



**SEMI-ANNUAL PROGRESS REPORT FOR  
UNIVERSITY TRANSPORTATION CENTERS**

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Office of the Secretary of Transportation

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**Project Title:** Safety Research Using Simulation (SAFER-SIM)

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**Submitting Official:** Same as Program Director

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5 Gilmore Hall  
Iowa City, IA 52242

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**Signature of Submitting Official:** 

## **1. Accomplishments**

### **1.1 What are the major goals of the program?**

#### *1.1.1 Research*

Safety Research Using Simulation (SAFER-SIM) is a Tier 1 University Transportation Center (UTC) with a research priority of promoting safety. The UTC includes five institutions: University of Iowa (lead), University of Wisconsin Madison, University of Massachusetts Amherst, University of Central Florida, and University of Puerto Rico Mayaguez. SAFER-SIM leverages research from a range of disciplines to study how road users, roadway infrastructure, and new vehicle technologies interact and interface with each other. The center uses microsimulation and state-of-the-art human in the loop driving, bicycling, pedestrian simulators to develop solutions for safer transportation in the US and globally.

SAFER-SIM works to promote safety by addressing these research topic areas:

- Automated Vehicles Technology
- Connected Vehicles Technology
- Vulnerable Road Users
- Roadway Infrastructure Design
- Distributed Simulation Technology

#### *1.1.2 Leadership Development*

SAFER-SIM sites are recognized nationally and internationally as leaders in transportation safety research with a distinction in applying simulation to safety problems. Developing the next generation of leaders in safety research and simulation is a key function of our work. Our center will accomplish this using seminars, symposia, web-based discussions, and other opportunities to share our expertise.

#### *1.1.3 Education and Workforce Development*

SAFER-SIM will educate the next generation of safety professionals, building the transportation workforce for tomorrow, and fostering a vibrant community of researchers.

#### *1.1.4 Technology Transfer*

SAFER-SIM will establish and promote opportunities for research collaboration with industry, state and local governments, and other organizations with an interest in transportation safety. The center will promote commercialization activities and will provide highly trained scientists for the industrial workforce

#### *1.1.5 Collaboration*

Strong collaboration efforts will take place across consortium sites, within consortium sites, and with government agencies and industry partners. Collaboration plays an important role in reaching goals in all areas at our center.

#### *1.1.6 Diversity*

SAFER-SIM is committed to promoting diversity through student involvement on research projects and to reaching underrepresented populations in community outreach.

## 1.2 What was accomplished under these goals?

### 1.2.1 Research

The center has funded seventy-eight (78) projects under the FAST Act – seventy-six (76) research and two (2) outreach. Twenty-seven (27) projects remain active and fifty-one (51) projects are complete. All project information can be found on the research tab of the [SAFER-SIM website](#). Active projects are listed on the Transportation Research Board’s [Research in Progress \(RIP\) Database](#).

SAFER-SIM directors discussed plans for Year 6 projects this period. The center decided to forgo the annual Request for Proposals process in favor of each site determining the optimal project(s) to fund in the final year of the UTC with the end of the performance period approaching in September 2023. Project selection is focused on advancing the findings of previously funded projects and providing project level funding to promising previously completed pilot projects. Project decisions will be made early next period, and projects will begin as soon as possible in the summer of 2022 and complete by the summer of 2023. New projects funded next period will be posted on [Research in Progress \(RIP\) Database](#):

Year	Funded/Inactive	Projects Active	Projects Complete	Total Projects
Y1	0	0	9	9
Y2	0	0	16	16
Y3	0	2	16	18
Y4	0	8	9	17
Y5	0	17	1	18
Y6	In Progress	0	0	In Progress
Total	0	27	51	78

SAFER-SIM completed five (5) research projects this period listed below. These projects are finalizing revisions to reports and datasets, and final submission to TRID will happen early next period. The delays due to COVID created a backlog of work on the research and administrative sides, yet our center is working diligently through these delays to return to normal operating procedures. More description is available in [Section 6.1](#).

Projects Completed this Period	TRID
Evaluating the Effects of Cooperative Perception on Avoiding Pedestrian Crashes for Connected and Automated Vehicles	In Progress
Using Augmented Reality to Help Older Adults Make Safe Road-Crossing Decisions	In Progress
Investigation of Merge Strategies at Ramp Area in Connected Vehicle Environment based on Multi-Driver Simulator System	In Progress
Using Simulation to Study Communication between Autonomous Vehicles and Vulnerable Road Users	In Progress
Understanding Bicyclists’ Behaviors Through Learning from Big Trip Data	In Progress

Zhaomiao Guo from UCF was awarded a [grant from the National Science Foundation](#). This project addresses the use of advanced sensing, communications, and computing technologies in studying value of information in transportation systems made up of heterogeneous traffic (cars, autonomous and connected vehicles, buses, bicycles, etc.) The wealth of data available on these systems enables new approaches to information provisioning that have the potential to improve transportation system efficiency, reliability, and resilience. Data from [this SAFER-SIM project](#) helped write the proposal for this grant.

- Title: Optimizing Information Value in Heterogeneous Multi-agent Transportation Systems (OPTIMA)
- PI: Zhaomiao Guo, University of Central Florida
- Sponsor: National Science Foundation
- Amount: \$351,000

Below is a summary of research performance metrics for the current performance period. Full list can be found [here](#).

Performance Metric	Result
Peer-reviewed journal publications (published)	17
Book chapters	0
Edited books	0
Conference papers, posters, and symposia	17
Paper/poster awards	1
External grants related to SAFER-SIM	1

### 1.2.2 Leadership Development

Researchers and students gained and shared valuable experience through SAFER-SIM work this period.

SAFER-SIM researchers continued representing the center at professional meetings through invited presentations. This work shows the combined expertise of our center along with the wide range of stakeholders interested in our research including state departments and tech companies. Some invited presentation highlights include:

- Dr. Mohamed Abdel-Aty: 2021 Florida Automated Driving (FAV) Summit, November 2021
- Dr. Elizabeth O’Neal: “Learning to Drive: Parent-Teen Study.” Statewide Traffic Records Coordinating Committee. September 23, 2021.
- Dr. Shannon Roberts: “Distraction and Glance Behavior” for Google Lunch & Learn on October 27, 2021.

SAFER-SIM contributed to the advancement of simulation and road safety through other leadership development activities this period. Researchers actively participated on grant review panels, advisory committees, professional organizations, and other scholarly endeavors. SAFER-SIM researchers were honored by an array of awards for impactful achievements in transportation. Some exemplary awards were given to our Co-Directors and are listed below:

- Dr. Mohamed Abdel-Aty, a professor and trustee chair at the University of Central Florida’s (UCF)

Department of Civil, Environmental and Construction Engineering, is the 2022 recipient of the American Road & Transportation Builders Association’s (ARTBA) prestigious [S.S. Steinberg Award](#).

Dr. Abdel-Aty has been a professor for 27 years, serving as a teacher and mentor to many students. He has supervised the completion of 36 Ph.D. and 60 master’s degree students and is currently advancing 18 more Ph.D. candidates. Several of Dr. Abdel-Aty’s students have been given Council of University Transportation Centers (CUTC) awards, which honor outstanding transportation students, faculty and leaders for their accomplishments in the field of transportation research and education. He has also designed and established the first master’s degree in Engineering in Smart Cities in the United States.

- Dr. Michael Knodler, the College of Engineering Associate Dean of Research and Graduate Affairs, is the recipient of the [Outstanding Senior Faculty Award](#) in the College of Engineering at University of Massachusetts. Knodler is internationally renowned for his work on transportation safety and operations, which has had a significant impact on the practice of transportation engineering. As director, he has transformed the UMass Transportation Center into a leading organization for transportation education, research, and public outreach

Below is a summary of leadership development performance metrics. Full list can be found [here](#).

<b>Leadership Development Performance Metric</b>	<b>Result</b>
Invited presentations	5
Invited papers	0
Invited workshops	1
Grant review panels	4
Advisory committees	59
Journal editing	40
Leadership positions in professional organizations	25
SAFER-SIM webinars	12
Professional awards	10

### 1.2.3 Education and Workforce Development

Consortium members continued engaging students of all levels this period in transportation, safety, and STEM (science, technology, engineering, and math).

The University of Iowa actively engaged K-12 students this period through tours, events, and classroom visits. The UI team collaborated with Oelwein High School to develop a distracted driving experiment for the classroom. This project-based learning activity taught students about STEM concepts while relating to the real-world problem of distracted driving. Additionally, UI researchers are again involved in the organizing committee for the [Iowa National Transportation Summer Institute \(INTSI\)](#), which will occur next period. The INTSI is a STEM Camp for 7-9 grade students focusing on STEM education, careers in transportation, and leadership. More INSTI information describe in the diversity [Section 1.2.6](#).

K-12 highlights include:

- Johnson County STEAM Institute – 300 students
- Oelwein High School Science – 120 students
- Bettendorf 8<sup>th</sup> Grade Science Class – 95 students

SAFER-SIM developed an [online resource](#) in 2019 for Boy Scouts of America to earn the Traffic Safety merit badge. The goal of the resource is to create greater visibility and access to the merit badge. The Traffic Safety merit badge “gives Scouts crucial tools to stay safer when driving a car on a highway, riding a bike across town, or jogging across a busy street.” By completing the Traffic Safety merit badge, Scouts learn about transportation safety, careers, and research at an opportune time. The online resource continued making nationwide impacts this period with students this period. An additional 55 scouts started the resource this period with 41 more scouts successfully completing all requirements. In total 1020 scouts have used this resource and 653 have completed all requirements.

In 2020, SAFER-SIM developed a similar [online tool](#) for the Engineering Merit Badge. Whether it is improving personal electronics, developing health care solutions, creating automated vehicles, protecting the environment or sending people to Mars, engineers are using math and science to create a better tomorrow. Earning the Engineering Merit Badge gives Scouts a better understanding of how engineers work and how to apply the engineering process to daily problems. An additional 39 scouts started the resource this period with 13 more scouts successfully completing all requirements. In total 313 scouts have used this resource and 155 have completed all requirements.

Below is a summary of education and workforce development performance metrics. Full list can be found [here](#).

<b>Education and Workforce Development Performance Metric</b>	<b>Result</b>
Peer-reviewed journal publications w/ student authors	10
Book chapters w/ student authors	0
Conference posters and papers w/ student authors	5
Paper/poster awards w/ student authors	1
Graduate students working on and supported by SAFER-SIM related projects	30
Undergraduate students working on and supported by SAFER-SIM related projects	13
Student attendance and presentations at the SAFER-SIMposium	7 students 4 presentations
Transportation-related M.A. and PhD theses	2
Curriculum modules developed	2
Student Internships	0
Presentations to student groups or classes	6 presentations 120 students
# Schools visited and # students present	3 schools 335 students
# Career fairs visited and # of attendees	1 career fair

	300 attendees
Summer institutes and programs and # of students participating	NA

#### 1.2.4 Technology Transfer

SAFER-SIM-funded projects work toward technology transfer goals from the beginning through completion. State DOTs, industry partners, and other agencies work with researchers by using their expertise or findings to inform decisions that guide future research and projects.

A main aspect of our technology transfer activities involves webinars. Research projects are required to present webinars about their results which are shared with contacts in academia, industry, and government. The presentations focus on findings, recommendations, specifications, and guidelines. The center hosted twelve (12) webinars this period with 309 registrants – 174 from academia, 94 from industry, and 41 from government. The tables below include complete webinar information and highlights of the various organizations from all sectors that registered for webinars this period:

Webinar	Date	Registrants	Archived Views
Effect of Large Vehicles on Left Turn Gap Acceptance at Signalized Intersections	10/19/2021	21	42
Interfacing Synchrono & NADS for Virtual Simulation of Conventional, Connected & Autonomous Vehicles	11/2/2021	21	67
Using Simulation to Study Communication between Autonomous Vehicles and Vulnerable Road Users	11/16/2021	18	63
Impact of Road Information Assistive Systems on Pedestrian Crossing Safety	11/23/2021	39	59
Defining Safety-Critical Scenarios for Simulation-Based Automated Vehicle Evaluation	11/30/2021	23	64
Multitask Learning and Prediction of Baseline Driving Performance Measures	12/7/2021	9	32
Investigation of Driving Behavior at Alternative Intersection Designs and Safety Improvement	12/21/2021	25	47
Investigation of Merge Strategies at Ramp Area in Connected Vehicle Environment based on Multi-Driver Simulator System	2/8/2022	18	32
Understanding Bicyclists' Behaviors Through Learning from Big Trip Data	2/22/2022	16	25
Evaluating the Effects of Cooperative Perception on Avoiding Pedestrian Crashes for Connected and Automated Vehicles	3/1/2022	33	26
Using Augmented Reality to Help Older Adults Make Safe Road-Crossing Decisions	3/22/2022	17	28

Understanding of advanced vehicle technology: Role of system exposure and perceptions of other road users	3/29/2022	69	27
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Federal	State	Local	Industry	Nonprofit	Academia
Federal Highway Administration	Wisconsin Department of Transportation	City of Los Angeles	State Farm	AAA Foundation for Traffic Safety	University of Connecticut
National Highway Traffic Safety Administration	Iowa Department of Transportation		Hyundai America Technical Center, INC.	American Automobile Association	University of Leeds
US Department of Transportation	Massachusetts Department of Transportation		AECOM	Vulnerable Road User Safety Consortium (VRUSC)	University of Michigan Transportation Research Institute

Our center has been successful at receiving media attention from our work. Some highlights of SAFER-SIM sites in the media this period include:

- [UI simulator helps cut winter traffic deaths, develop new tech](#) – CBS 2 Iowa
- [UI researchers find link between cannabis and driving impairment](#) – The Daily Iowan
- [‘Arbitrary’ cutoffs of THC levels make it difficult to measure impaired driving](#) – NBC News
- [University of Central Florida’s Dr. Mohamed Abdel-Aty Honored With Prestigious National Research Award](#) – ARTBA
- [College of Engineering Selects Michael Knodler and Yubing Sun as 2022 Outstanding Faculty Members](#) – UMass College of Engineering

Lab tours picked up across sites following a slow period due to COVID-19. Our center offered 20 facility tours to the following stakeholders from industry, government, and our local community:

- Transportation Research Center, Inc.
- Iowa DOT
- Legislators in the Lab including Iowa State Senators and Representatives and UI staff
- Wisconsin DOT
- US. Representative Marionette Miller Meeks Staff

Below is a summary of our technology transfer plan performance metrics with the full list accessible [here](#) and more detail provided in [Section 3](#) below.

Technology Transfer Performance Metric	Result
SAFER-SIM webinars	12
Registrations for webinars	309



Views of archived webinar content	512
Press releases for SAFER-SIM related research	1
Media requests	8
Tours of facilities	20
Website traffic	2,771 users 4,155 sessions 7,961 page views
Patents filed	0
DOT requests for presentations or proposals related to SAFER-SIM	0
Practitioner attendance at events	43
Number of improved or new simulation technologies, software, methods, or processes	1

### 1.2.5 Collaboration

Collaboration drives our consortium in all aspects of our work. Our collaboration is described further in [Section 2](#) of this report.

The center hosted a virtual symposium in October 2021 to encourage collaboration across sites and across disciplines within our center and from external organizations. 43 attendees participated over the four day event, including 2 from government, 2 from industry, 7 students, and 32 faculty/staff members. The symposium focused on emerging themes in transportation safety and consisted of the following sessions:

- Keynote Address from Lisandra Garay-Vega PhD of the National Transportation Safety Board
- Panel Discussion on Emerging Transportation Safety Themes; panelists include
  - Dan McGehee – National Advanced Driving Simulator, University of Iowa
  - Adam Shell – Iowa Department of Transportation
  - Tammy Trimble – Virginia Tech Transportation Institute
  - Josh Domeyer – Toyota Collaborative Safety Research Center
  - Laura Sandt – Highway Safety Research Center, University of North Carolina
- Brainstorming Session on how SAFER-SIM can address emerging topics
- Year 5 Project Introductions

Below is a summary of collaboration performance metrics. Full list can be found [here](#).

Collaboration Performance Metric	Result
Attendance at the SAFER-SIMposium	43
Interdisciplinary research projects within and across sites	6
Collaborative research projects across SAFER-SIM or other UTC sites	8
Collaborations with industry partners and government agencies	17
Collaborative peer-reviewed journal publications	0
Collaborative book chapters	0
Student exchanges with other SAFER-SIM sites	0
Students pursuing advanced degrees at other SAFER-SIM sites	0

Programs involving community colleges	1
Graduates hired at other SAFER-SIM or UTC sites	0

### 1.2.6 Diversity

Diversity continues to play an important part in our research and outreach. The University of Puerto Rico Mayaguez and University of Central Florida are minority serving institutions. Twenty-three (23) students from historically excluded groups were involved in twenty (22) SAFER-SIM projects this period. Individuals from historically excluded groups contribute to SAFER-SIM at all levels including the directors, advisory board, principal investigators, and students.

Shannon Roberts attended the Annual Meeting for the National Society of Black Engineers, as the faculty advisor for the UMass Chapter, from March 23-27, 2022. The meeting comprises the largest gathering of Black engineers, with >5000 attendees. Twenty students from UMass attended the Annual Meeting.

Below is a summary of diversity performance metrics. Full list can be found [here](#).

Diversity Performance Metric	Result
# SAFER-SIM projects involving underrepresented/minority (U/M) students	22
# U/M events attended	1
# U/M students at attended events	5000
Graduating U/M student placement	1

### 1.3 What opportunities for training and professional development have been provided?

SAFER-SIM provides opportunities for training and professional development in numerous ways. Students gain direct training from faculty and research staff from involvement in research projects. Researchers and students are encouraged to attend conferences to share their work and continually develop their professional skills and share their knowledge with others in the transportation industry.

### 1.4 How have the results been disseminated?

Final reports and datasets are posted on all required repositories after completion. Additionally, research projects are required to submit two-page summaries and prepare online webinar presentations about their results which are shared with contacts in academia, industry, and government. Researchers and students also share their work at meetings, conferences, and with the public.

### 1.5 What do you plan to do next reporting period to accomplish these goals?

SAFER-SIM will fund an additional year of projects next period. The center will continue progressing toward final reports from projects. Sites and administration teams have been working through a backlog of delays due to COVID-19, and the center will see many delayed projects complete next period. Online webinars and online outreach will continue as normal. Education and outreach activities, both in-person and virtual, will increase as more events and visits are possible following a couple years of restriction due to COVID-19. Expanded discussion on COVID-19 effects in [Section 6](#).

## 2. Participants & Collaborating Organizations

### 2.1 What organizations have been involved as partners?

The following organizations have been involved as SAFER-SIM partners:

<i>Organization Name</i>	<i>Location</i>	<i>Contribution</i>
Aisin Technical Center of America	Northville, MI	Financial support
AAA Foundation for Traffic Safety	Washington D.C.	Financial support Collaborative research
InSight Learning Technologies	Pacific Palisades, CA	Personnel exchange
Mandli Communications Inc.	Madison, WI	In-kind support Facilities Collaborative Research
Continental Mapping Consultants Inc	Madison, WI	In-kind support Facilities Collaborative Research
Council of University Transportation Centers	Washington D.C	Financial support
Hyundai America Technical Center Inc.	Superior Township, MI	Financial support
City of Orlando	Orlando, FL	Collaborative Research
Recreative Association of Sport Buenaventura	Mayaguez, PR	Facilities
Mayaguez Bureau of Highway Patrol	Mayaguez, PR	Facilities Personnel Exchange
Club de Oficinistas de Mayagüez	Mayaguez, PR	Facilities
Puerto Rico LTAP Center, University of Puerto Rico at Mayaguez	Mayaguez, PR	Facilities
VHB	Washington D.C.	In-kind support
Lee Engineering	Phoenix, AZ	In-kind support
UW-Madison Global Health Institute	Madison, WI	Collaborative Research
City of Racine	Racine, WI	Financial support
Gateway Technical College	Racine, WI	In-kind support

### 2.2 Have other collaborators or contacts been involved?

A main focus of SAFER-SIM UTC is collaboration, both within consortium sites and across disciplines. Consortium members engage in regular web conferencing, teleconferences, and email communications, as well as face-to-face interactions via site visits and time set aside during symposia. Site directors participate in a conference call once a month to share information about the progress at each university.

SAFER-SIM researchers have a diverse range of backgrounds that span many colleges throughout the universities. The variety of expertise within the consortium creates a collaborative environment to take a holistic approach on safety issues. The backgrounds of our researchers include:

- Civil, Environmental, & Construction Engineering

- Mechanical & Industrial Engineering
- Industrial & Systems Engineering
- Computer Science
- Psychology & Brain Sciences
- Public Health
- Management Sciences
- Urban and Regional Planning

Our advisory board currently includes 10 individuals from industry, government, and academia.

William Horrey	AAA Foundation for Traffic Safety
Patrick Hoye	Iowa Governors Traffic Safety Bureau
Rich Romano	University of Leeds
Lisa Schletzbaum	Massachusetts DOT
Gary Huttman	MetroPlan Orlando
Chuck Green	Industry consultant (formerly GM)
Elizabeth Pulver	State Farm
Don Fisher	Volpe
John Corbin	USDOT
Linda Boyle	University of Washington
Rebecca Burkel	Wisconsin DOT

### 3. Outputs

Below is a summary of our technology transfer plan output performance metrics. Further description can be found in [Section 1.2.4](#) Technology Transfer Accomplishments with the full list accessible [here](#).

Performance Metric	Target	Result	Target Next Period
SAFER-SIM webinars	10	12	10
Registrations for webinars	200	309	200
Views of archived webinar content	200	512	200
Press releases related to SAFER-SIM	1	1	1
Media requests	10	8	10
Tours of facilities	5	20	5
Website traffic	3,000 users 5,000 sessions 8,500 pageviews	2,771 users 4,155 sessions 7,961 page views	3,000 users 5,000 sessions 8,500 pageviews
Patents filed	1	0	1
DOT requests for	1 per year	0	1 per year

presentations or proposals related to SAFER-SIM			
Practitioner attendance at events	100	43	100
Number of improved or new simulation technologies, software, methods, or processes	5	1	5

### 3.1 Publications, conference papers, and presentations

#### *Journal Publications*

1. Mahdavian, A., Shojaei, A., McCormick, S., Papandreou, T., Eluru, N. and Oloufa, A.A., 2021. Drivers and Barriers to Implementation of Connected, Automated, Shared, and Electric Vehicles: An Agenda for Future Research. *IEEE Access*, 9, pp.22195-22213. <https://doi.org/10.1109/ACCESS.2021.3056025>
2. Amin Vahedian Khezerlou, Xun Zhou, Xinyi Li, W. Nick Street, Yanhua Li. DILSA+: Predicting Urban Dispersal Events Through Deep Survival Analysis with Enhanced Urban Features. In *ACM Transactions on Intelligent Systems and Technology (TIST)*, <https://doi.org/10.1145/3469085>
3. Yiqun Xie, Xiaowei Jia, Shashi Shekhar, Han Bao and Xun Zhou. Significant DBSCAN+: Statistically Robust Density-based Clustering. In *ACM Transactions on Intelligent Systems and Technology (TIST)*, <https://doi.org/10.1145/3474842>.
4. Han Bao, Xun Zhou, Yiqun Xie, Yingxue Zhang, Yanhua Li. COVID-GAN+: Estimating Human Mobility Responses to COVID-19 through Spatio-Temporal Generative Adversarial Networks with Enhanced Features. In *ACM Transactions on Intelligent Systems and Technology (TIST)*, <https://doi.org/10.1145/3481617>.
5. Yingxue Zhang, Yanhua Li, Xun Zhou, Jun Luo, and Zhi-Li Zhang. Urban Traffic Dynamics Prediction -- A Continuous Spatial-Temporal Meta-Learning Approach.. In *ACM Transactions on Intelligent Systems and Technology (TIST)*, <https://doi.org/10.1145/3474837>.
6. Kasarla, P., Wang, C., Brown, T. L., & McGehee, D. (2021). Modeling and prediction of driving performance measures based on multi-output convolutional Gaussian process. *Accident Analysis & Prevention*, 161, 106360. October 2021. <https://doi.org/10.1016/j.aap.2021.106360>
7. McGehee, D., Roe, C., Kasarla, P., & Wang, C. (2021). Quantifying and recommending seat belt reminder timing using naturalistic driving video data. *Journal of Safety Research*. <https://doi.org/10.1016/j.jsr.2021.12.022>
8. Lishengsa Yue, Mohamed Abdel-Aty, Zijin Wang, Effects of Connected and Autonomous Vehicle Merging Behavior on MainLine Human Driven Vehicle, *Journal of Intelligent & Connected Vehicles*. <https://doi.org/10.1108/JICV-08-2021-0013>
9. Subramanian, L. D., O'Neal, E. E., Mallaro, S., Williams, B., Sherony, R., Plumert, J. M. & Kearney, J. K. (2022). A comparison of daytime and nighttime pedestrian road-crossing behavior using an immersive virtual environment, *Traffic Injury Prevention*, 23:2, 97-101, DOI: <https://doi.org/10.1080/15389588.2021.2023738>
10. Rahimian, P., Plumert, J. M., & Kearney, J. K. (2021). The Effect of Visuomotor Latency on

Steering Behavior in Virtual Reality. *Frontiers in virtual reality*, 2,  
<https://doi.org/10.3389/frvir.2021.727858>

11. O’Neal, E. E., Rahimian, P., Jiang, Y., Zhou, S. Nikolas, M., Kearney, J. K., & Plumert, J. M. (2022). How do child ADHD symptoms and oppositionality impact parent-child interactions when crossing virtual roads? *Journal of Pediatric Psychology*, 47(3), 337-349,  
<https://doi.org/10.1093/jpepsy/jsab102>
12. Subramanian, L. D., O’Neal, E. E., Roman, A., Sherony, R., Plumert, J. M., & Kearney, J. K. (2021). How do pedestrians respond to adaptive headlamp systems in vehicles? A road-crossing study in a virtual environment. *Accident Analysis and Prevention*, 160, 106298,  
<https://doi.org/10.1016/j.aap.2021.106298>
13. Parr, M. D. N., Tang, H., Mallaro, S. R., Kearney, J. K., & Plumert, J. M. (2021). Do inattention/hyperactivity and motor timing predict children’s virtual road-crossing performance? *Journal of Pediatric Psychology*, 46(9):1130-1139. <https://doi.org/10.1093/jpepsy/jsab054>
14. Yue, L., Abdel-Aty, M. and Wang, Z. (2022), "Effects of connected and autonomous vehicle merging behavior on mainline human-driven vehicle", *Journal of Intelligent and Connected Vehicles*, Vol. 5 No. 1, pp. 36-45. <https://doi.org/10.1108/JICV-08-2021-0013>
15. Deliali, A., Tainter, F., Ai. C., and Christofa, E., 2022. A Framework for Mode Classification in Multimodal Environments Using Radar-based Sensors. *Journal of Intelligent Transportation Systems: Technology, Planning, and Operations*. <https://doi.org/10.1080/15472450.2022.2051702>
16. Deliali, A., Esenther, S., Frisard, C., Goins, K.V., Lemon, S., Pollitt, K., Christofa, E., 2021. Incorporating health-related criteria for project scoring in Massachusetts. *Transportation Research Record*, 03611981211057050. <https://doi.org/10.1177%2F03611981211057050>
17. Parthasarthy, A. R., Mehrotra, S., Fitzpatrick, C., Roberts, S., Christofa, E., & Knodler Jr, M. 2021. Driver behavior and performances on in-vehicle display based speed compliance. *Accident Analysis & Prevention*, 162, 106390. <https://doi.org/10.1016/j.aap.2021.106390>

#### *Conference papers and presentations*

1. “Using Virtual Simulator to Evaluate the Automated Emergency Braking System for Avoiding Pedestrian Crash at Intersections under the Occluded Conditions (2022).” The 101th Annual Meeting of the Transportation Research Board, Washington D.C., U.S.
2. Wang, Z., Yue, L\*, Abdel-Aty, M., Zhu, J., Zheng, O., & Zaki, M. “Cooperative Driving at Non-Signalized Intersection in a Mixed Traffic Environment: A Co-Simulation Based Multi-Driver Driving Simulator Study.” The 101th Annual Meeting of the Transportation Research Board, Washington D.C., U.S.
3. O’Neal, E.E., Peek-Asa, C., Wendt, L., Hamann, C., Reyes, M., & Yang, J. (March, 2022). Factors associated with teens’ crash culpability. Oral presentation submitted for presentation at the 2021 annual meeting of the Society for Violence and Injury Research, Washington D.C.
4. O’Neal, E.E., Plumert, J.M., & Peek-Asa, C. (March, 2022). A method for evaluating parent-teen conversations about potential roadway hazards. Oral presentation submitted for presentation at the 2021 annual meeting of the Society for Violence and Injury Research, Washington D.C.
5. Peek-Asa, C., Zhang, L., Hamann, C., Reyes, M., O’Neal, E.E., Yang, J. (March, 2022). Direct medical costs of teen-involved vehicle crashes by culpability in a rural state. Oral presentation submitted for presentation at the 2021 annual meeting of the Society for Violence and Injury Research, Washington D.C.

6. Yiqun Xie, Erhu He, Xiaowei Jia, Han Bao, Xun Zhou, Rahul Ghosh and Praveen Ravirathinam. A Statistically-Guided Deep Network Transformation and Moderation Framework for Data with Heterogeneity. In Proc. IEEE International Conference on Data Mining (ICDM'21), Auckland, New Zealand, Nov. 7-10, 2021
7. Xin Zhang, Yanhua Li, Xun Zhou, Oren Mangoubi, Ziming Zhang, Vincent Filardi, and Jun Luo, DAC-ML: Domain Adaptable Continuous Meta-Learning for Urban Dynamics Prediction. In Proc. IEEE International Conference on Data Mining (ICDM'21), Auckland, New Zealand, Nov. 7-10, 2021
8. Yingxue Zhang, Yanhua Li, Xun Zhou, Zhenming Liu, and Jun Luo. C3-GAN: Complex-Condition-Controlled Urban Traffic Estimation through Generative Adversarial Networks In Proc. IEEE International Conference on Data Mining (ICDM'21), Auckland, New Zealand, Nov. 7-10, 2021.
9. Menghai Pan, Xin Zhang, Yanhua Li, Xun Zhou and Jun Luo. Learning Decision Making Strategies of Non-experts: A NEXT-GAIL Model for Taxi Drivers. In Proceedings of the ACM SIGSPATIAL International Conference on Advances in Geographic Information Systems (SIGSPATIAL'21), 2021.
10. Yiqun Xie, Xiaowei Jia, Han Bao, Xun Zhou, Jia Yu, Rahul Ghosh and Praveen Ravirathinam. Spatial-Net: A Self-Adaptive and Model-Agnostic Deep Learning Framework for Spatially Heterogeneous Datasets. In Proceedings of the ACM SIGSPATIAL International Conference on Advances in Geographic Information Systems (SIGSPATIAL'21), 2021.
11. Deliali A., Fournier, N., Knodler, M., and Christofa, E. 2022. Investigating the safety impact of segment- and intersection-level bicycle treatments on bicycle-motorized vehicle crashes Transportation Research Board 101st Annual Meeting, 9-13 January, Washington D.C., Paper No. 22-04595.
12. Christofa, E. Ai, C., Deliali, A., Tainter, F., Cesic, L., Hannon, T., and Kostopoulou, E. 2022. Bicyclist and motorist behavior at bike boxes. Transportation Research Board 101st Annual Meeting, 9-13 January, Washington, D.C., Paper No. 22-04722.
13. Han, Z., Gonzales, E.J., Christofa, E., Oke, J. 2022. Modeling system-wide urban rail transit energy consumption: A case study of Boston. Transportation Research Board 101st Annual Meeting, 9-13 January, Washington, D.C., Paper No. 21-00892.
14. Han, Z., Gonzales, E.J., Christofa, E., and Oke, J. 2021. Modeling system-wide energy in urban rail systems for sustainable strategy discovery and decision-making. INFORMS Annual Meeting, 24 -27 October, Anaheim, California.
15. Deliali, A., Ai, C., and Christofa, E. 2021. Assessing the impact of bicycle infrastructure treatment type on the frequency of right-hook conflicts between bicyclists and motor vehicles at signalized intersections. International Cycling Safety Conference, 10-12 November, Lund, Sweden.
16. Christofa, E., 2021. Effectiveness of Bike Boxes in Massachusetts, 2021 Moving Together Conference, December 7 [Online]
17. Alberto Figueroa-Medina, Didier Valdés, Benjamín Colucci, Natacha Cardona, and Andrés Chamorro. September 2021. Pedestrian Walking speeds and Success Rates on Mid-Block Crossing Using Virtual Reality Simulation.

*Books or other non-periodical, one-time publications*

Nothing to report



### 3.2 Policy Papers

Nothing to report

### 3.3 Websites(s) or other Internet site(s)

[SAFER-SIM website](#) - contains descriptions of research projects and final reports, news articles about our work, contact information, and other important information related to the center. The website is updated regularly with news stories and outreach events. Traffic measures from the website are below:

Metric	This Period	Lifetime
Total Users	2,771	25,158
New Users	2,723	24,598
Sessions	4,155	46,892
Page Views	7,961	98,429

[SAFER-SIM YouTube Channel](#) - contains webinars, virtual symposium presentations, simulation boot camp, and online traffic safety merit badge videos. Metrics from those videos are below:

Metric	This Period	Lifetime
Uploaded videos	14	151
Views	7,617	42,217
Subscribers	31	208

[SAFER-SIM Twitter Account](#) – contains tweets about webinars, news digests, news articles, merit badge opportunities, and YouTube playlists. Metrics from the account are below:

Metric	This Period	Lifetime
Tweets	0	394
Tweet Impressions	0	82,600
Followers	0	170

[SAFER-SIM Dataverse](#) - data repository containing final data from research projects.

Metric	This Period	Lifetime
Datasets	6	42
File Downloads	935	14,176

### 3.4 New methodologies, technologies, or techniques

Nothing to report

### 3.5 Inventions, patent, and/or licenses

Nothing to report

### 3.6 Other products

[Simulation Boot Camp Videos](#) –A webinar series developed by the collective expertise of SAFER-SIM to train researchers on using simulation as a research tool. The boot camp was translated into an in-person workshop at the Road Safety & Simulation conference. The online videos have been viewed 552 times.



[Online Traffic Safety Merit Badge](#) – 1020 Scouts have started the materials and 653 have completed the requirements. More information in [Section 1.2.3.](#)

Metric	This Period	Lifetime
Scouts Started	55	1020
Scouts Completed	41	653

[Online Engineering Merit Badge](#) – 313 Scouts have started the materials and 155 have completed the requirements. More information in [Section 1.2.3.](#)

Metric	This Period	Lifetime
Scouts Started	39	313
Scouts Completed	13	155

[Two-page Project Summaries](#) – Each research project is required to submit a 2-page summary of the research for a quick overview and takeaways from the work. The summaries focus on recommended practices for transportation professionals providing easier access to key information than the technical report and are available on the “[Research](#)” tab of our website within specific project information.

[Biweekly News Digest](#) – The email campaigns serve to provide information about SAFER-SIM webinars, final reports, conferences, news articles, and job opportunities. Metrics from the news digest are below:

Metric	This Period	Lifetime
Subscribers	+2	351 *inactive emails removed
Campaigns Sent	14	146
# Opens	1,488	10,446

#### 4. Outcomes

SAFER-SIM included three performance measures related to outcomes in our technology transfer plan:

Performance Measure	Target	Result	Target Next Period
Number of improved or new technologies, software, methods, or processes adopted	5	1	5
Stakeholders who adopt, implement or deploy SAFER-SIM research findings or technologies through policy, practice, regulation, rulemaking or legislation	2	0	2
Number of projects that reach adoption, implementation or deployment	1	0	1

*Number of improved or new technologies, software, methods, or processes adopted*

1. Through this project, UM developed two interfaces that better informs drivers of the functionality of automated vehicle technology. In comparison to a bare bones interface, the two improved interfaces yielded optimal performance (i.e., drivers took back control of the vehicle quickly and efficiently).

*Stakeholders who adopt, implement or deploy SAFER-SIM research findings or technologies through policy, practice, regulation, rulemaking or legislation*

Nothing to report

*Number of projects that reach adoption, implementation or deployment*

Nothing to report

#### **4.1 Increased understanding and awareness of transportation issues**

SAFER-SIM makes efforts to reach all stakeholders with our research and outreach. Researchers and students share work at conferences, meetings, and with the general public to promote safety and bring awareness to transportation issues.

#### **4.2 Passage of new policies, regulation, rulemaking, or legislation**

Nothing to report

#### **4.3 Increases in the body of knowledge**

SAFER-SIM research continues to build on the knowledge of transportation safety and simulation through final reports, summaries, journal articles, and presentations at conferences, meetings, and other avenues. Full list [here](#).

#### **4.4 Improved processes, technologies, techniques and skills in addressing transportation issues**

Highlighted in [Section 1.2.4](#) and in [Section 4](#).

#### **4.5 Enlargement of the pool of trained transportation professionals**

Our center supports the development of trained transportation professionals in numerous ways. College students directly involved in research will graduate and join the workforce as members of industry, academia, or government. Outreach efforts focused on middle school and high school students will spark the interest of some to study and join the transportation field. The recorded webinars and presentations from the boot camp continue to draw interest online.

#### **4.6 Adoption of new technologies, techniques or practices**

Nothing to report

### **5. Impacts**

SAFER-SIM included two performance measures related to impacts in our technology transfer plan:

<b>Performance Measure</b>	<b>Target</b>	<b>Result</b>
Expected reductions in crashes from implemented policy, practice, regulation, rulemaking or legislation	Not yet determined	Not yet realized
Expected reductions in congestion and traffic conflicts implemented policy, practice, regulation, rulemaking or legislation	Not yet determined	Not yet realized

*Expected reductions in crashes from implemented policy, practice, regulation, rulemaking or legislation*

1. We expected the research outcome from this [SAFER-SIM project](#) to have a clear idea of traffic safety factors of the highway before starting a major project.
2. If the advanced dashboard interface from this [SAFER-SIM project](#) were implemented on a larger scale, more drivers would be aware of automated vehicle functionality and would more closely monitor the technology when it is activated. This would in turn lead to fewer instances of unexpected vehicle behavior (e.g., the vehicle doesn't stop for a pedestrian at an intersection) and fewer crashes.

*Expected reductions in congestion and traffic conflicts implemented policy, practice, regulation, rulemaking or legislation*

1. We expected the research outcome from [this SAFER-SIM project](#) to improve the transportation infrastructure and stakeholders to be informed about possible scenarios for reducing traffic congestion.

### **5.1 Impact on the effectiveness of the transportation system**

SAFER-SIM's approach to understanding the role that humans play in a complex, ever-changing transportation environment will lead to improved safety and effectiveness of the transportation system. Our research will lead to a safer roadway environment that encourages multiple modes of transportation, thereby also reducing traffic congestion and preserving the environment.

### **5.2 Impact on the adoption of new practices, or instances where research outcomes have led to the initiation of a start-up company**

Nothing to report

### **5.3 Impact on the body of scientific knowledge**

Highlighted in [Section 1](#) and [Section 3](#)

### **5.4 Impact on transportation workforce development**

Highlighted in [Section 1](#)

## **6. Changes/Problems**

### **6.1 Changes in approach and reasons for change**

The center is still affected by COVID-19 although we are beginning to return to normal activities. Research projects have resumed progress toward completion, but there have been some additional delays due to a backlog of projects at sites. This backlog has led to delays on research and administrative sides. Research teams are balancing multiple active projects with new, overlapping timelines causing delays in finalizing report revisions and datasets. The administrative burden has increased to process these deliverables because the shifted timelines led more projects completing at the same time than originally expected.

We are working with PIs to finalize these materials from completed projects early next period, and we expect these COVID-related submission delays to not be as prominent moving forward through the remainder of the grant performance period once we are caught up. All funded SAFER-SIM projects have

plans to ensure completion before the main award end date.

Following COVID-19, researchers in our center are slowly returning to normal in-person outreach events and attending professional meetings and conferences. Sites are still complying with their university's travel and community engagement guidelines, and our center already has plans to share our work at in-person conferences, schools, and community events next period.

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

Described in [Section 6.1](#)

**6.3 Changes that have a significant impact on expenditures**

Described in [Section 6.1](#)

**6.4 Significant changes in use or care of human subjects, vertebrate animals, and/or biohazards**

Described in [Section 6.1](#)

**7. Special Reporting Requirements**

Nothing to report