

**Program Progress Performance Report  
for the  
New England University Transportation Center  
Massachusetts Institute of Technology**

**Federal Grant DTRT13-G-UTC31  
Grant Period: September 1, 2013 – September 30, 2019**

**Reporting Period: October 1, 2017 – March 31, 2018**

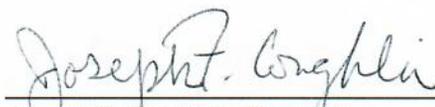
**Submitted to  
US Department of Transportation  
Office of the Assistant Secretary for Research and Technology (OST)  
April 27, 2018**

**Project Title**  
University Transportation Centers Program – Region 1

**DUNS number**  
00-142-5594

**EIN number**  
04-210-3594

**Recipient Account No**  
6928838



---

Joseph F. Coughlin, Director  
coughlin@mit.edu  
617.253.4978

Massachusetts Institute of Technology  
77 Massachusetts Avenue, E40-279  
Cambridge, MA 02139

## REPORTING CATEGORIES

### 1. Accomplishments

#### 1A. Research Projects

##### Major goals as stated in New England UTC Prospectus

##### Research Goal

- To conduct research in technology applications and systems integration with related work in policy, planning and human factors that improve transportation safety as well as further our understanding and realization of livable communities to support mobility across the lifespan.
- To support peer-reviewed investigations that address safety and livability by exploring and furthering research, policy, and practice in the application of ubiquitous intelligence, use of big data, and improved human performance

Following is the list of the 37 research projects under this grant, and their current status:

Project No.	PI	Project Title	Status
MITR25-1	Abou-Zeid Ben-Akiva	Capturing the Relationship between Social Interaction and Travel Behavior Using Smart Phones	active
MITR25-2	Caplice Caballero	High-Resolution Urban Freight Modeling in Cambridge, MA	completed
MITR25-3	Coughlin	Assessing Navigability and Livability of Public Transportation Systems	active
MITR25-4	Ellis Lavalliere	Transportation Workforce Health and Wellbeing	completed
MITR25-5	D'Ambrosio	Understanding the Adoption of and Education about New Auto Technologies among Older Adults	completed
MITR25-6	Frazzoli	Modeling the Impact of One-Way Car Sharing: An integrated data- and optimization-driven approach	completed

MITR25-7	Goentzel	Stochastic Analysis of Logistics Capacity in Disaster Response Networks	active
MITR25-8	Gonzalez	Coupled Mobility Networks: A Data Driven Approach	completed
MITR25-9	Isaacson	Out and About in New England: Maintaining Active Life styles in Later Life	completed
MITR25-10	Lee	Effectiveness of Various Information Channels on User Training and Learning in Automobiles	completed
MITR25-11	Osorio	Optimal Road Traffic Operations for an Increasingly Autonomous and Connected Vehicle Fleet	completed
MITR25-12	Pentland Shmueli	Incentivizing Safer Driving Using Peer-Pressure	completed
MITR25-13	Reimer Dobres	Assessing the Effect of Typography on In-Vehicle Glance-Like Reading Across the Lifespan	completed
MITR25-14	Salvucci Murga	MALL Transit and Wider Economic Benefit Assessment	completed
MITR25-15	Sussman	Hub Stations As Catalysts for Regional Growth: The Case of New York Penn Station	completed
MITR25-16	Trancik	From Trip Data to the Energy Requirements of Personal Vehicle Travel	active
MITR25-17	Zegras Pereira	Scenario Discovery for Resilient Urban Systems (or, The Future is "Big Data")	completed
MITR25-18	Zhao	Humanizing Travel: How E-hail Apps Transform Stakeholder Relationships in Taxi Services	completed

HVDR25-19	Glaeser	Transportation Stimulus Spending and Long Term Unemployment	completed
HVDR25-20	Gomez-Ibanez Fagan	The Experience with Managed Toll Lanes	active
HVDR25-21	Howitt	Recreating Livable Communities after Catastrophe: Managing the Recovery from Japan's Earthquake, Tsunami, and Nuclear Disaster of 2011	active
HVDR25-22	Mayne	The Politics of Transport Policy in the Greater Copenhagen Region, Part 2	active
HVDR25-23	Shoag	The Local Effects of the American Recovery and Reinvestment Act on Economic Activity and Traffic Safety	completed
UMAR25-24	Christofa Knodler	Operational and Emission Analyses of Roundabouts under Varied Vehicle and Pedestrian Demands	active
UMAR25-25	Fisher Knodler Zafian	Evaluating the Effect of Google Glass on Driver Distraction	active
UMAR25-26	Gao	Routing Policy Choice Models in Stochastic Time-Dependent Networks: The Stockholm Case Study	active
UMAR25-27	Gonzales	Route Choice in Congested Grid Networks	active
UMAR25-28	Knodler Fisher	A Driving Simulator Evaluation of Driver Distraction and Traffic Control Device Comprehension for At-Grade Railroad Crossings	active
UMAR25-29	Krishnamurty	An Innovative Design to Retrofit Seatbelts in Motorcoaches	active
UMAR25-30	Ni Wang	Supplementary Vehicle Positioning to Connected Vehicles	active
UCNR25-31	Atkinson-Palombo Garrick	A Multi-Scalar Model to Identify the Causes of Decreased Vehicle Miles Traveled (VMT) in the United States	completed

UCNR25-32	Garrick Atkinson-Palombo	Factors Contributing to the Decrease in Traffic Fatality Rates for Young People in America	completed
UCNR25-33	Ivan Ravishanker Townsend	Social Network Effects on Attitudes about Pedestrian Street Crossing Behavior	completed
UCNR25-34	Konduri Dalal	Exploration of Human Psychological Factors Underlying Mobile Phone Usage Behaviors while Driving	completed
UCNR25-35	Lownes	Clustering Algorithms for Transit Network Design	active
UMER25-36	Garder	Deficient Bridges and Safety Information	completed
UMER25-37	Rubin Garder	Automated Vehicles: Economic Incentives for Environmental Benefits and Safety	completed

### **Accomplishments under the New England UTC's research goal**

#### **Nicholas Fournier named 2017 Outstanding Student of the Year November 3, 2017**

Nicholas Fournier was awarded the 2017 UTC Outstanding Student of the Year Award by the New England University Transportation Center at MIT. He will receive \$1,000 plus the cost of attendance to the 2018 96th Annual TRB Meeting taking place in Washington, DC January 7-11, 2018. All of the national UTC award winners were honored at the 26th Annual Outstanding Student of the Year Awards ceremony, which took place as part of the CUTC annual banquet on January 6, 2018. Mr. Fournier was awarded the 2017 UTC Outstanding Student of the Year Award by the New England University Transportation Center at MIT for several reasons. His research, academic record, professional experience and student leadership in the field of transportation studies all contributed to make him the award-winning candidate.

#### **Project MITR25-7**

##### **Stochastic Analysis of Logistics Capacity in Disaster Response Networks**

The project has now fully commenced with the hiring of a postdoctoral associate. We have engaged stakeholders with the FEMA Logistics Management Directorate and they have provided data and collaboration in guiding development of decision support tools. We are also collaborating with a faculty member at Penn State University to enhance our previous model and have implemented Python code to prototype a new transportation portfolio feature. We have commenced discussions with the National Oceanic and Atmospheric Administration (NOAA) regarding data that could improve our forecasts. Additional model enhancements will be created in April and May, and preliminary solution analysis will occur in June and July.

### **Project MITR25-16**

#### **From Trip Data to the Energy Requirements of Personal Vehicle Travel:**

We continue to develop and apply TripEnergy—a model of personal vehicle energy consumption across the U.S. that is faithful to vehicle performance, individual driving patterns, and nationwide travel trends. We have finalized extending the energy model to allow it to estimate aggregate electricity demand from a fleet of electric vehicles, under different weather conditions, for different locations throughout the US, and given different charging behavior and access. We have further extended the functionality and selection of models available at our online tool, carboncounter.com. In particular, we launched a survey on the website in November 2017, aiming to gauge whether the website is influencing consumers' perceptions of different vehicle technologies (in particular, battery electric vehicles) and whether it has the potential to influence consumers' purchasing decisions. We completed the survey this week, collecting 300 responses.

### **Project HVDR25-21**

#### **Recreating Livable Communities after Catastrophe: Managing the Recovery from Japan's Earthquake, Tsunami, and Nuclear Disaster of 2011**

Investigators continued their analysis of data collected from fieldwork conducted during early phases of the project and tracked subsequent developments in Japan's recovery process through the review of media accounts, academic literature, and documentary sources. The investigators also continued to refine their research themes and findings through ongoing dialogue with contacts in the tsunami-affected town of Rikuzentakata, Japan, and at Iwate University in Morioka, Japan.

### **Project UMAR25-24**

#### **Operational and Emission Analyses of Roundabouts under Varied Vehicle and Pedestrian Demands**

During this reporting period, we developed a Cellular Automata (CA) model for a roundabout and one for the corresponding signalized intersection and validated it against a microsimulation model of the same roundabout and signalized intersection in Aimsun. We used these CA models to assess the impact of vehicle and pedestrian demand as well as left turning ratio on the operational and environmental performance of the roundabout and compare it against related measures at signalized intersections. The CA model tests results revealed that roundabouts are advantageous compared to signalized intersections in terms of both operational and environmental performance for a variety of vehicle and pedestrian demands as well as left turning ratios when operating in undersaturated traffic conditions. In addition, both the roundabout and signalized intersection result in steady increases in the performance measures as total vehicle demand increases.

### **Project UMAR25-26**

#### **Routing Policy Choice Models in Stochastic Time-Dependent Networks: The Stockholm Case Study**

An enhanced version of the adaptive route learning and choice model in a highly disrupted network was developed and tested using laboratory data. The learning model was based on sound psychological findings in terms of forgetting and reinforcement in declarative memory. It was found that learning is more prevalent when the uncertainty in the environment is reduced by traffic information. It is shown to be better than several baseline models that only account for inertia and/or immediate response to disruptions, in terms of both within-sample and out-of-sample fit.

### **Project UMAR25-27**

#### **Route Choice in Congested Grid Networks**

Efficient Frontier has broad applications for modeling heterogeneity and choices. An important outcome of this research project is the development of a method for modeling equilibrium conditions with heterogeneous users. Most equilibrium models in the literature rely on simplifying assumptions about user preferences such as treating all people as having identical preferences with respect to

travel decisions. The models developed in this study provide a way to characterize the collective decisions of populations of diverse individuals. Applications to modeling equilibrium in traffic networks, managing demand responsive transit systems, and developing customized traveler information systems. These contributions have been published in peer-reviewed journal papers.

### **Project UMAR25-29**

#### **An Innovative Design to Retrofit Seatbelts in Motorcoaches**

Toward the goals of advancing user performance with a focus on safety and economically competitive, yet livable communities, the project focused on the technology transfer of the invention that resulted from this research for potential implementation in the bus industry. To this end, this project progressed during this reporting period with research activities most vital to the successful achievement of these goals. Work in the past six months focused on technology transfer of the intellectual property developed by this research. The team filed a provisional patent application to protect innovations developed since the original patent application. A coauthor and presenter of our SAE conference paper is working with Central Institute of Road Transport (CIRT) in Pune, India to gain acceptance for seatbelt retrofits that are needed on an even greater scale in India. Toward that end, simulation was done to verify that occupant protection in head on frontal collisions exceeds requirements in India. Domestically, the team initiated an NDA and a field testing agreement with American Seating in Michigan. CAD models of the design were provided to American Seating and they plan to manufacture and test a prototype for potential Beta testing on a bus. American Seating is evaluating their interest level in purchasing a license of this technology from TTO. DATTCO expressed an interest in installing retrofits on buses after the product becomes available from a supplier, such as American Seating. The benefits of seat belt safety on buses were presented by our team at the Commercial Vehicle Safety Research Summit in October.

### **Project UMAR25-30**

#### **Supplementary Vehicle Positioning to Connected Vehicles**

We have completed literature review to understand vehicle positioning technologies in terms of major issues, challenges, practices, and lessons associated with vehicle positioning technologies and their suitability for connected vehicle applications. We have identified a few options of alternative vehicle positioning technologies. We gave consideration to their abilities to work independently on GPS, high reliability, low cost, and sufficient accuracy under all operational conditions. Radio-frequency identification (RFID) technology seems to fit our need best and will be pursued further. We have developed a scheme to evaluate the performance of the proposed vehicle positioning technology. Evaluation criteria include: accuracy, reliability, cost, and dependence on GPS. These criteria will be further elaborated and ideally a set of measures of effectiveness be devised to assess the performance of the proposed technology. We have designed a vehicle positioning system to detect and report the position of vehicles as they move through the detection zone at varying speeds. The design incorporates the following considerations: geographical area to be covered by the positioning system, the choice of sensors, detection zone configuration, and parts and materials needed in this design. We have gathered a list of inventory of materials needed in this design, vendors to purchase the necessary materials, locations that are possible to setup field experiments to test the design, and personnel needed in the coordination of field experiments. We have designed field experiments. This includes selection of test location, installation of sensors in the field and on vehicles, determination of data to collect, schedule of test runs, field test coordination, task assignment among personnel, etc. We have carried out field experiments according to the design in the previous steps, and collected field data as needed. The field data have been processed and analyzed. Measures of effectiveness were calculated and the result was compared against the criteria set forth in evaluation scheme developed in previous task.

### **Project UCNR25-34**

#### **Exploration of Human Psychological Factors Underlying Mobile Phone Usage Behaviors while Driving**

In an effort to better characterize and understand distracted driving behavior, this research explores emailing and social networks (Facebook, Twitter, Instagram, etc.) usage behaviors while driving. Utilizing the Theory of Planned Behavior (TPB) as the foundation, a nationwide survey was carried out to measure email and social network usage behaviors and the individuals' attitudes towards them. The survey was implemented in Qualtrics and participants were recruited from the pool of adults in the United States on the Amazon's Mechanical Turk platform. Complete responses were collected from 550 individuals. Results indicate that about 47% (259 respondents) at least occasionally email or access social networks while driving and 12.9% (71 respondents) indicate that they perform a target behavior for at least half of their trips. This work further contributes to the literature on distracted driving, in particular associated with email and social network usage behaviors. Furthermore, the underlying attitudes toward these behaviors can help inform decision-makers design effective policies to curb distracted driving behaviors.

### **Project UCNR25-35**

#### **Clustering Algorithms for Transit Network Design**

This research uses genetic algorithm (GA) to solve large instances of transit network design problems. Equity-based objective functions have been implemented into trial networks utilizing a new crossover paradigm within the GA. Solutions have been validated against existing designs and the performance of the algorithm suggests larger-scale implementations are feasible. Extensions to the project have investigated the use of optimization models to factor in environmental considerations in transit network management.

### **How the New England UTC's research results have been disseminated**

#### **Project HVDR25-21**

##### **Recreating Livable Communities after Catastrophe: Managing the Recovery from Japan's Earthquake, Tsunami, and Nuclear Disaster of 2011**

Professor Howitt, the project P.I., disseminated research results for this reporting period by incorporating lessons learned from Japan's experience in the aftermath of the 2011 tsunami into the curricula for two graduate-level management courses he teaches at the Harvard Extension School on (1) emergency preparedness and response and (2) disaster relief and recovery. Students in these courses represent a mix of disciplines, including international relations, general management, and public policy.

#### **Project UMAR25-29**

##### **An Innovative Design to Retrofit Seatbelts in Motorcoaches**

A conference paper was published and presented at an SAE International symposium in Pune, India. 3D printed miniature samples were produced to demonstrate the product at the event. A coauthor presented the solution there to CIRT, a leading organization for implementing an accreditation system for Bus Body Builders in India. In response to our recent presentation, NHTSA began a promotion for seatbelt use on motorcoaches found at <https://twitter.com/NHTSAgov/status/808370846746152960>. Information about the filed patent application for this retrofit solution is available at [http://tto-umass-amherst.technologypublisher.com/tech?title=\\_Seatbelt\\_System\\_for\\_Buses\\_%E2%80%93\\_Retrofit\\_or\\_New](http://tto-umass-amherst.technologypublisher.com/tech?title=_Seatbelt_System_for_Buses_%E2%80%93_Retrofit_or_New). A provisional patent application was filed in this period to capture the latest product innovations. Presentations of the latest design were given under NDA to potential early adopters in industry at American Seating and DATTCO.

**Project UCNR25-34****Exploration of Human Psychological Factors Underlying Mobile Phone Usage Behaviors while Driving**

A final report was prepared and transmitted to New England University Transportation Center. The study team members are currently preparing manuscripts for presentation in conferences and publications in journals. A copy of the report and manuscripts will be made available on the PI website at: <http://karthikkonduri.weebly.com/publications.html>.

**Project UCNR25-35****Clustering Algorithms for Transit Network Design**

This work was represented in the UConn 2016 National Summer Transportation Institute held on UConn campus in June 2016, funded by the Federal Highway Administration. Eighteen high-school students from across Connecticut participated in a week-long residential program in Storrs, CT learning about transportation careers and seeing results from several ongoing research efforts, including Project UNCR25-35.

**Plans during the next reporting period to accomplish the New England UTC's research goal**

No change on our major goals contained within our approved Application.

## **1B. Education Projects**

### **Education & Workforce Goal**

- To introduce transportation to all levels of education: K-12, undergraduate, graduate and continuing education.
- To place graduates into transportation fields.
- To provide current and developing methods, tools and insights to today's transportation workforce to support their capacity to build, operate and manage a safe and efficient transportation system.

Following is the list of the 2 education projects under this grant, and their current status:

<b>Project No.</b>	<b>PI</b>	<b>Project Title</b>	<b>Status</b>
HVDE25-38	Howitt	Teaching Case Study on Korea Ferry Disaster of April 2014	completed
HVDE25-39	Davis Altshuler	Transforming Urban Transport: A Set of Case Studies	active

### **Accomplishments under the New England UTC's education goal**

#### **Project HVDE25-39**

##### **Transforming Urban Transport a Set of Case Studies**

This project has produced a book manuscript consisting of a variety of case studies, bracketed by an introductory and a concluding chapter, which is being published by Oxford University Press (Spring 2018). The book's focus is on the origins and implementation pathways of significant urban transport innovations that have recently been adopted in major, democratically governed world cities that are seeking to advance sustainability aims. The cases document how proponents of new transportation initiatives confronted a range of administrative, fiscal, environmental, and political obstacles to move a good idea from the drawing board to implementation. Together, they highlight a range of leadership skills, technical resources, negotiation capacities, and governance styles deployed to successfully overcome entrenched opposition. Moreover, the book provides a rich introduction to some of the most interesting urban transport departures of recent years, together with accounts of their pathways to adoption and implementation. The case studies are structured and streamlined to provoke critical reflection and stimulating discussions in university classrooms (graduate, professional, and undergraduate).

## **1C. Technology Transfer Projects**

### **Technology Transfer Goal**

- To increase the awareness and level of information concerning transportation issues facing New England.
- To further our well-established technology transfer and outreach activities.
- To engage the public and private transportation sectors throughout the New England Region and the nation.

Following is the list of the 2 technology transfer projects under this grant, and their current status:

<b>Project No.</b>	<b>PI</b>	<b>Project Title</b>	<b>Status</b>
MITT25-43	Coughlin	MIT Centralized Technology Transfer Initiatives	active
UMAT25-44	Collura	UMass Centralized Technology Transfer Initiatives	active

### **Accomplishments under the New England UTC's technology transfer goal**

#### **Project UMAT25-44**

##### **UMass Centralized Technology Transfer Initiatives**

The focus of this initiative is on workforce development and technology transfer.

During the Fall semester 2017 UMass, Amherst offered a course in transportation aviation, "Application of Unmanned Aerial Systems".

In January, a total of 32 UMass, Amherst students, faculty and staff participated at the Transportation Research Board (TRB) 97<sup>th</sup> Annual Meeting in Washington, DC.

An Air Traffic Control Simulator was installed in the UMass Transportation Center in the Department of Civil and Environmental Engineering, in the College of Engineering. The system consists of a seven-channel simulator with three controller working positions (local, ground, and radar), three pseudo-pilot positions, and one instructor/data preparation position. The simulator's application programming interface allows such information as traffic, weather, and flight-plan data to be integrated with external systems or other simulators.

Dr. Daiheng Ni, Associate Professor, Civil and Environmental Engineering Department, was awarded a four-year research grant from Toyota Motor North America Research and Development entitled "Driver Modeling to Predict Operational Control on a Short Horizon." The overall objective of this research is to develop a mathematical model to predict driver's operational control in terms of anticipated speed and acceleration on a short horizon of between

0 and 10 seconds of reaction time.

UMassAir has received approval from the MassDOT for a pilot study entitled “The Application of Unmanned Aerial Systems in Surface Transportation” to address surface transportation needs in the Commonwealth.

In October 2017, we participated in the “Intercity Bus Safety Summit Promoting Seat Belt Usage”, held in Washington, DC.

Also of note, students/faculty/staff participated in 13 UMass, Amherst Transportation Engineering Program seminars, which included topics such as: “Leadership and Project Management in Transportation” (speaker - Patty Leavenworth, Chief Engineer, MassDOT); “A Place for Everyone: why we need tech and non-tech expertise for real innovation” (speaker - Heather Rothenberg, PhD, Lead of the Trust and Safety Group at Uber); “The Nexus Between Student Absenteeism and Public Transportation in Baltimore City” (speaker - Celeste Chavis, PhD, Morgan State University); “All-Red Clearance Intervals for Use With Flashing Yellow Arrows in the Left-turn Application” (speaker - Francis Tainter, MS candidate, UMass/Amherst); “A Safety and Emissions Analysis of Continuous Flow” (speaker - Joshua Wolfram, MS candidate, UMass/Amherst); “Driver Understanding of Flashing Yellow Arrow and Dynamic No Turn on Red Signal for Right Turn Applications” (speaker - Elizabeth Casola, MS candidate, UMass/Amherst); “ADHD Young Driver Skill Evaluation and the Development of an ADHD Young Driver Training Tool” (speaker - Melissa Paciulli, PhD candidate, UMass/Amherst); “Traffic Signal Control with Connected and Autonomous Vehicles in the Traffic Stream” (speaker - Lily Elefteriadou, PhD, UF Transportation Institute).

## 2. Products

### Journal publications

Amirgholy, M., Golshani, N., Schneider, C., Gonzales, E.J., Gao, H.O. (2017). An advanced traveler navigation system adapted to route choice preferences of the individual users. *International Journal of Transportation Science and Technology*, 6(4):240-254.

<https://www.sciencedirect.com/science/article/pii/S2046043017300345>

Amirgholy, M., Gonzales, E.J. (2016). Demand responsive transit systems with time dependent demand: User equilibrium, system optimum, and management strategy. *Transportation Research Part B*, 92:234-252.

<https://www.sciencedirect.com/science/article/pii/S0191261515002374>

Amirgholy, M., Gonzales, E.J. (2017a). Analytical equilibrium of bicriterion choices with heterogeneous user preferences: Application to the morning commute problem. *Transportmetrica B*, 5(4):455-487.

<https://www.tandfonline.com/doi/abs/10.1080/21680566.2017.1279087>

Amirgholy, M., Gonzales, E.J. (2017b). Efficient frontier of route choice for modeling the equilibrium under travel time variability with heterogeneous traveler preferences. *Economics of Transportation*, 11-12:1-14.

<https://www.sciencedirect.com/science/article/pii/S2212012217300746>

Bertolaccini, K. and N. Lownes (2017) Developing and Solving an Equitable Transit Network Design Model with a Genetic Algorithm Solution Approach, *Proceedings of the 96<sup>th</sup> Annual Meeting of the Transportation Research Board*, Paper # 17-06547.

Bertolaccini, K. and N. Lownes (in review) Measuring and Mapping transit opportunity: an expansion and application of the Transit Opportunity Index, *Journal of Transport Geography*.

Ding-Mastera, J., Gao, S., Jenelius, E. and Ben-Akiva, M. A Latent-Class Adaptive Route Choice Model in Stochastic Time-Dependent Networks. *Transportation Research Part B*. Under 2<sup>nd</sup> Review.

Guevara, C. A., Tang, Y.\* and Gao, S. (Forthcoming). The Initial Condition Problem with Complete History Dependency in Learning Models for Travel Choices. *Transportation Research Part B*.

Islam, A. and N. Lownes (In final prep) Minimization of Carbon Footprint of Transit Agencies by Adopting Alternative Fuel Technologies, *Transportation Research Part C*.

Khalighi, F., and Christofa, E. A Cellular Automata Model for Roundabouts: An Environmental and Operational Assessment in Multimodal Environments. [in preparation]

Needell, Z. A., and Trancik, J. E., (2018). Efficiently simulating personal vehicle energy consumption in mesoscopic transport models. *Transportation Research Record: Journal of the Transportation Research Board*.

Wei, W., Needell, Z.A., Ramakrishnan, S., Trancik, J.E. Potential for increasing electric vehicle adoption through charging infrastructure expansion [in preparation].

### **Books, dissertations, or one-time publication**

Amirgholy, M. (2016). Modeling choice problems with heterogeneous user preferences in the transportation network. Ph.D. Dissertation. University of Massachusetts, Amherst.

\*Winner of Milton Pikarsky Award for Outstanding Dissertation in Science and Technology, 2017.

Bertolaccini, K. L. (2015). Designing Transit Networks for Equity and Accessibility, Doctoral Dissertation,

<http://digitalcommons.uconn.edu/cgi/viewcontent.cgi?article=7214&context=dissertations>.

Gerte, R., Enam, A., Konduri, K.C., Ramachandran, N., and Dalal, D. (2018). Understanding the Psychological Factors Underlying Smartphone Related Distracted Driving. Final Report for New England University Transportation Center Project: UCN25-34.

Khalighi, F. *Intersection Signal Control and Design for Improved Person Mobility and Air Quality in Urban Multimodal Transportation Systems*, PhD Dissertation.

### **Other publications, conference papers and presentations**

Amirgholy, M., Golshani, N., Schneider, C., Gonzales, E.J. (2017). An advanced traveler navigation system adapted to route choice preferences of individual users. Paper Number 17-05826. *Transportation Research Board 96th Annual Meeting*, 8-12 January, Washington, D.C.

Amirgholy, M., Gonzales, E.J. (2015). Efficient frontier of route choice for modeling the equilibrium under travel time variability with heterogeneous preferences. *56th Annual Transportation Research Forum*, 12-14 March, Atlanta, Georgia.

Amirgholy, M., Gonzales, E.J. (2016). An analytical solution to the morning commute problem for a single bottleneck with heterogeneous commuter preferences: User equilibrium, system optimum, and pricing. Paper Number 16-5834. *Transportation Research Board 95th Annual Meeting*, 10-14 January, Washington, D.C.

Amirgholy, M., Gonzales, E.J. (2016). Efficient frontier of route choices under travel time variability. Paper Number 16-5800. *Transportation Research Board 95th Annual Meeting*, 10-14 January, Washington, D.C.

Amirgholy, M., Gonzales, E.J. (2016). Operation and management strategies for demand-responsive transit systems with time-dependent demand. Paper Number 16-4579. *Transportation Research Board 95th Annual Meeting*, 10-14 January, Washington, D.C.

Amirgholy, M., Gonzales, E.J. (2017). Efficient frontier of the trip schedules in morning commute problem: User equilibrium, system optimum, and dynamic pricing. Paper Number 17-05891. *Transportation Research Board 96th Annual Meeting*, 8-12 January, Washington, D.C.

Eddy, D., Patil, S., Krishnamurty, S., Grosse, I. et al., "Design and Evaluation of an Affordable Seatbelt Retrofit for Motor Coach Occupant Safety," SAE Technical Paper 2017-26-0018, 2017, DOI: 10.4271/2017-26-0018.

Lownes, N.E. and K. Bertolaccini (2016) Transit Planning Web Application Development Using GTFS, *Innovations in Public Transportation Planning and Modeling Utilizing General Transit Feed Specification (GTFS) Webinar*, The National Academies, TRB, May 12, 2016.  
<http://www.trb.org/ElectronicSessions/Blurbs/174385.aspx>

Miotti, M., Trancik, J.E. Leveraging data to estimate localized emissions and costs of personal vehicles. Accepted for poster presentation at 2018 Gordon Research Conference Industrial Ecology and for oral presentation at 2018 Gordon Research Seminar Industrial Ecology.

Needell, Z. A., and Trancik, J. E. Efficiently simulating personal vehicle energy consumption in mesoscopic transport models. 2018 Transportation Research Board Annual Meeting.

“Response to NHTSA on March 2016 Report to Congress on: (Lap/Shoulder Belts) Retrofit Assessment for Existing Motorcoaches”, submitted to NHTSA.

S. Bakhtiari, S. Samuel T. Zhang, T. Zafian, M. Knodler, “Effectiveness of visual & auditory collision warning alerts on old drivers at intersections”, Safer-Sim Symposium, Orlando, FL, February 4-6, 2018

Wei, W., Needell, Z.A., Ramakrishnan, S., Trancik, J.E. Potential for increasing electric vehicle adoption through charging infrastructure expansion. 2018 Transportation Research Board Annual Meeting.

### Websites or other Internet sites

#### **Project UMAR25-29**

##### **An Innovative Design to Retrofit Seatbelts in Motorcoaches**

A brief project summary appears at <http://edesign.ecs.umass.edu/projects/an-economical-retrofit-seat-belt-design-upgrade-for-motor-coaches/>. The latest news update on this project appears at <http://mie.umass.edu/news/retrofit-seat-belts-buses-are-going-places-fast>.

### Media

Nothing to report

### Technologies or techniques

#### **Project UMAR25-29**

##### **An Innovative Design to Retrofit Seatbelts in Motorcoaches**

The technologies and techniques that result from this project focus on those that provide the most effective guidelines to the safe and economical implementation of seatbelts on motorcoaches. Discussion with individuals who would be directly involved in seatbelt retrofit installations at DATTCO and American Seating were an important step toward actual implementation of the developed technology and installation techniques.

**Project UCNR25-35**  
**Clustering Algorithms for Transit Network Design**

The research team uses a novel form of Genetic Algorithm (GA) to solve instances of the transit network design problem. The GA uses new initial solution generation, crossover and mutation functions to address complexities introduced by the use of equity as an objective as opposed to cost minimization.

**Inventions, patent applications, and licenses**

**Project UMAR25-29**  
**An Innovative Design to Retrofit Seatbelts in Motorcoaches**

A US patent for "Retrofit Seat Belt System" was filed as patent application PCT/US/1532218 in May of 2015 and is published as WO2015179784 A1 in January 2016.

UMA 17-040 provisional patent application Ref. No.: 42740-38PROV, "Retrofit Seatbelt System".

**Other products**

**Project UMAR25-24**  
**Operational and Emission Analyses of Roundabouts under Varied Vehicle and Pedestrian Demands**

We have an AIMSUN microsimulation model of the roundabout at N. Pleasant and Governors Dr. at the UMass campus in Amherst, MA. The model has been calibrated so far with volumes obtained through video cameras. The model of the signalized intersection that used to exist at the same location has also been developed in Aimsun. In addition, we have developed two Cellular Automata models for the same test site, one for the roundabout and one for the signalized intersection design, which have been validated against the corresponding microsimulation models for undersaturated traffic conditions.

**Project UCNR25-35**  
**Clustering Algorithms for Transit Network Design**

A GTFS extraction tool and transit system analysis package has been developed and will be made available through the t-HUB website.

**3. Participants & Other Collaborating Organizations**

**Organizations that have been involved as partners**

Charles and Anne Schewe, Sara's Wish Foundation (SWF), Amherst, MA  
FEMA Logistics Management Directorate, Washington, DC  
National Oceanic and Atmospheric Administration (NOAA), Washington, DC  
Penn State University, State College, PA  
Tsinghua University, China, Collaborative research  
University of Queensland, Brisbane, Australia

## Other collaborators or contacts that have been involved

### **Project HVDR25-21**

#### **Recreating Livable Communities after Catastrophe: Managing the Recovery from Japan's Earthquake, Tsunami, and Nuclear Disaster of 2011**

Representatives of the tsunami-affected town of Rikuzentakata, Japan, and Iwate University, Morioka, Japan, provided feedback on research undertaken as part of this project. The research team also engaged and communicated with other individuals researching the topic, including Kyle Cleveland of Temple University (Tokyo) and James Simms, a Tokyo-based freelance journalist. Throughout this reporting period, project P.I. Howitt also collaborated with Iwate University representatives in organizing a conference (to be held in summer 2018) that is in large part informed by this research.

### **Project UMAR25-29**

#### **An Innovative Design to Retrofit Seatbelts in Motorcoaches**

A bus seat without seatbelts was provided for the retrofit study by Dave McLaughlin the American Seating Corporation, and he is interested in implementing the technology under a current field testing agreement. The mounting structure hardware and installation feedback for the retrofit study was provided by John Cieplik, General Manager of the Coach Builders Facility at Peter Pan Bus Lines. The kinematic modeling and dynamic simulation of the rollover and frontal crash scenarios work was currently subcontracted to Dr. Chandra K. Thorbole, Director at Thorbole Simulation Technologies. Dr. Thorbole has also advised the team about market potential and implementation strategy. Dr. Thorbole presented at the SAE conference and to CIRT in Pune, India throughout 2017, and provided simulation results to CIRT. Helpful feedback about the cast-ability and preliminary design pricing for the main aluminum part was provided by Marlborough Foundry. Garrett Monde at DATTCO expressed interest in doing installations upon commercialization.

## 4. Impact

### The impact on the development of the principal disciplines of the program

#### **Project UMAR25-24**

##### **Operational and Emission Analyses of Roundabouts under Varied Vehicle and Pedestrian Demands**

The development of the CA models for signalized intersections and most importantly for roundabouts are a great asset for the program since they facilitate continuation of research on alternative intersection designs and in particular, their operational, safety, and environmental aspects. They can also facilitate the development and testing of real-time signal control and other management strategies.

#### **Project UMAR25-29**

##### **An Innovative Design to Retrofit Seatbelts in Motorcoaches**

The key players and stakeholders in the motor coach industry are now informed about this technology and well aware that an economical and safe solution now exists that did not exist before. Furthermore, early adopters in the industry are now considering implementation of the technology.

### **Project UCNR25-34**

#### **Exploration of Human Psychological Factors Underlying Mobile Phone Usage Behaviors while Driving**

This work contributes to the literature on distracted driving, in particular associated with email and social network usage behaviors. Furthermore, the underlying attitudes toward these behaviors can help inform decision-makers design effective policies to curb distracted driving behaviors. The project also supported the training and preparation of multiple graduate and undergraduate students in areas of transportation safety research.

### **Project UCNR25-35**

#### **Clustering Algorithms for Transit Network Design**

This research has made advances in transit network design modeling and solution methods, most significantly with respect to the inclusion of equity as a priority in reconfiguring transit networks. This work has enhanced the ability of public transportation systems researchers to consider aspects such as equity in service provision as well as allowed them to leverage the increasing amount of data and test beds openly available to researchers. The extension to transit management and fleet replacement provides a very useful tool for managing transit fleets with environmental considerations and implications of new technologies.

### **The impact on other disciplines**

#### **Project HVDR25-21**

##### **Recreating Livable Communities after Catastrophe: Managing the Recovery from Japan's Earthquake, Tsunami, and Nuclear Disaster of 2011**

The project P.I. incorporated findings from research conducted through this project in several lectures and presentations to graduate students representing a mix of disciplines, exposing them to public policy considerations of transportation infrastructure recovery and post-disaster land-use. This includes the inclusion of lessons learned on Japan's recovery experience into the curricula for two graduate-level management courses he teaches at the Harvard Extension School.

#### **Project UMAR25-27**

##### **Route Choice in Congested Grid Networks**

The research addresses problems that fall at the intersection of transportation engineering, economics, management science, and finance. With applications to traveler information systems, there are also connections to the fields of computer science and psychology, which are important for transferring the research results into practice.

### **The impact on the development of transportation workforce development**

#### **Project UMAR25-29**

##### **An Innovative Design to Retrofit Seatbelts in Motorcoaches**

One of the co-inventors, who completed a Bachelor's degree in Mechanical Engineering, has advanced to work at an internship back in Germany at BMW. The experience gained by that student while working on this project helped with the development of that person's career in transportation. This person also completed an extensive report of their work for this project on which other students built. The added business of retrofitting is expected to create more jobs in the industry in proportion to the number of installations ordered.

**Project UCNR25-35**  
**Clustering Algorithms for Transit Network Design**

This project has allowed a PhD student multiple opportunities for research, teaching and presenting her findings at scholarly venues over the course of the project. Additionally, the results have informed the material of existing courses at UConn (CE 5735) that address elements of the transit network design problem. Lastly, the findings were shared with high school students (in a very condensed manner) as part of the 2016 UConn National Summer Transportation Institute, funded by FHWA.

**The impact on physical, institutional, and information resources at your university or other partner institutions**

**Project UMAR25-24**  
**Operational and Emission Analyses of Roundabouts under Varied Vehicle and Pedestrian Demands**

We have an AIMSUN microsimulation model of the roundabout at N. Pleasant and Governors Dr. at the UMass campus in Amherst, MA. In addition, we have developed driving simulator scenarios with roundabouts and have programmed the appearance of pedestrians at crosswalks when vehicles are approaching those roundabouts. We also have eye tracking and trajectory data from 24 subjects that participated in the driving simulator experiments. All these resources can become available to other researchers within the NEUTC.

**The impact on technology transfer**

Nothing to report

**The impact on society beyond science and technology**

**Project UMAR25-29**  
**An Innovative Design to Retrofit Seatbelts in Motorcoaches**

The project could have some impact on influencing public policy regarding transportation safety. Awareness and engagement throughout the motor coach industry should lead to other innovations to further improve public safety. For example, National Highway Traffic Safety Administration (NHTSA) changed their position regarding seatbelts on school buses by an announcement that they now recommend 3-point seatbelts on all school buses and other buses. Such heightened awareness is expected to accelerate the demand for seatbelts over time. The bus industry now knows that a solution exists to retrofit seatbelts onto motorcoaches. Discussions and presentations have been done with numerous key players and stakeholders at this stage. A marketing presentation was delivered to the Ad Council to address the issue of low passenger use of seatbelts on buses. An increase in passenger demand is expected to increase the potential market for the bus industry and accelerate the availability of seatbelts. Awareness of a solution by NHTSA and the National Safety Council are expected to support that momentum. This is especially apt to the driver of parent's demand for safety and protection of their children.

## **5. CHANGES/PROBLEMS**

Nothing to report.

### **Additional information regarding Products and Impacts**

#### **Project UMAR25-24**

#### **Operational and Emission Analyses of Roundabouts under Varied Vehicle and Pedestrian Demands**

Human Resources: During the past 6 months, the project involved one PhD student Farnoush Khalighi. Farnoush worked on developing and validating the CA models for the roundabout and the signalized intersection as well as running all the tests to assess the impact of vehicle and pedestrian demand on the operational and environmental performance of the roundabout vs the signalized intersection. She also worked on documenting all of these in her dissertation she recently successfully defended. She is currently in the process of preparing a paper on comparing the operational and environmental performance of roundabouts vs signalized intersections as a function of vehicle and pedestrian demand to be submitted for a journal publication.

Diversity: PhD student Farnoush Khalighi is female

#### **Outputs**

Nothing to report.

#### **Outcomes**

Nothing to report.

#### **Impacts**

Nothing to report.