. Department of Transportation, September 2022.</p>
<p>2. Leadership</p>	<ul style="list-style-type: none"> • Associate Editor, <i>IEEE Transactions on Intelligent Transportation Systems</i>, <i>ITE Journal - Institute of Transportation Engineers</i> • Editorial Board, <i>Transportation Research Part B</i>, <i>Transportation Research Part C</i>, <i>Journal of Infrastructure Systems</i> • Chair, TRB Transit, Freight, and Logistics Subcommittee • Member, TRB Transportation Network Modeling Committee 	<ul style="list-style-type: none"> • Editorship (5) • Number of professional committees (2)
<p>3. Education and Workforce Development</p>	<ul style="list-style-type: none"> • Five undergraduate courses and three graduate courses • Three undergraduate students and seven graduate students in CAMMSE projects • One degree program in the Cockrell School of Engineering in the Civil, Architectural and Environmental Engineering Department • One MS and one PhD student graduated with CAMMSE support • Five Ph.D. students, one MS student, and one undergraduate have been supported by CAMMSE this past year 	<ul style="list-style-type: none"> • Transportation related course offered by faculty (8) • Number of students participating in CAMMSE funded projects (10) • Number of transportation related degree programs with students funded by CAMMSE (1) • Number of CAMMSE students graduated (2) • Number of students supported by CAMMSE (7)
<p>4. Technology Transfer</p>	<ul style="list-style-type: none"> • The CAMMSE-supported students that have graduated during this reporting period will carry the new technology that they have developed with them for the rest of their careers • The professors at UT Austin have also used their classes to teach the 	<ul style="list-style-type: none"> • Presentations given at professional and academic meetings (16) • Number of students in courses taught by CAMMSE-related faculty members (385)



	<p>new techniques developed through the CAMMSE UTC, therefore planting the new technology in students that are not directly supported by the UTC</p>	
5. Collaboration	<ul style="list-style-type: none">• City of Austin, Dallas District of TxDOT, Austin District of TxDOT in collaborative research and UT's Center for Transportation Research providing in-kind support, facilities, etc.• National Science Foundation (NSF) on Project 2020 Project 08• Prof. Thomaz Edison's group in ECE at UT Austin• Prof. Linda Boyle's group in Civil Engineering at University of Washington• Center personnel: Drs. Randy Machemehl, Christian Claudel, Carolina Baumanis	<ul style="list-style-type: none">• Number of collaborative partners (5)• Number of Center personnel involved (3)





3.3. University of Connecticut

Part II – UTC-Specific Performance Indicators	
UTC Name	Center for Advanced Multimodal Mobility Solutions and Education (CAMMSE)
University	University of Connecticut
Grant #	69A3551747133
Reporting Period	October 1, 2021 - September 30, 2022

Category	Description of indicator	Metric
1. Research Capability	<ul style="list-style-type: none"> • Research results published in: <i>Journal of Urban Planning and Development, Federal Reserve Bank of St. Louis REVIEW</i> • Research results presented in: 2022 International Conference on Transportation and Development, Seattle, WA 	<ul style="list-style-type: none"> • Number of refereed journal publications (2) <ol style="list-style-type: none"> 1. Ren, Z., Fusco, G., Lownes, N., and Zhu, J, Entropy-Based Diversity Quantification of Multimodal Transportation Systems: Physical Infrastructure Perspective versus Travel Behavior Perspective. <i>Journal of Urban Planning and Development</i>, 148(3), 04022029. February 2022. 2. Cohen, J. P., Lownes, N., and Zhang, B., 1960s Interstate Highways and Homeowner Wealth Distribution. <i>Federal Reserve Bank of St. Louis REVIEW</i>, Forthcoming, September 2022. • Number of conference papers presented (1) <ol style="list-style-type: none"> 1. Rezwana, S., Jackson, E., Filipovska, M., and Lownes, N. (2022). <i>A Modified Social Force Model (SFM) for Pedestrian Behavior in the Presence of Autonomous Vehicles (AVs)</i>. In International Conference on



		<p>Transportation and Development, June 2022.</p> <ul style="list-style-type: none">• Number of technical research reports published (5) <ol style="list-style-type: none">1. Ricketts, L. and Cohen, J.P., <i>Arrival of Interstate Highway System Brought Housing Wealth, but to Whom?</i>, Federal Reserve Bank of St. Louis Economic Equity Insights, May 2022.2. Ivan, J., Burnicki, A., and Packer, Q., <i>Estimation of Pedestrian Compliance at Signalized Intersections Considering Demographic and Geographic Factors</i>, Technical Report for CAMMSE Research 2021 Project 04 and 2022 Project 11, U.S. Department of Transportation, June 2022.3. Atkinson-Palombo, C. and Garrick, N., <i>Characteristics of Pooled Trips Offered by Ride-sourcing Services in Chicago</i>, Technical Report for CAMMSE Research 2021 Project 05, U.S. Department of Transportation, September 2022.4. Lownes, N., Rezwana, S., Shaon, M.R.R., and Jackson, E., <i>Pedestrian Behavior and Interaction with Autonomous Vehicles</i>, Technical Report for CAMMSE Research 2021 Project 06, U.S. Department of Transportation, September 2022.5. Ren, Z. and Zhu, J., <i>Disaster Resilience through Diverse Evacuation and Emergency Transportation System (Phase II)</i>, Technical Report for CAMMSE Research 2022 Project 10, U.S. Department of Transportation, September 2022.
--	--	---





<p>2. Leadership</p>	<ul style="list-style-type: none"> • Associate Editor, <i>Accident Intervention and Prevention, Journal of Transportation Safety and Security</i> • Member, TRB Standing Committees (ADB10, AP025), ASCE Public Transportation Committee, Connecticut Transportation Institute 	<ul style="list-style-type: none"> • Editorship (2) • Number of professional committees or affiliated centers (4)
<p>3. Education and Workforce Development</p>	<ul style="list-style-type: none"> • Nine undergrad course offerings and seven graduate course offerings • Three graduate students in CAMMSE projects • Two degree programs in civil engineering, geography and statistics 	<ul style="list-style-type: none"> • Transportation related courses offered by faculty (16) • Number of students participating in CAMMSE funded projects (3) • Number of transportation related degree programs with students funded by CAMMSE (2)
<p>4. Technology Transfer</p>	<ul style="list-style-type: none"> • Two presentations at professional and academic meetings 	<ul style="list-style-type: none"> • Presentations given at professional and academic meetings (2) • Number of professionals in the audience (est. 100)
<p>5. Collaboration</p>	<ul style="list-style-type: none"> • Connecticut DOT, Connecticut Transportation Institute • Center personnel: Drs. Nicholas Lownes, John Ivan, Jin Zhu, Amy Burnicki 	<ul style="list-style-type: none"> • Number of collaborative partners (2) • Number of Center personnel involved (4)



3.4. Washington State University – Pullman

Part II – UTC-Specific Performance Indicators		
UTC Name	Center for Advanced Multimodal Mobility Solutions and Education (CAMMSE)	
University	Washington State University	
Grant #	69A3551747133	
Reporting Period	October 1, 2021 - September 30, 2022	
Category	Description of indicator	Metric
1. Research Capability	<ul style="list-style-type: none"> Research results published in: <i>ASCE Journal of Cold Regions Engineering, Transportation Research Record</i> Research results presented at: the 2021 4th Annual CAMMSE Research Symposium, the 2021 Society for Risk Analysis Annual Meeting, the 2021 TriDurLE Annual Symposium, the 20th and 21st Joint COTA International Conference of Transportation Professionals 	<ul style="list-style-type: none"> Number of refereed journal publications (2) <ol style="list-style-type: none"> Qi, Y., Cornwell, M., Shi, X. Field Test of Living Snow Fences along Illinois Freeways. <i>ASCE Journal of Cold Regions Engineering</i>, October 2021. Zhao, J. and Lee, J.Y., Effect of Connected and Autonomous Vehicles on Supply Chain Performance, <i>Transportation Research Record</i>, August 2022. Number of presentations (8) Number of technical research reports published (3) <ol style="list-style-type: none"> Liu, J., Liu, J., Shi, X., and Honavar Nazari, M., <i>Snow and Ice Treatment Products Evaluation</i>, Report No. CMR-21-009, Prepared for the Missouri Department of Transportation, Jefferson City, MO., December 2021. Lee, J. Y. and Zhao, J., <i>Effect of Connected and Autonomous Vehicles on Supply Chain Performance</i>, Technical Report for CAMMSE Research 2021 Project 10, U.S. Department of Transportation, August



		<p>2022.</p> <p>3. Deng, Y., Chen, C., and Shi. X., <i>Prediction of Traffic Mobility Based on Historical Data and Machine Learning Approaches</i>, Technical Report for CAMMSE Research 2022 Project 15, U.S. Department of Transportation, August 2022.</p>
<p>2. Leadership</p>	<ul style="list-style-type: none"> • Editor-in-Chief, <i>Journal of Infrastructure Preservation and Resilience</i> • Editorial Board, <i>International Journal of Transportation Science and Technology</i> • Director, Washington State Transportation Center • Member, Transportation & Infrastructure Committee, Cold Regions Engineering Division of ASCE • Affiliated Faculty, WSU Center for Environmental Research, Education, and Outreach 	<ul style="list-style-type: none"> • Editorship (2) • Number of professional committees or affiliated centers (4)
<p>3. Education and Workforce Development</p>	<ul style="list-style-type: none"> • Teaching the following undergraduate level course related to transportation: CE 405 Decision-making for sustainable and resilient civil infrastructure, 29 students; Teaching one graduate level course related to transportation: CE531, Probability and Stat. Models, 16 students • Supporting three PhD students, and one undergraduate student in CAMMSE funded projects • One female PI, two Ph.D. students, one female staff, and one female undergraduate student contributed to CAMMSE funded projects 	<ul style="list-style-type: none"> • Transportation related courses offered by faculty (2) • Student scholarships or awards (4) 1. Jie Zhao, 1st Place at the CAMMSE Research Symposium Student Presentation 2. Vishnupriya Jonnalagadda, Waheed Uddin Diversity Graduate Research Fellowship 3. Yan Zhang, 2021 Milton Pikarsky Memorial Award for Outstanding Doctoral Dissertation, awarded by CUTC 4. Mehdi Honarvar Nazari, Outstanding Research Assistant Award, selected by the Department of Civil & Environmental Engineering, Washington State University, 2022 • Number of students



		<p>participating in CAMMSE funded projects (4)</p> <ul style="list-style-type: none">• Number of transportation related degree programs with students funded by CAMMSE (1)
4. Technology Transfer	<ul style="list-style-type: none">• Two presentations at the 2021 4th Annual CAMMSE Research Symposium; one keynote presentation for the 20th and 21st Joint COTA International Conference of Transportation Professionals; one keynote presentation for the 1st International Workshop on Resilient Infrastructure	<ul style="list-style-type: none">• Presentations given at professional and academic meeting (4)• Number of professionals in the audience (est. 242)
5. Collaboration	<ul style="list-style-type: none">• West Virginia University with Dr. Kakan Dey• Region 10 UTC PacTrans, WSU Vancouver School of Engineering and Computer Science• Center personnel: Drs. Xianming Shi, Ji Yun Lee	<ul style="list-style-type: none">• Number of collaborative partners (3)• Number of Center personnel involved (2)



3.5. Texas Southern University

Part II – UTC-Specific Performance Indicators		
UTC Name	Center for Advanced Multimodal Mobility Solutions and Education (Cammse)	
University	Texas Southern University	
Grant #	69A3551747133	
Reporting Period	October 1, 2021 - September 30, 2022	
Category	Description of indicator	Metric
1. Research Capability	<ul style="list-style-type: none"> • Research results published in: <i>Conservation and Recycling</i>, <i>Entropy</i>, <i>International Journal of Transportation Science and Technology</i>, <i>Journal of Transportation Research Part D</i>, <i>Resources</i> • Research Results presented at: 101st Transportation Research Board Annual Meeting, Cammse Research Symposium • Invited presentations at: C2SMART virtual event, TexITE Houston Luncheon, TSU Research Week, HBCU-Georgia Tech Transport Researcher Forum, 2022 East End Chamber of Commerce Education Symposium. 	<ul style="list-style-type: none"> • Number of refereed journal publications (7) 1. Qu, W., Li, J., Song, W., Li, X., Zhao, Y., Dong, H., Wang, Y., Zhao, Q., and Qi, Y., Entropy-Weight Method-Based Integrated Models for Short-Term Intersection Traffic Flow Prediction, <i>Entropy</i>, 24(7): 849, June 2022. 2. Zhao, Q., Qi, Y., and Wali, M. M., A method for assessing the COVID-19 infection risk of riding public transit, <i>International Journal of Transportation Science and Technology</i>, July 2022. 3. Zhang, Y., Chen, X., Zhao, Y., Ma, J. and Yu, L., A methodology for measuring the environmental effect of autonomous bus considering platooning, <i>Transportation Research Part D: Transport and Environment</i>, Volume 107, p.103300., June 2022. 4. Du, J., Qiao, F., and Yu, L., Forecasting Ground-Level Ozone Concentration Levels Using Machine Learning, <i>Resources, Conservation and Recycling</i>, Volume 184, p.106380., September 2022. 5. Fan, P., Song, G., Zhu, Z., Wu, Y., Zhai, Z. and Yu, L.,



		<p>Road grade estimation based on Large-scale fuel consumption data of connected vehicles.</p> <p><i>Transportation Research Part D: Transport and Environment</i>, Volume 106, p.103262., May 2022.</p> <p>6. Guo, R., Liu, J., Zhao, Q., & Qi, Y., Signal timing and geometric design at contraflow left-turn lane intersections, <i>International Journal of Transportation Science and Technology</i>, October 2021.</p> <p>7. Qi, Y., Liu, J., Tao, T., & Zhao, Q., Impacts of COVID-19 on public transit ridership, <i>International Journal of Transportation Science and Technology</i>, November 2021.</p> <ul style="list-style-type: none"> • Number of conference papers (8) <p>1. Liu, J., Y. Qi and J. Tao, <i>Predicting the Severity of Large Truck Crashes Using Machine Learning Methods</i>. Transportation Research Board, accepted for presentation at the 101st Transportation Research Board Annual Meeting, Washington, D.C., January 2022.</p> <p>2. Ma, J., X. Chen, X. Zhang, and L. Yu, <i>Exploring the Willingness to Pay for High-occupancy Toll Lanes Based on a Hybrid Utility and Regret Model Considering Latent Variables</i>. The 101st Transportation Research Board Annual Meeting Paper 22-04030, Session 1129, Transportation Research Board of the National Academies, Washington, D.C., January 2022.</p> <p>3. Zhang, Y., X. Chen, Y. Zhao, J. Ma, and L. Yu, <i>A Proposed Methodology for Measuring the Environmental Effect of Automated Bus Considering Platooning</i>. The 101st Transportation Research</p>
--	--	--





		<p>Board Annual Meeting Paper 22-04095, Session 1311, Transportation Research Board of the National Academies, Washington, D.C., January 2022.</p> <p>4. Jiang, Y., G. Song, Y. Wu, T. Wang, and L. Yu, <i>The Impact of Cold-start Emissions on Air Pollution Exposure during Active Travel: A Case Study in Beijing</i>. The 101st Transportation Research Board Annual Meeting Paper 22-04517, Session 1196, Transportation Research Board of the National Academies, Washington, D.C., January 2022.</p> <p>5. Meng, D., G. Song, H. Lu, Y. Wu, and L. Yu, <i>Comparative Analysis of Platoon Stability of Car-Following Models for Emission Estimation</i>. The 101st Transportation Research Board Annual Meeting Paper 22-04521, Session 1196, Transportation Research Board of the National Academies, Washington, D.C., January 2022.</p> <p>6. Ding, S., X. Chen, and L. Yu, <i>Platoon Recognition in a Connected and Autonomous Vehicles Environment</i>. The 101st Transportation Research Board Annual Meeting Paper 22-03869, Session xxx, Transportation Research Board of the National Academies, Washington, D.C., January 2022.</p> <p>7. Chen, X, K. Ma, J. Liu, and L. Yu, <i>Design of Intermodal Hub-and-Spoke Freight Network Considering Hub Failure</i>. The 101st Transportation Research Board Annual Meeting Paper 22-04906, Session xxx, Transportation Research Board of the National Academies, Washington, D.C., January 2022.</p>
--	--	---





		<p>8. Chen, X, Y. Wang, Z. Fu, and L. Yu, <i>Impact Analysis of Surrounding Vehicles Behavior on Autonomous Truck Platoon</i>. The 101st Transportation Research Board Annual Meeting Paper 22-04648, Session 1392, Transportation Research Board of the National Academies, Washington, D.C., January 2022.</p> <ul style="list-style-type: none"> • Number of presentations (5) • Number of technical research reports published (3) <p>1. Azimi, M., Qi, Y., and Li, J., <i>Studying the Impact of Pandemic Outbreaks on Maritime Transportation and Port Operation</i>, Technical Report for CAMMSE Research 2021 Project 07, U.S. Department of Transportation, September 2022.</p> <p>2. Qi, Y., Zhao, Q., and Azimi, M., <i>Short Term Intersection Traffic Flow Forecasting</i>, Technical Report for CAMMSE Research 2021 Project 08, U.S. Department of Transportation, September 2022.</p> <p>3. Qi, Y., Liu, J., Tao, T., Zhao, Q., Wali, M., and Li, J., <i>Impacts of COVID-19 on Public Transit Ridership</i>, Technical Report for CAMMSE Research 2021 Project 09, U.S. Department of Transportation, September 2022.</p>
<p>2. Leadership</p>	<ul style="list-style-type: none"> • Associate Editor, <i>Current Trends in Civil & Structural Engineering, International Journal of Transportation Science and Technology</i> • Editorial Board, <i>Asian Transport Studies, Journal of Transportation Research Part D</i> • Guest Editor, <i>Vehicles, Special</i> 	<ul style="list-style-type: none"> • Editorship (4) • Guest Editor (1) • Number of professional committees or board members (6)



	<p><i>Issues on Recent Developments in Intelligent Transportation System (ITS)</i></p> <ul style="list-style-type: none"> • Member, TRB Standing Committees (AT045, AT050, AW010, AW020, AW010(2), AW010(3)) • Member, Maritime Education, Training, and Outreach subcommittee of the Lone Star Harbor Safety Committee (LSHSC) 	
<p>3. Education and Workforce Development</p>	<ul style="list-style-type: none"> • Five undergrad courses and ten graduate courses • One undergraduate student and eight graduate students supported by CAMMSE projects • One undergraduate degree program and one M.S. degree program in the College of Science, Technology and Engineering at TSU • Organized one Transportation Workshop: “Traffic Signal Timing and Coordination with TranSync” • Co-organized and sponsored Department of Transportation Studies EVENTS @ TSU, hosted 4 seminars • Organized one CAMMSE-ITE joint seminar “METRO Rapid Inner Katy Project” • CAMMSE funded students received: ITS Texas Scholarship, HCBFFA (Houston Customs Brokers & Freight Forwarders Association) Scholarship, Flight Training Scholarship for Instrument (IFR), and Flight Training Scholarship for Commercial MultiEngine 	<ul style="list-style-type: none"> • Transportation related courses offered by faculty (15) • Number of faculty members in transportation areas (4) • Number of students participating in CAMMSE funded projects (9) • Number of transportation related degree programs with students funded by CAMMSE (2) • Number of seminars (6) • Number of student scholarships or awards (4)
<p>4. Technology Transfer</p>	<ul style="list-style-type: none"> • Technical reports: <ol style="list-style-type: none"> 1. Studying the Impact of Pandemic Outbreaks on Maritime Transportation and Port Operation 2. Short Term Intersection Traffic 	<ul style="list-style-type: none"> • Number of peer-reviewed journals (7) • Number of conference papers (8) • Number of technical research reports published



	Flow Forecasting 3. The impacts of COVID-19 on Public Transit	(3)
5. Collaboration	<ul style="list-style-type: none">• City of Houston, METRO• Collaborated with several universities to develop new proposals• Center personnel: Drs. Yi Qi, Lei Yu, Mehdi Azimi	<ul style="list-style-type: none">• Number of collaborative partners (2)• Number of Center personnel involved (3)





**Center for Advanced Multimodal Mobility
Solutions and Education**