CAMMSE

2019 CAMMSE Research Symposium

FINAL PROGRAM

November 7-8, 2019

Charlotte, NC, USA

Center for Advanced Multimodal Mobility Solutions and Education

A Consortium of Five Universities:

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

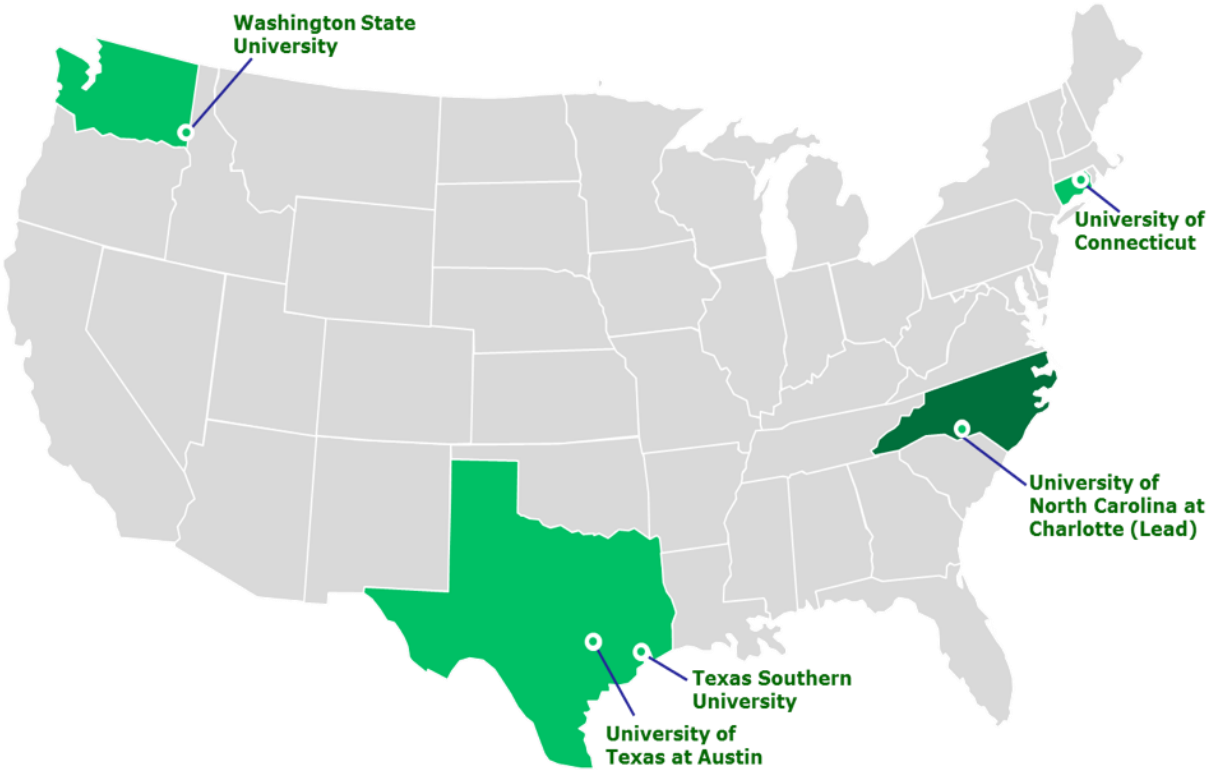

Table of Contents

Welcome Message from CAMMSE Director

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

This booklet provides the symposium program and general information we hope is useful during your visit. We have two outstanding keynote lectures. The morning keynote is on "Role of Computer and Data Sciences in Defining the Present and Future of Transportation Engineering" by Dr. Amit Bhasin of The University of Texas at Austin. And a lunch keynote lecture on "The Intersection of Innovation – How Academia, Government and the Private Sector Work Together to Advance Transportation?" by Mr. Neil Mastin of North Carolina Department of Transportation. The one and a half day program also includes two technical sessions and a workshop. On the first day, the morning session will be on emerging technologies and advanced models for advancing transportation planning, operations and management, and the afternoon session will focus on improving multimodal mobility. In addition the program will include a graduate student poster session in the afternoon where we hope students and faculty can engage in productive discussions with positive feedback to our students. On the second day, we will have a workshop entitled "Developing A Systematic Method for Identifying and Ranking Freeway Bottlenecks Using Vehicle Probe Data". All keynote presentations, technical sessions and workshop will offer Professional Development Hours (PDHs).

In closing, I hope that this event will provide an opportunity to exchange ideas, foster collaborations, and generate new ideas. Participants from industry and the government are highly encouraged as they will further enable opportunities for technology transfer. On behalf of the symposium organizing committee, we are glad to see that you are here and I hope that you will enjoy this symposium and what this great city has to offer. Thank you very much and again, welcome to the beautiful Queen City!

Sincerely,

Wei (David) Fan

Symposium Planning Committees

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

Organizing and Planning Committee:

Dr. Wei Fan, UNC Charlotte

Dr. Martin Kane, UNC Charlotte

Dr. David Weggel, UNC Charlotte

Ms. Kim Wilson, UNC Charlotte

Poster Session Committee:

Dr. Wei Fan, UNC Charlotte

Dr. Martin Kane, UNC Charlotte

Dr. David Weggel, UNC Charlotte

Workshop Committee:

Dr. Wei Fan, UNC Charlotte

Dr. Martin Kane, UNC Charlotte

Social and Catering Committee:

Dr. Wei Fan, UNC Charlotte

Ms. Kim Wilson, UNC Charlotte

Second Annual CAMMSE Research Symposium - FINAL PROGRAM

Day 1: Thursday, November 7 (8:00AM-6:00PM) – At ***UNC Charlotte, Center City***

7:45-9:00AM	**Registration** (Registration desk located first floor of UNCC Center City)
8:00-9:00AM	**Continental Breakfast** (*Atrium* located 2nd floor of UNCC Center City)
8:40-9:00AM	**Welcome Ceremony** (*Lecture Hall,* 2nd Floor UNCC Center City Bldg.) Moderator: Dr. Wei Fan 8:40-8:50 Dr. John Daniels, Chair, Department of Civil and Environmental Engineering, UNCC 8:50-9:00 Dr. Wei Fan, CAMMSE Director
9:00-10:00AM	**Keynote Presentation No. 1** (*Lecture Hall*, Moderator: Dr. Wei Fan) Title: **"Role of Computer and Data Sciences in Defining the Present and Future of Transportation Engineering"** Speaker: **Dr. Amit Bhasin**, The University of Texas at Austin
10:00-10:30AM	Coffee Break (*Atrium*)
10:30-11:50AM	**Technical Session #1: *Advancing Transportation Planning, Operations and Management: Emerging Technologies and Advanced Models*** *Moderator: Dr. David Weggel (Lecture Hall)* "Work Zone Road User Cost Estimation" Speaker: Randy Machemehl, Ph.D., University of Texas at Austin "Optimal Variable Speed Limit Control in Connected Autonomous Vehicle Environment for Relieving Freeway Congestion" Speaker: Wei (David) Fan, Ph.D., P.E., University of North Carolina at Charlotte "IEA: Inner Ensemble Average Within a Convolutional Neural Network" Speaker: Claudel Christian, Ph.D., University of Texas at Austin "Connected Infrastructure for Enhanced Winter Roadway Maintenance Operations: Current Practices and Potential Opportunities" Speaker: Xianming Shi, Ph.D., P.E, Washington State University
11:50-Noon	**Break** (Transition to lunch)
Noon-1:30PM	**Lunch** (Served at *Atrium*)
12:30-1:30PM	**Lunch Keynote Presentation** (*Lecture Hall*, Moderator: Dr. Wei Fan) Title: **"The Intersection of Innovation – How Academia, Government and the Private Sector Work Together to Advance Transportation?"** Speaker: **Mr. Neil Mastin**, North Carolina Department of Transportation
1:30-3:00PM	**Student Research: Poster Presentations (***Atrium and Mezzanine*) (Coordinator: Dr. Wei Fan) (*See Poster section in Page 18 of this booklet for more information on poster titles. For poster abstracts see pages 19 to 28.*).

Day 1 (Continued):

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

3:00-4:20PM **Technical Session #2: *Improving Multimodal Mobility***
(*Moderator: Dr. Martin Kane) (Lecture Hall)*

"Connecting Affordable Housing to Basic Services with Public Transportation"
Speaker: Nicholas E. Lownes, Ph.D., P.E., University of Connecticut

"Methods for Identifying Truck Crash Hotspots"
Speaker: Yi Qi, Ph.D., Texas Southern University

"Highways and Wealth Distribution: A Geospatial Analysis"
Speaker: Jeffrey P. Cohen, Ph.D., University of Connecticut

"Impact of Different Attributes on Bicycling Mode Share in Houston"
Speaker: Mehdi Azimi, Ph.D., P.E., Texas Southern University

4:30-6:00PM **Reception** (*Atrium and Mezzanine*)
Note: Announcement of Student Poster Awards (Top 3) will be made during the reception.

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

Notes:
- Attendees are encouraged to explore and dine in "Uptown" Charlotte.
- Entertainment options are provided on Page 8.
- End of Day 1 marks the end the research component of the CAMMSE Research Symposium. Workshop will be offered in Day 2.

Day 2: Friday, November 8 (8:00AM-2:30PM) – At ***UNC Charlotte, Center City***

8:00-9:00AM **Continental Breakfast** (*Atrium* located 2nd floor of UNCC Center City)

9:00-10:30AM **Executive Meeting** (Closed meeting, CAMMSE members only)

9:00-9:15	CAMMSE Vision and Past Research Activities (Wei Fan)
9:15-9:55	CAMMSE Site Reports (10 minutes each)
9:55-10:05	FY20 Call for Proposals, Current Status, Future Research Direction (Wei Fan)
10:05-10:25	Discussions (All)
10:25-10:30	Date for 3rd CAMMSE Research Symposium (All)

10:30-11:00AM **Coffee Break** (*Atrium*)

11:00-Noon Workshop: "**Developing A Systematic Method for Identifying and Ranking Freeway Bottlenecks Using Vehicle Probe Data**"
Speaker: Wei (David) Fan, Ph.D., P.E., University of North Carolina at Charlotte

Noon-1:00PM **Lunch** (Served at *Atrium*)

1:00PM Conference Ends

Entertainment Options:

1. NBA Game: Boston vs. Charlotte at 8:00 PM
   Spectrum Center, Uptown Charlotte, 333 E Trade St, Charlotte, NC
2. THE FRITZ, 9:00 – 11:30 PM
   Free Range Brewing, 2320 N Davidson St, Charlotte, NC
3. QC Social Thursdays- FREE ALL NIGHT!, 10:00 PM
   Alleyway entrance, 300 North College Street, ##105, Charlotte, NC
4. Fall Choral Concert, 7 PM
   Belk Chapel, 2234 Radcliffe Ave, Charlotte, NC
5. MUSIC BINGO! at TGIFRIDAY'S - STEEL CREEK in Charlotte, 7 PM
   TGI Fridays, 12811 S Tryon St, Charlotte, NC
6. Nick Nace and Jon Latham, 7:30 – 9:30 PM
   The Evening Muse, 3227 N Davidson St, Charlotte, NC
7. Matthew Postle, 7:15 – 10:00 PM
   Middle C Jazz, 300 S Brevard St, Charlotte, NC
8. CONTRA-TIEMPO'S "joyUS justUS", 7:30 PM
   Belk Theater at Blumenthal Performing Arts Center, 130 N Tryon St, Charlotte, NC
9. Featherpocket in Charlotte, 8 PM
   Skylark Social Club, 2131 Central Ave, Charlotte, NC
10. Opera Carolina: MacBeth, 10:30 PM
    Belk Theater at Blumenthal Performing Arts Center, 130 N Tryon St, Charlotte, NC
11. SiriusXM Coffeehouse Tour featuring JOSHUA RADIN, 7:30 PM
    McGlohon Theater at Spirit Square, 345 N College St, Charlotte, NC
12. Jazzin' & Bluzin' With the Seniors, 10:30 AM – 11:59 PM
    Southview Recreation Center, 1720 Vilma St, Charlotte, NC
13. Color of Jazz - Nicci Canada sings Dinah Washington, 6:30 – 8:00 PM
    Mallard Creek Recreation Center, 2530 Johnston Oehler Rd, Charlotte, NC
14. Indianola, 8 – 11 PM
    Neighborhood Theatre, 511 E 36th St, Charlotte, NC
15. Wreckless Eric in Charlotte!, 8 – 11 PM
    Petra's, 1919 Commonwealth Ave, Charlotte, NC
16. World of Outlaws World Finals, 6 PM
    Charlotte Motor Speedway, 5555 Concord Pkwy S, Concord, NC
17. NASCAR Hall of Fame, 10:00 AM – 6:00 PM, Both Days
    400 E M.L.K. Jr Blvd, Charlotte, NC 28202

2019 CAMMSE RESEARCH SYMPOSIUM - KEYNOTE SPEAKERS:

Keynote No. 1: Thursday November 7, 9:00 - 10:00 AM (*Lecture Hall, UNCC Center City*)

Dr. Amit Bhasin, The University of Texas at Austin
Title: *"Role of Computer and Data Sciences in Defining the Present and Future of Transportation Engineering"*
Moderator: Dr. Wei Fan, UNC Charlotte

Abstract: Significant and rapid advances in computer and data sciences have provided a new arsenal of tools for engineers to enhance the current practice and define the future of transportation engineering. This talk will present a few examples that reflect the role of computing and data analytics on the changing face of transportation engineering. This talk will also discuss some future implications of such technologies.

Speaker Bio: Prof. Bhasin is a Temple Foundation Endowed Fellow in the Department of Civil, Architectural, and Environmental Engineering at The University of Texas at Austin. He is also the Director of the Center for Transportation Research (CTR), which is multi- and inter-disciplinary center that conducts research on all aspects of transportation. He has an active research program in the area of pavements and materials supported by a range of private and public agencies from within and outside of the United States. He is involved in several national and international organizations and committees pertaining to research in the area of pavements and materials. He is a founding member and the Past President for the Academy of Pavement Science and Engineering, which is an international body of academics in this area. His research and teaching have been recognized through several prestigious awards and honors.

Keynote No. 2 (Lunch Presentation): Thursday Nov. 7, 12:30 - 1:30 PM (*Lecture Hall, UNCC Center City*)

J. Neil Mastin, PE, CPM, NCDOT Research and Development Manager
Title: "*The Intersection of Innovation – How Academia, Government and the Private Sector Work Together to Advance Transportation*?"
Moderator: Dr. Wei Fan, UNC Charlotte

Abstract: State Transportation Agencies (STAs) occupy a strategic location in the world of Transportation Research. These agencies act as coordinators between their own activities, universities, the federal government, private sector companies and national research bodies. STAs fund research, consume research, and most importantly implement research. Receiving the maximum benefit from research programs requires a constant and dedicated effort and focused communications. This presentation will discuss how NCDOT interacts with our research partners at all levels, including a focus on identifying high value research ideas, engaging our workforce in research efforts, and putting quality results into practice.

Speaker Bio: Neil Mastin is the Manager of the NCDOT Research and Development Office. This office oversees an annual research program of more than $8 million. The research program provides access to cutting edge university and national resources to the wider NCDOT community. As the agency AASHTO Research Advisory Committee member and Transportation Research Board (TRB) representative, he coordinates NCDOT activities with TRB, the National Cooperative Highway Research Program (NCHRP), Transportation Pooled Funds and other national programs. Under his leadership, the R&D Office has placed renewed emphasis on implementation of research innovations, including a formalized Technology Transfer Program. Mr. Mastin has a background in Pavement Design and Asset Management. In previous roles, he oversaw a technology improvement program that included the implementation of a new, web-based Pavement and Asset Management System and the use of automated and tablet-based pavement and inventory data collection. Mr. Mastin has co-authored several papers on the practical use of pavement management data and is active in several TRB and AASHTO committees. He is a graduate of the University of Oklahoma, obtaining a Bachelor's in Civil Engineering and NC State University, receiving a Master's in Civil Engineering with a transportation materials focus. He has worked with NCDOT since 1998.

TECHNICAL SESSIONS & ABSTRACTS FOR FACULTY PRESENTATIONS:

Technical Session #1: (Lecture Hall, UNCC Center City) - November 7, 10:30-11:50AM
Advancing Transportation Planning, Operations and Management: Emerging Technologies and Advanced Models

10:30 – 10:50 AM:
Work Zone Road User Cost Estimation
Speaker: Randy Machemehl, Ph.D., University of Texas at Austin
Abstract Page 10

10:50 – 11:10 AM:
Optimal Variable Speed Limit Control in Connected Autonomous Vehicle Environment for Relieving Freeway Congestion
Speaker: Wei (David) Fan, Ph.D., P.E., University of North Carolina at Charlotte
Abstract Page 11

11:10 – 11:30 AM:
IEA: Inner Ensemble Average Within a Convolutional Neural Network
Speaker: Claudel Christian, Ph.D., University of Texas at Austin
Abstract Page 12

11:30 – 11:50 AM:
Connected Infrastructure for Enhanced Winter Roadway Maintenance Operations: Current Practices and Potential Opportunities
Speaker: Xianming Shi, Ph.D., P.E, Washington State University
Abstract Page 13

Technical Session #2: (Lecture Hall, UNCC Center City) - November 7, 3:00-4:20PM
Improving Multimodal Mobility

3:00 – 3:20 PM:
Connecting Affordable Housing to Basic Services with Public Transportation
Speaker: Nicholas E. Lownes, Ph.D., P.E., University of Connecticut
Abstract Page 14

3:20 – 3:40 PM:
Methods for Identifying Truck Crash Hotspots
Speaker: Yi Qi, Ph.D., Texas Southern University
Abstract Page 15

3:40 – 4:00 PM:
Highways and Wealth Distribution: A Geospatial Analysis
Speaker: Jeffrey P. Cohen, Ph.D., University of Connecticut
Abstract Page 16

4:00 – 4:20 PM:
Impact of Different Attributes on Bicycling Mode Share in Houston
Speaker: Mehdi Azimi, Ph.D., P.E., Texas Southern University
Abstract Page 17

Work Zone Road User Cost Estimation

Technical Session #1: Advancing Transportation Planning, Operations and Management: Emerging Technologies and Advanced Models

10:30 – 10:50 AM - Speaker: Randy Machemehl, Ph.D., University of Texas at Austin

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Abstract:
Work zones on public roads typically cause negative mobility impacts to road users. Many roadway construction projects utilize the design-bid-build project delivery method, and time-sensitivity often necessitates use of additional contracting strategies, such as incentives for early completion and/or disincentives for late completion. Often the bid is modified from being cost alone to cost plus time. The economic predicate on which these strategies depend is broadly termed "road user costs" (RUC) consisting of travel delay costs and vehicle operating costs. Determining RUC for a project, or a project phase can be challenging due to limited traffic data availability, incomplete plans, and limited time to conduct the analysis. This paper describes a procedure to allow estimation of RUC, such as daily travel time, using peak-hour values and the fraction of the daily value that occurs during the peak-hour. Eleven construction cases are examined using CORSIM and VISSIM producing RUC's for each hour of a typical 24-hour day and fractions of the daily travel time are computed. For the case study, the arithmetic mean of peak-hour travel time as a fraction of the daily value is 8.2 percent. Relationships are developed to predict daily total travel time using the peak-hour fraction of daily traffic volume and the number of inbound lanes serving traffic, a surrogate for capacity. Due to concerns of heteroskedasticity, predictive models are developed using logarithmic and Box-Cox transformations.

Optimal Variable Speed Limit Control in Connected Autonomous Vehicle Environment for Relieving Freeway Congestion

Technical Session #1: Advancing Transportation Planning, Operations and Management: Emerging Technologies and Advanced Models

10:50 – 11:10 AM - Speaker: Wei (David) Fan, Ph.D., P.E., University of North Carolina at Charlotte

Authors:

Wei (David) Fan, Ph.D., P.E., **(Corresponding Author)**
Director of USDOT Center for Advanced Multimodal Mobility Solutions and Education (CAMMSE), Professor, Department of Civil and Environmental Engineering, University of North Carolina at Charlotte, 9201 University City Blvd., Charlotte, NC 28223.
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Abstract:
This study presents an optimal variable speed limit (VSL) strategy in a connected autonomous vehicle (CAV) environment for a freeway corridor with multiple bottlenecks. The VSL control was developed by using an extended cell transmission model (CTM) which takes into account capacity decrease and mixed traffic flow, including traditional human-driven cars and heavy vehicles, and autonomous vehicles (AVs). A multiple-objective function was formulated which aims to improve the operational efficiency and smooth the speed transition. A genetic algorithm (GA) was adopted to solve the integrated VSL control problem. A real-world freeway stretch was selected to test the designed control framework. Sensitivity analyses were performed to investigate impacts of both the penetration rate of CAVs and communication range. Simulation performances demonstrated that the developed VSL control not only improves the overall efficiency but also reduces tailpipe emission rate. Simulation results also showed that the VSL control integrating vehicle-to-vehicle (V2V), vehicle-to-infrastructure (V2I), and infrastructure-to-vehicle (I2V) communication outperforms the VSL control only. In addition, as the penetration rate of CAVs increases, better performance can be achieved.

IEA: Inner Ensemble Average Within a Convolutional Neural Network

Technical Session #1: Advancing Transportation Planning, Operations and Management: Emerging Technologies and Advanced Models

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

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Abstract:
Ensemble learning is a method of combining multiple trained models to improve model accuracy. We propose the usage of such methods, specifically ensemble average, inside Convolutional Neural Network (CNN) architectures by replacing the single convolutional layers with Inner Average Ensembles (IEA) of multiple convolutional layers. Empirical results on different benchmarking datasets show that CNN models using IEA outperform those with regular convolutional layers. A visual and a similarity score analysis of the features generated from IEA explains why it boosts the model performance.

Ensemble learning is the method of combining multiple models trained over the same dataset or a random set of datasets to improve the model performance. The methods of ensemble have been widely used in deep learning to improve the overall model accuracy. Combining neural networks in ensemble is known to reduce the variance in prediction, in other words, it helps the network to generalize more than the usage of one network. Convolutional Neural Networks (CNNs) are extremely successful architectures that are widely used in different areas such as computer vision, text analysis and even general temporal sequence problems. One important feature of convolutional layers that the weights are shared for creating the features. By having this feature of shared weights, convolutional layers do not strongly contribute to the total parameter size of the deep model unlike the contribution of the fully connected layer. In this work, we show empirically, visually and through similarity score analysis that replacing ordinary convolutional layer by an Inner Ensemble Average (IEA) of convolutional layers in a CNN can reduce the variance of this model. We propose it as a convenient technique to improve the performance of CNN predictive models. We developed this method in order to improve the performance of CNNs used in pedestrian trajectory prediction. Having less variance in our estimation is quite crucial as pedestrian motion is sophisticated and CNNs have a strong tendency to overfit.

Connected Infrastructure for Enhanced Winter Roadway Maintenance Operations: Current Practices and Potential Opportunities

Technical Session #1: Advancing Transportation Planning, Operations and Management: Emerging Technologies and Advanced Models

11:30 – 11:50 AM - Speaker: Xianming Shi, Ph.D., P.E, Washington State University

Authors:

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Abstract:
Up to 50% of the Northern Hemisphere across the world is snow covered during winter, and short-term weather anomalies and long-term effects of climate change influence snow cover distribution, duration, and amount. In the U.S., more than 70 percent of the roads and approximately 70 percent of the population are located in snowy regions. The existing transportation infrastructure system is vulnerable to extreme weather events which are becoming more frequent. The transportation agencies are under increasing pressure to conduct their winter roadway maintenance (WRM) operations in a cost-effective, socially responsible, and environmentally conscious manner.

In this context, this talk will review the current practices of WRM operations, with a focus on those that are already or potentially associated with connected infrastructure (CI) technologies and would enable reduced usage of snow and ice control materials. These practices include: 1) appropriate design of roadway and snow fences for snowdrift control, 2) fixed automated spray technology, 3) pavement sensors and thermal mapping, 4) smart snowplows and on-board sensors, 5) enhanced weather forecasts for WRM operations, and 6) Maintenance Decision Support System (MDSS). The talk will conclude with a discussion of potential opportunities where CI technologies may make a positive impact on the WRM operations.

Connecting Affordable Housing to Basic Services with Public Transportation

Technical Session #2: Improving Multimodal Mobility

3:00 – 3:20 PM - Speaker: Nicholas E. Lownes, Ph.D., P.E., University of Connecticut

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Abstract:
For households near or below the poverty line the financial burden of owning multiple vehicles is significant. In areas with limited alternative mobility options, owning multiple vehicles is often the only way for household members to access basic services such as food, jobs, medical facilities, schools and government services. Members of these households may need to work additional jobs to afford the vehicles, pulling them away from time with families – which has broad societal consequences. This research sought to measure the accessibility of basic services via public transit in the Hartford metropolitan region, with the hypothesis that by investing in affordable housing in these areas, these households could afford to own fewer vehicles and thereby experience less financial strain. Conversely, this work identified areas with poor access and existing affordable housing units that needs additional transit service investment. The research team partnered with the Partnership for Strong Communities (PSC), a statewide non-profit policy and advocacy organization dedicated to ending homelessness and expanding the creation of affordable housing. PSC led efforts in the application of metrics to housing analysis and the development of policy recommendations based on the findings of the study.

Methods for Identifying Truck Crash Hotspots

Technical Session #2: Improving Multimodal Mobility

3:20 – 3:40 PM - Speaker: Yi Qi, Ph.D., Texas Southern University

Authors:

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Abstract:
Detecting hot spots where crashes occur is an effective way to identify the factors that cause the crashes in order to develop strategies for preventing such crashes. The goal of this study was to develop a new method for identifying the actual risky spots by using the Geographic Information System (GIS) method. For this purpose, in this study, three different methods for detecting hot spots are proposed, i.e., 1) Annual Average Daily Traffic (AADT) normalization method that considers both the frequency of crashes and the ADDT on a segment of the roadway; 2) AK percentage method that considers both crash frequency and percentage of severe level crashes (AK crashes, where A is incapacitating crash and K is fatal crash); and 3) Distribution difference method that is based on the difference between the distribution of AK crashes and the distribution of all of the crashes. To evaluate the performances of these three hot-spot detection methods along with a baseline method that only considered the frequency of crashes, we applied these three methods to identify the top 20 hot spots for truck crashes in two representative areas in Texas, i.e., the Houston-Galveston Area and the Eagle Ford Shale area in South Texas. The results indicated that 1) all three proposed methods produced more reasonable results than the baseline method and 2) the "distribution difference" method outperformed the other methods.

Highways and Wealth Distribution: A Geospatial Analysis

Technical Session #2: Improving Multimodal Mobility

3:40 – 4:00 PM - Speaker: Jeffrey P. Cohen, Ph.D., University of Connecticut

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Abstract:
Highways have changed America's land use patterns, affected travel behavior, shaped domestic and international trade, and influenced the development of the manufacturing sector, as well as other industries. The magnitude of highway investment economic impacts remains subject to significant debate because of a great deal of variance in the estimates of the impacts. But relatively little research has been published on the effects of the introduction of the U.S. interstate highway system on household-level real estate values. A major focus of this research is to leverage geospatial analysis to assess the net benefits households have received from living near highways (which may be positive or negative). Housing is the largest expenditure item for many American households, and it is one of the major mechanisms for households to accumulate wealth. The introduction of new highways can substantially change land use patterns and the values of real estate nearby. Geospatial analyses are crucial tools to examine highways, land use, and wealth distribution.

This study first develops an extensive dataset of nearly 2,500 residential properties in the City of Hartford that sold in the 1960's (after the development of the two major interstates, I-84 and I-91) and matched the data for each of these properties to the corresponding property in the 1940 U.S. Census. So for each property address, there are 2 observations on that property's estimated value – one before the development of the interstate highway system (in 1940) and one after the opening of the two major interstate highways that run through Hartford. After geocoding these properties, several geospatial maps are developed, demonstrating how the changes in values in these properties over time are different in various parts of the city. Included among these maps is one showing properties that appreciated and one showing dollar ranges for residential property appreciation. While some patterns are evident from visual inspection of these maps, a more rigorous analysis using multiple regression analysis finds the following. First, properties closer to the nearest exit of I-84 have experienced appreciation between 1940 and the 1960's. Second, proximity to the nearest point on the highway (opposed to the nearest exit) leads to lower appreciation in property values, likely because of noise and air pollution. Next, properties that were worth more in 1940 actually appreciated less between the period of 1940 and the 1960's, after controlling for highway proximity and drive time to the highway. Finally, the racial composition of the Census tract in 1940 had no significant effect on individual property value appreciation between 1940 and the 1960's.

Impact of Different Attributes on Bicycling Mode Share in Houston

Technical Session #2: Improving Multimodal Mobility

4:00 – 4:20 PM - Speaker: Mehdi Azimi, Ph.D., P.E., Texas Southern University

Authors:

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Abstract:
The role of cycling in city transportation systems has gain increasing attention in the recent years with the initiation of increasing cycle usage, improving the first mile/last mile connection to other modes of transportation, and lessening the environmental impacts of transportation activities. Houston implemented its public bike share system in May 2012, and the system has experienced major increase in ridership and users since the last seven years. Therefore, there was a need to examine the users' activities and investigate the impacts of different attributes on the bike share usage. This study investigated the effects of built environment and temporal characteristics on a station-level hourly ridership. The ridership data and also the data for the weather and built environment information were collected from various sources. A regression model was used to evaluate the effects of the attributes on the hourly bicycle checkouts and returns at each bike share station.

POSTER SESSION & ABSTRACTS FOR POSTER PRESENTATIONS:

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

Posters will be judged by at least 3 judges using posted rubric. People who are interested in serving as a judge are encouraged to contact Dr. Wei Fan at wfan7@uncc.edu.

ID	Authors	Title	Institution
P01	Zhen Chen, and Wei Fan	Use of Multisensor Data in Modeling Freeway Travel Time Prediction	University of North Carolina at Charlotte
P02	Yang Li, and Wei Fan	Using General Transit Feed Specification (GTFS) Data as a Basis for Evaluating and Improving Public Transit Equity	University of North Carolina at Charlotte
P03	Patrick Toman, Jingyue Zhang, Nalini Ravishanker, and Karthik C. Kondurl	Dynamic Predictive Models for Ridesourcing Services in New York City Using Daily Compositional Data	University of Connecticut
P04	Chuang Chen, and Xianming Shi	Applying ANN Models for Mobility Benefits Analysis of Winter Maintenance Operations on Washington Highways	Washington State University
P05	Hao Liu, Christian Claudel, and Randy Machemehl	A Robust Control Method for Highway Networks Based on a First Order Macroscopic Traffic Flow Model	The University of Texas Austin
P06	Hasin Fahad Jinna, Tao Tao, Qun Zhao, Yi Qi, and Mehdi Azimi	Countermeasures for Reducing Truck Congestion at Marine Terminals	Texas Southern University
P07	Zijing Lin, and Wei Fan	Modeling Bicycle Volume Using Crowdsourced Bicycle Data from Strava	University of North Carolina at Charlotte
P08	Mohammed Suyedur Luqman Rahman, Yi Qi, and Mehdi Azimi	Houston Bike Share System and Equity Considerations for Underserved Communities	Texas Southern University
P09	Nicholas Lownes, Kelly Bertolaccini, and Rob Smith	Investigating the Linkage Between Transit Access to Services and Affordable Housing Availability	University of Connecticut
P10	Pengfei Liu, and Wei Fan	Exploring the Impact of Connected and Autonomous Vehicles on Freeway Capacity Using Microscopic Traffic Simulation	University of North Carolina at Charlotte

See Abstracts for posters in Pages 19 through 28.

Abstracts for Poster Presentations:

Poster P01:

Use of Multisensor Data in Modeling Freeway Travel Time Prediction

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Abstract:
Nowadays anonymous vehicle probe data have been greatly improved in both data coverage and data fidelity. Thus, vehicle probe data have become a reliable source for freeway travel time analysis. travel time prediction plays a significant role in traffic data analysis and applications as it can assist in route planning and reducing traffic congestion. With the development of artificial intelligence technologies, various novel prediction methods have been developed accordingly in recent years. Machine learning is an example of a data driven method which aims to increase efficiency and accuracy of predictions. Recently, different machine learning-based approaches, such as neural network, ensemble learning, and support vector machines, have been employed by the researchers and the results indicate that such approaches for prediction are adaptable and can give better performances than traditional models.

This research is intended to employ an advanced machine learning-based approach (i.e. XGBoost model) to predict the freeway travel time. Detailed information about the input variables and data pre-processing is presented. Parameters of the XGBoost model are introduced and the parameter tuning process is also discussed. The relative importance of each variable in the model is presented and interpreted. Optimized modeling result of the proposed XGBoost travel time prediction model is evaluated and compared with those of the gradient boosting model. The results also demonstrate that the developed XGBoost travel time prediction model significantly improves the computation accuracy and efficiency. Summary and conclusions of the whole study are made, and further research directions are given at the end of study.

Poster P02:

Using General Transit Feed Specification (GTFS) Data as a Basis for Evaluating and Improving Public Transit Equity

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Abstract:
As a critical part of economic and social fabric of metropolitan areas, public transit is necessary to provide mobility for users. A crucial task of transit planning is to better assess the equity and accessibility of public transit and it is still challenging due to many types of barriers (including spatial, temporal, financial, and social, etc.), all of which can limit accessibility. Meanwhile, the development of General Transit Feed Specification (GTFS), a well formatted transit feeds open data, provides new opportunities for transit performance measurement, benchmarking and research, especially in the field of transit equity and accessibility assessment. However, the progress of studies combining those two together is still relatively slow and modest. To fill the research gap, the objective of this project is to bring GTFS data in for a better assessment of public transit equity and accessibility. A transit gap index is developed incorporated with GTFS data and a case study is conducted on the City of Charlotte. Based on the results, guidelines and recommend best practices for the use of GTFS data as a main data source are provided to better understand and assess public transit equity and accessibility for public transportation planning and operation.

Poster P03:

Dynamic Predictive Models for Ridesourcing Services in New York City Using Daily Compositional Data

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Abstract:
In recent years, there has been a momentous change in the market for shared ride modes such as subway systems and taxi services. Indeed, much of this disruption can be attributed to novel modes of shared ridership such as Uber and Lyft, companies collectively known as Transportation Network Companies (TNCs). Due to the nascency of these companies, there is a small but rapidly growing body of literature on the impacts these ridesharing services are having on traditional forms of shared ride modes, however, most of the emerging literature centers on the relationships between only two ride modes (e.g. TNCs and Public Transit). To address the sparsity of literature examining multiple ride modes simultaneously, we use a joint modeling framework to study New York City ridership data for TNCs, taxi services, bikesharing, and the subway from January 2015 to June 2018. The goal of our paper is two-fold: explore "substitutionary" and "complementary" dynamics between TNCs and other modes of shared ridership as well as to build a predictive model for the daily ridership counts for each modal offering and total daily ridership count. To accomplish these tasks, we first used a compositional time series approach in which the four series are modeled as proportions of total daily demand and then, after a suitable transformation, jointly modeled them via a vector auto-regression with exogenous predictors (VARX) to account for trend, a weekly seasonal structure, and exogenous predictors. The second part of our analysis involved modeling the daily total count of the four modes with a dynamic linear model (DLM) and then using that model to draw inferences about the total ridership in NYC. Results of the models are then combined to produce generate medium-term forecasts for each modal count. Our findings corroborate those of others which is that there appears to be a strong "substitutionary" relationship between TNCs and taxis as these ridesharing companies vie for the same consumer segment. In keeping with our second goal, this analysis demonstrates that our modeling framework is a useful forecasting tool for helping to develop informed transportation policy for large metropolitan areas in which there are several competing types of shared ride modes.

Poster P04:

Applying ANN Models for Mobility Benefits Analysis of Winter Maintenance Operations on Washington Highways

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Abstract:
Washington State Department of Transportation (WSDOT) maintains a network of more than 7,000 miles of state highways. Winter weather reduces both the average traffic speed and traffic volume, whereas the implementation of winter road maintenance (WRM) operations tends to mitigate such reductions. However, research is currently lacking in understanding the relationship between highway mobility and WRM operations, especially when it comes to the specific road weather scenarios in the Pacific Northwest.

This study explored the macroscopic effects of WSDOT winter road maintenance (WRM) operations on traffic mobility over a 20-mile segment on Washington Interstate highway I-5. Specifically, a substantial amount of historical data on WRM activities, macroscopic traffic parameters, and climatic conditions was collected, organized, normalized and coupled for modeling. The result demonstrated a strong correlation between Sf Status and the Friction Index with R-square of 0.8516. An empirical equation was developed, which could be used to fill the gaps of the missing Friction Index data for modeling purposes. Two multilayer feed-forward Artificial Neural Networks (ANNs) with a modified BP algorithm were extensively employed for Volume(0h) and Speed(0h). Volume(-1h), Speed(-1h), Maintenance(-1h), AirTemp, SfTemp, Accumulated Precip, Sf Status, and Friction Index were used for the model development and validation. Randomly selected datasets were used to train and test the ANN models. The learning process continued until the prediction error across all samples in the training data was minimized to a reasonable range or converge. The ANN models captured the hidden relationships under a hypothetical “no WRM” scenario. Hourly traffic volume and average traffic speed would drop an average value of 26.9% and 6.6% (or a median value of 17.2% and 8.1%), respectively, in the absence of WRM operations. An average value of 4.7% (or a median value of 8.8%) elimination in travel delay was quantified as the mobility benefits of WSDOT WRM operations.

Poster P05:

A Robust Control Method for Highway Networks Based on a First Order Macroscopic Traffic Flow Model

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Abstract:
Traffic control lies at the core of transportation engineering research because it serves as one of the most efficient practices for reducing traffic congestion. Challenges in modeling traffic control include uncertainty in the model parameters and traffic states, which in turn has given rise to modeling traffic control stochastically. Traffic flow has traditionally been modeled with deterministic Partial Differential Equations (PDEs), and a common way of dealing with uncertainty in the flow model is to add a stochastic term. However, adding stochastic terms is only appropriate for a short highway segment. In addition, to find the optimal solution, the PDEs are usually discretized into Ordinary Differential Equations (ODEs). Recently, a new control method that does not require any discretization or approximation has been proposed. This method shows that the traffic control problem can be posed as a Linear Programming (LP) problem, consequently this reduces computational complexity significantly over standard traffic control computational methods.

Using this framework as a building block, this study proposes a robust control model for highway networks by modeling the uncertainty in the initial density conditions using chance constraints. By assuming the initial densities are normally distributed, our model ensures the constraints are satisfied within a certain confidence level. Since Moskowitz solutions are monotone density functions, one can convert chance constraints to linearly deterministic constraints which can be solved quickly. We test the effect of this robust control model on both a single highway link and on a highway network. Compared to the classic method, our model is more adaptable to real-world applications therefore it can improve mobility significantly. In addition, we make approximations to convert the chance constraints to linear constraints. The accuracy of our model is demonstrated by Monte Carlo simulation and shows that the largest error among the tested scenarios is less than five percent.

Poster P06:

Countermeasures for Reducing Truck Congestion at Marine Terminals

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Abstract:
International trade and the volume of freight have been increasing over the past few decades, especially at U.S. marine terminals. Forecasts suggest that this growth will increase dramatically by 2020. Most of the goods arriving at and departing from marine terminals are carried by trucks, and this results in congestion inside the ports and at the gates of the marine terminals. Thus, there almost always are long lines of trucks at the gates waiting to enter and leave the terminals. Due to the increasing time that the trucks must wait, the areas become very congested, and, sometimes, the congestion even extends to the surrounding networks of roads. This situation seriously hampers the smooth operation of ports and other nearby businesses, resulting in huge economic losses. To address this problem, this study was conducted to identify the cost-effective countermeasures that can be used to reduce waiting times for trucks at marine terminals. At first, a thorough literature review was conducted. After that, surveys were conducted among the officials at the drayage companies and the truck drivers. Based on the results of the analysis of the surveys, feasible and cost-effective countermeasures/strategies for reducing truck congestion at marine terminals were recommended.

Poster P07:

Modeling Bicycle Volume Using Crowdsourced Bicycle Data from Strava

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Abstract:
Cycling, as a healthier and greener travel mode, has been encouraged for short-distance trips by city planners and policy makers. To map ridership, data including network characteristics, sociodemographic variables, time of day, day of week, etc. are quite indispensable. The methods for data collection are diverse. The most prevailing data collection method is crowdsoucing. This research will focus on evaluating the potential use of crowdsourced bike data and compare it with the traditional bike counting data which is collected in the City of Charlotte. Using the bike data from the Strava smartphone cycling application and from the bicycle count stations, the bicycle volume models will be developed. Based on the model evaluation results, a predictive model will be concluded, and a map illustrating the bicycle volume of most of the road segments in the City of Charlotte will be generated. In addition, to have a better understanding of the impact attributes on cycling, other supporting data are collected and combined with the Strava bicycle count data. An ordered probit model is developed to analyze the impact of variables on Strava bicycle count value. Finally, recommendations will be made to help improve the cycling environment and increase the bicycle volume in the future accordingly.

Poster P08:

Houston Bike Share System and Equity Considerations for Underserved Communities

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Abstract:
Public bike share systems have increased from operating in few European cities to expanding in North America at an increasing pace. Bike share equity is defined as providing equitable, fair and impartial access to bicycle station facilities for each section of the society. Houston bike sharing system (Houston BCycle) was launched in May 2012 with just 18 bikes at three stations, and has since expanded to 635 bikes at 99 stations. Despite the appeal and expansion of the system, there have been legitimate concerns that traditionally underserved communities are marginalized or incompetent to take the full advantages of existing and future bicycle oriented designing efforts. Research has shown that bike-share users tend to have higher incomes, be more educated, and be more often white than the general population. In this study, we first identified the existing programs provided by Houston bike share system that could bring low-income and underserved community closer to the system and draw them into the system quickly. Then, we investigated different types of equity barriers to underserved communities in Houston. Based on the barriers, we have recommended strategies to engage the underserved communities and make the bicycle share system more equitable.

Poster P09:

Investigating the Linkage Between Transit Access to Services and Affordable Housing Availability

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Abstract:
In the Greater Hartford region about 50% of travel trips are in single occupant vehicles and 4.5% of trips are via public transit (CRCOG, 2019a), so the transportation system is mostly optimized for personal vehicle travel. However, more than 10% of households in this region do not have a vehicle so there is likely an unmet need for viable alternatives to personal vehicle travel in the region. Affordable housing advocates in the Greater Hartford region are concerned that given the strong focus on personal vehicle travel in the area, transit dependent populations do not have adequate access to opportunities. It is known that accessibility is not always fully assessed in transit plans; instead less comprehensive measures are used that only capture mobility or proximity to service.

The overall goal of this project was to provide a more complete measure of access to policy makers in the region by focusing on access to specific destinations including schools and colleges, fresh grocery stores, healthcare facilities, and government services. Subsidized housing units were scored using a metric called the Transit Opportunity Index which factors in proximity of transit service, the frequency of the nearby service, and the travel time to desirable destinations using the transit network. This is the first time that this metric is utilized in this way, looking a specific origins and destinations. The results of this work will be shared with local affordable housing advocates to inform policymakers and promote the use of accessibility measures in funding decisions.

Poster P10:

Exploring the Impact of Connected and Autonomous Vehicles on Freeway Capacity Using Microscopic Traffic Simulation

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Abstract:
Connected and autonomous vehicle technologies are expected to change the driving behavior on freeway. This study investigates the impact of connected and autonomous vehicles on freeway capacity using VISSIM, a traffic microsimulation tool. A basic freeway segment is selected as the study area through the Caltrans Performance Measurement System (PeMS) located in the northwest Los Angeles. To obtain valid results, various driving behavior parameters are calibrated to the real traffic conditions for human-driven vehicles. After the calibration process, the simulation is conducted on the basic freeway segment under mixed traffic environment including regular human-driven vehicles and connected and autonomous vehicles. The results show that a lower penetration rate of connected and autonomous vehicles may have a negative impact on freeway capacity, while a higher penetration rate of connected and autonomous vehicles could increase the freeway capacity. The improvement of freeway capacity varies according to different connected and autonomous vehicles penetration rates.

Workshop: Friday, November 8, 11:00 – Noon

Developing A Systematic Method for Identifying and Ranking Freeway Bottlenecks
Speaker: Wei (David) Fan, Ph.D., P.E., University of North Carolina at Charlotte

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

2019 CAMMSE RESEARCH SYMPOSIUM – OTHER USEFUL INFORMATION:

UNC Charlotte Center City:
Day 1: November 7, 2019: Research Symposium, and
Day 2: November 8, 2019: CAMMSE Executive Meeting and Workshop:

320 E. 9th Street, Charlotte, NC 28202
http://centercity.uncc.edu

Walking distance from the Ninth Street Light Rail Station (Blue Line).
Parking requires a UNCC parking pass available for a nominal fee of about $5/day.
Location: **Point B** in Figure 1, below.

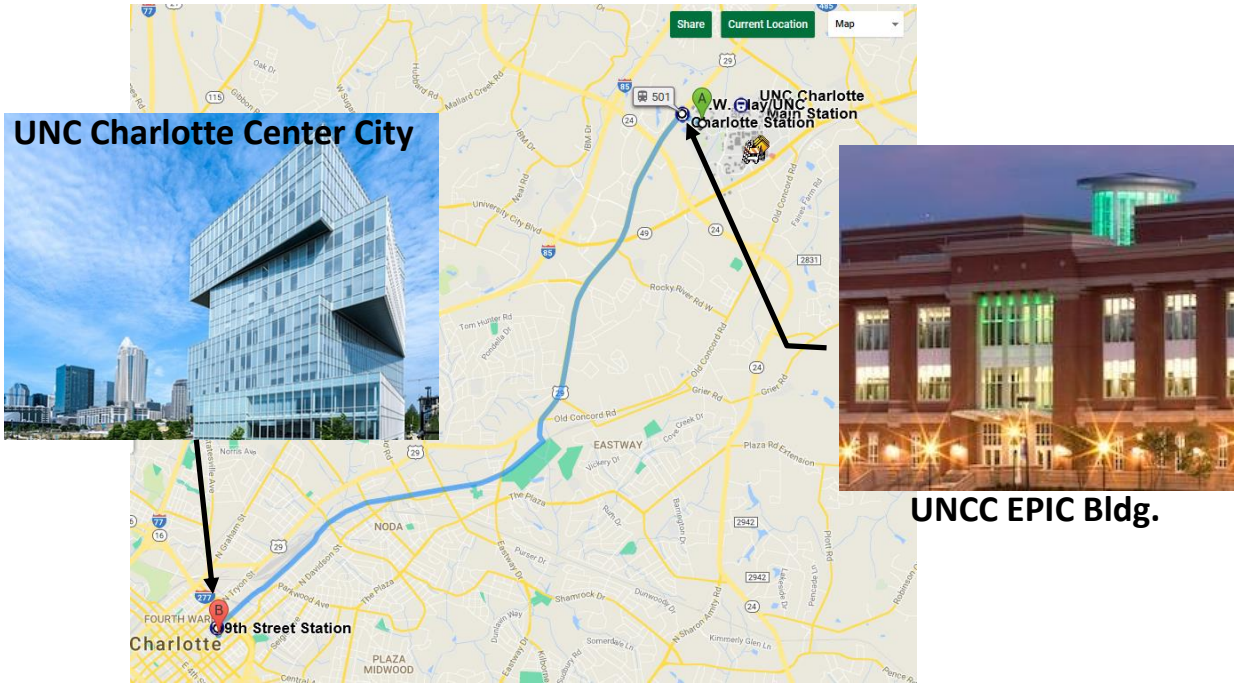

Figure 1 – UNCC and CAMMSE Research Symposium