SEMI-ANNUAL PROGRESS REPORT FOR UNIVERSITY TRANSPORTATION CENTERS

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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 5 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 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 work force

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

SAFER-SIM issued a Request for Proposals last period in September with proposals due in December 2019. The center received 26 proposals from the five consortium sites. 17 research projects were funded in Year 4. SAFER-SIM has funded 60 projects total – 59 research and 1 outreach – under the FAST Act. Twenty (20) projects remain active, 23 projects are complete, and 17 are funded but inactive. Information about these projects can be found on the Transportation Research Board's Research in Progress (RIP) Database and the SAFER-SIM website.

Year	Projects Active	Projects Complete	Funded/Inactive	Total Projects
Y1	1	8	0	9
Y2	2	14	0	16
Y3	17	1	0	18
Y4	0	0	17	17
Total	20	23	17	60

SAFER-SIM completed 6 research projects this period. These projects have submitted final reports to required entities and have uploaded final datasets in our Harvard Dataverse. Four (4) of these projects submitted reports on TRID that are still waiting to be posted.

Projects Completed this Period	TRID
Can Regenerative Braking Save Your Life? A Distributed Simulation Study	01721977
Human-Machine Interfaces to Convey Feedback in Automated Vehicles	01726579
Assessing Crash Risks of Evacuation Traffic: A Simulation-based Approach	Submitted
Assessing the Effectiveness of Connected Vehicle Technologies based on Driving Simulator Experiments	Submitted
A Machine Vision Approach for Estimating Motion Discomfort in Simulators and in Self-Driving Vehicles	Submitted
Multi-modal Distributed Simulation Combining Cars, Bicyclists, and Pedestrians	Submitted

The University of Massachusetts secured two external grants building off SAFER-SIM work:

1. *The Future of the Curb*, Massachusetts Department of Transportation, $100,000, 06/01/2020-05/31/2021, Shannon Roberts co-PI with PI Eric Gonzales. The objective of this grant is to explore the demands on the curbside lane, identify future demands on the curbside lane, and identify strategies for re-purposing and managing the curbside lane. It logically builds on the current SAFER-SIM work that is focused on understanding how future technology (driving automation systems) will impact the driving landscape. More specifically, the literature review and results from the SAFER-SIM project will be used to inform this grant.

2. *Effects of Automation on Material Handlers' Productivity and Efficiency*, Toyota Material Handling North America, $150,000, 06/01/2020-05/31/2021, Shannon Roberts - The goal of this proposal is to understand how automated technologies implemented in forklifts affect the job of

material handlers' It logically builds on the current [SAFER-SIM work](#) that is designed to investigate how driving automation technology affects driver performance.

The University of Central Florida had two researchers win awards on their work this period.
1. Mdhasibur Rahman from the University of Central Florida won the Milton Pikarsky Memorial Award at the 2020 CUTC National Student Awards. He won for best Master's thesis in the field of science and technology in transportation studies.
2. Rezaur Rahman (UCF) - Best MS Thesis Award in the College of Engineering and Computer Science at UCF. This award has been given among all the submissions from engineering schools at UCF.

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)	5
Book chapters	2
Edited books	0
Conference papers, posters, and symposia	15
Paper/poster awards	2
External grants related to SAFER-SIM	3

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

Thirty-five (35) SAFER-SIM researchers attended a symposium on October 13, 2019 at the University of Iowa. The event was held the day before the Road Safety & Simulation conference to ease travel and support attendance at both events. The focus was on professional development. Workshops and presentation topics included Professional Networking by Travis Greenlee, Director of Engineering Career Services; Constructing a CV & Job Opportunities by Dr. Jodie Plumert - University of Iowa and Dr. Mike Knodler - University of Massachusetts-Amherst; and Operational Definitions of Driving Performance Measures and Statistics (SAE_201506) by Dr. Chris Schwarz – University of Iowa. Attendees also played Simulator Research Bingo to strengthen their understanding of simulation as a research tool. SAFER-SIM initiated two levels of excellence awards to recognize the contributions of students to the work we do. One undergraduate and one graduate student from each institution will be recognized each year. Three (3) undergraduate and four (4) graduate students were honored for exceptional work within SAFER-SIM.

SAFER-SIM members Dawn Marshall and Chris Schwarz lead a Simulation Boot Camp workshop at the Road Safety and Simulation Conference. The workshop mirrored the online simulation boot camp webinar series developed by SAFER-SIM and included an overview of simulation, experimental design, scenario design, development and testing, and data analysis. Both informational presentations and hands-on activities were included.

SAFER-SIM researchers from University of Iowa and University of Massachusetts-Amherst also lead a

workshop at the Road Safety & Simulation Conference on Advanced Driver Assistance Systems and automated vehicles.

SAFER-SIM researchers continued representing the center at professional meetings. Some center highlights include:

- Dan Negrut of UW, *"Chrono: a multi-physics simulation framework for computational dynamics,"* January 15, 2020, Hong Kong University of Science and Technology, China
- Alberto M. Figueroa Medina of UPR presented on *New Model of Performance-Based Geometric Design of Highways*, as keynote speaker in the closure session of the 1st International Congress on Highway Engineering. The congress was held at Cauca University in Popayan, Colombia. October 2, 2019.
- Michelle Reyes of UI presented at the 2019 Traffic & Safety Forum organized by the Iowa Department of Transportation on October 2, 2019.
- John Lee from UW gave a keynote presentation at the Road Safety & Simulation conference titled *Envisioning the Future of Transportation* on October 16, 2019

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. The leadership of individuals in our center has been recognized by other organizations leading to the following highlighted awards this period:

1. Eleni Christofa (UM) received the Greek Diaspora Fellowship, Institute of International Education, funding from the Stavros Niarchos Foundation
2. Shannon Roberts (UM) received the Stephanie Binder Young Professional Award from the Human Factors and Ergonomics Society – Surface Transportation Technical Group for her contribution to transportation Human Factors.
3. Yalda Ebadi (UM) won the WTS Boston Helene M. Overly Memorial/Ann Hershfang Memorial Scholarship to help her pursue a career path in transportation.
4. Francis Tainter (UM) received the CUTC Student of the Year award from our center.
5. UCF SST team - Prince Michael International Road Safety Awards
6. Benjamín Colucci, American Society of Civil Engineers (ASCE) Fellow Member

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

Leadership Development Performance Metric	Result
Invited presentations	16
Invited papers	0
Invited workshops	9
Grant review panels	2
Advisory committees	37
Journal editing	48
Leadership positions in professional organizations	10
SAFER-SIM webinars	6
Professional awards	13

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).

Last period, SAFER-SIM developed an online resource for Scouts across the country to earn the Traffic Safety merit badge. The goal of the resource was to create greater visibility and access to the merit badge. The Traffic Safety merit badge "gives Scouts some 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 expanded rapidly this period with students home from COVID-19. 617 Scouts have started the materials and 254 have successfully completed the requirements

Below is a summary of education and workforce development performance metrics. Full list can be found here.

Education and Workforce Development Performance Metric	Result
Peer-reviewed journal publications w/ student authors	5
Book chapters w/ student authors	0
Conference posters and papers w/ student authors	10
Paper/poster awards w/ student authors	1
Graduate students working on and supported by SAFER-SIM related projects	39
Undergraduate students working on and supported by SAFER-SIM related projects	23
Student attendance and presentations at the SAFER-SIMposium	19
Transportation-related M.A. and PhD theses	2
Curriculum modules developed	3
Student Internships	3
Presentations to student groups or classes	11 presentations 417 students
# Schools visited and # students present	5 schools 425 students
# Career fairs visited and # of attendees	4 fairs 693 attendees
Summer institutes and programs and # of students participating	1 institute NA

1.2.4 Technology Transfer
Projects funded by SAFER-SIM 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 6 webinars this period with 179 registrants – 120 from academia, 35 from industry, and 24 from government.

Webinar	Date	Registrants	Archived Views
Can Regenerative Braking Save Your Life?	10/8/2019	23	13
Driver Behavior and Performance Study on In-Vehicle Display Based Speed Compliance	11/5/2019	33	12
Evaluation of Managed Lane Facilities in a Connected Vehicle Environment	11/19/2019	31	12
Assessing Crash Risks of Evacuation Traffic: A Simulation-based Approach	2/18/2020	20	4
Assessing the Effectiveness of Connected Vehicle Technologies based on Driving Simulator Experiments	3/17/2020	42	18
A Machine Vision Approach for Estimating Motion Discomfort in Simulators and in Self-Driving Vehicles	3/31/2020	30	11
		179	70

Our center has been successful at receiving media attention from our work. Some highlights of SAFER-SIM sites in the media this period include:
- There's an $80 million driving simulator in Iowa, and we tried it out - Ars Technica
- Bicycle safety tips to keep you cruising through the winter months - KWWL
- Experts stress winter driving safety following recent snowfall - KCRG
- Experts seeing more phone-related injuries - KCRG

Sharing our work with stakeholders has led to site tours from government and industry. Individuals from the following organizations visited this period:
- State Farm
- Road Safety & Simulation Conference
- Daily Iowan
- FHWA
- Hyundai
- Aisin Technical Center of America
- University of Nebraska
- Toyota
- Colorado DOT
- Iowa DOT

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

Technology Transfer Performance Metric	Result
SAFER-SIM webinars	6
Registrations for webinars	237
Views of archived webinar content	162
Press releases for SAFER-SIM related research	0
Media requests	7
Tours of facilities	12
Website traffic	4011 users 6992 sessions 11,515 page views
Patents filed	0
DOT requests for presentations or proposals related to SAFER-SIM	1
Practitioner attendance at events	35
Number of improved or new simulation technologies, software, methods, or processes	6

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.

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

Collaboration Performance Metric	Result
Attendance at the SAFER-SIMposium	35
Interdisciplinary research projects within and across sites	4
Collaborative research projects across SAFER-SIM or other UTC sites	8
Collaborations with industry partners and government agencies	12
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 is a minority serving institution. In addition, minority students make up one-third of the student population at the University of Central Florida, and they are now considered a Hispanic Serving

Institution. Twenty (20) diverse students were involved in 28 SAFER-SIM projects this period.

A couple diversity highlights from this period are:
- Shannon Roberts wrote a chapter titled "Advancing Diversity, Inclusion, and Social Justice through Human Systems Engineering" in the book *Automation, work, and racial equity: How human systems engineering can shape the future of work.*
- Jacob Heiden participated on the Femineer 2020 Summit Planning Committee. The Femineers program provides K-12 students with project-based learning, undergraduate women engineering student mentors, and opportunities to visit UI's campus. The summit was planned for May 2020 but unfortunately, it is canceled due to COVID-19.

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	28
# U/M events attended	1
# U/M students at attended events	28
Graduating U/M student placement	0

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

SAFER-SIM provides opportunities for training and professional development in a number of 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.

The Road Safety and Simulation (RSS) conference hosted by The University of Iowa October 14-17, 2019 hosted 160 attendees from 13 countries, and 27 U.S. states. Conference focus areas mirrored SAFER-SIM themes of vulnerable road users, automated vehicles, connected vehicles, roadway infrastructure, and simulation as well as distributed simulation, naturalistic driving studies, and law and other topics. Three half-day workshops on Automated Vehicles, Human Factors, and Simulation Boot Camp with 48 registrants. Tours of 6 labs including the Hank Lab, Visual Intelligence Laboratory, Virtual and Augmented Reality Business Unit, 3D Bio-Motion Research Lab, National Advanced Driving Simulator, and the Operator Performance Labs were included as another half-day activity. The conference program included five (5) panel discussions, 18 lectern presentations, and three (3) poster sessions with a total of 162 presentations.

Exhibitors included industry stakeholders such as entities that provide research simulator and eye tracking hardware and software. Sponsors included the UI Injury Prevention Research Center and AAA Foundation for Traffic Safety.

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 2-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.

SAFER-SIM was selected as one of the UTC's to exhibit in the US DOT booth at CES in January 2020. The center provided an interactive driving simulator experience that is used for public outreach. Final report summaries were shared with CES attendees.

1.5 What do you plan to do next reporting period to accomplish these goals?
New projects as well as some ongoing projects funded by SAFER-SIM will be delayed due to COVID-19. The center will continue progress on final reports for projects that have completed data collection. Online webinars and online outreach will continue. Full 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:

Organization Name	Location	Contribution
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. **Previously not reported**	Superior Township, MI	Financial support
City of Orlando **New this period**	Orlando, FL	Collaborative Research
Recreative Association of Sport Buenaventura **New this period**	Mayaguez, PR	Facilities
Mayaguez Bureau of Highway Patrol **New this period**	Mayaguez, PR	Facilities Personnel Exchange
Club de Oficinistas de Mayagüez **New this period**	Mayaguez, PR	Facilities
Puerto Rico LTAP Center, University of Puerto Rico at Mayaguez **New this period**	Mayaguez, PR	Facilities

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 wholistic 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. Rebecca Burkel, WisDOT Administrator for the Division of Transportation System Development, joined our advisory board in October 2019.

William Horrey	AAA Foundation for Traffic Safety
Patrick Hoye	Iowa Governors Traffic Safety Bureau
Rich Romano	University of Leeds
Lisa Schletzbaum	Massachusetts DOT
Gary Huttmann	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	6	6	6

Registrations for webinars	250	179	200
Views of archived webinar content	200	70	150
Press releases related to SAFER-SIM	1	0	1
Media requests	20	7	10
Tours of facilities	10	12	10
Website traffic	3000 users 5000 sessions 8500 page views	4011 users 6992 sessions 11,515 page views	
Patents filed	1		
DOT requests for presentations or proposals related to SAFER-SIM	1 per year	1	1 per year
Practitioner attendance at events	100	35	100
Number of improved or new simulation technologies, software, methods, or processes	5	6	5

3.1 Publications, conference papers, and presentations

Journal Publications

1. Deliali, A., Campbell, N., Knodler, M. and Christofa, E., 2020. Understanding the Safety Impact of Protected Intersection Design Elements: A Driving Simulation Approach. Transportation Research Record, https://doi.org/10.1177/0361198120909382.
2. Fournier, N., Bakhtiari, S., Valluru, K.D., Campbell, N., Christofa, E., Roberts, S. and Knodler Jr, M., 2020. Accounting for drivers' bicycling frequency and familiarity with bicycle infrastructure treatments when evaluating safety. Accident Analysis & Prevention, 137. https://doi.org/10.1016/j.aap.2019.105410
3. D. Valdés, B. Colucci, A. Figueroa-Medina, M. Rojas, E. Colón, and Y. Taveras. 2019. Seguridad de Peatones en Zonas Escolares Utilizando Simulador de Conducción. Revista Técnico-Científica del Colegio Dominicano de Ingenieros, Arquitectos y Agrimensores (CODIA), Vol. 2, pp. 10-20, Dec. 2019.
4. D. Valdés, B. Colucci, J. Ruiz, R. Garcia, B. Ruiz, E. Colón, and Y. Taveras. 2019. Uso de Simuladores de Conducción para Evaluar el Comportamiento de los Conductores y Mejorar la Seguridad en las Carreteras. Revista Técnico-Científica del Colegio Dominicano de Ingenieros, Arquitectos y Agrimensores (CODIA), Vol. 2, pp. 46-57, Dec. 2019.
5. D. Valdés, A. Figueroa-Medina, B. Colucci, M. Rojas, A. Bustillo and Y. Taveras. October 2019. Innovation in Transportation Safety and Driving Simulation: Puerto Rico Experience. FLITE Magazine, Vol. 61. No. 2 pp 10-13. ITE Florida Section.

Conference papers and presentations

1. H. Nassereddine, K. R. Santiago-Chaparro, and D. A. Noyce, "Advanced Warning System for Safer Interaction Between Vehicles and Vulnerable Road Users," presented at the 2020 Transportation Research Board Annual Meeting, Washington, DC, 2020.

2. H. Nassereddine, K. R. Santiago-Chaparro, and D. A. Noyce, "Modeling Vehicle-Pedestrian Interactions Using a Non-Probabilistic Regression Approach," presented at the 2020 Transportation Research Board Annual Meeting, Washington, DC, 2020.

3. Paper and presentation: A. Elmquist, D. Hatch, R. Serban, D. Noyce, D. Negrut, "Sensing Simulation for the Virtual Testing of Autonomous Vehicle Safety and Performance", Road Safety and Simulation Conference, 2019

4. D. Valdés, C. Lopez, B. Colucci and A. Figueroa-Medina. 2020. Developing an Educational Module to Increase Construction Engineering Students´ Knowledge of Work Zones and Temporary Traffic Control Plans. Paper accepted to the 127th Annual Conference & Exposition of the American Society for Engineering Education (ASEE), Montreal, Canada, June 20-24, 2020.

5. A. Figueroa-Medina, D. Valdés, B. Colucci, M. Rojas, A. Bustillo, and N. Cardona. 2020. Simulation of Driver-Pedestrian Conflicts at a Mid-Block Location in an Urban Setting. Paper accepted to the 2020 International Conference on Transportation and Development (ICTD). American Society of Civil Engineers, Seattle, Washington, May 2020.

6. D. Valdes, A. Figueroa-Medina, B. Colucci, M. Rojas and E. Colon. 2019. Evaluation of Driver Performance in an-Urban Arterial Highway Using a Driving Simulator. Poster presented at 2019 Road Safety & Simulation Conference. Oct. 14-17, 2019, Iowa City, Iowa, USA.

7. A. Figueroa-Medina, D. Valdés, B. Colucci, M. Rojas, A. Bustillo and N. Cardona. 2020. Simulation-Based Analysis of a Driver-Pedestrian Conflict at an Uncontrolled Location in an Urban Multi-lane Arterial. 99th Annual Meeting of the Transportation Research Board (TRB) of the National Academies, Wash., D.C., Jan. 12-16, 2020.

8. A. Figueroa-Medina, M. Abid, H. Nieves, and B. Santiago. 2019. The Experience with the Electric Scooter Shared-ride Service in Mayaguez, Puerto Rico. ITE Florida-Puerto Rico District Annual Meeting. Hotel La Concha, Nov. 8, 2019, San Juan, PR.

9. Deliali, A., Campbell, N., Knodler, M., Jr., Christofa, E., 2019. Does the existence and configuration of protected intersections affect bicycle safety at intersections? A driving simulator approach. Road Safety and Simulation Conference, 14-17 October 2019 - Iowa City, IA, USA.

10. Deliali, A., Campbell, N., Knodler, M., Jr., Christofa, E., 2020. Understanding The Safety Impact of Protected Intersection Design Elements – A Driving Simulation Approach. Transportation Research Board 99th Annual Meeting, January 12-16, Washington D.C.

11. Zhang, F., Russo, L., Landry, S., Sharma, P., Roberts, S. C., Seppelt, B., & Reimer, B. (2020). Perceptions of automated driver assistance systems (ADAS): Using text mining to uncover insights from drivers with real-world ADAS experience. In Proceedings of the Transportation Research Board 99th Annual Meeting 2020.

12. Zhang, F., Petit, J., & Roberts, S. C. (2019). A Simulator Study on Drivers' Response and Perception Towards Vehicle Cyberattacks. Human Factors and Ergonomics Society Annual Meeting Proceedings, 63, 1498–1502.

13. Rahman, R., Hasan, S., and Zaki, M. H. (2020) Towards Reducing the Number of Crashes during Hurricane Evacuation: Assessing the Potential Safety Impact of Adaptive Cruise Control Systems, TRB Annual Meeting 2020, D.C. Washington.

14. Guo, Z. (2020). Spatial Pricing of Ride-sourcing Services in a Congested Transportation Network. Presentation at the Transportation Research Board 99th Annual Meeting, Washington D.C.
15. Guo, Z., Huang, J., Zhou, Y., Macal, C. (2020). Agent-Based Modeling for Electrified Ride-Sourcing Services. Presentation at the Transportation Research Board 99th Annual Meeting, Washington D.C.

Books or other non-periodical, one-time publications
1. Christofa, E., Esentehr, S., Pollitt, K., 2019. Chapter 16: Incorporating Health Impacts in Transportation Project Decision Making, Transport and Health, Elsevier.
2. Roberts, S. C., Smith-Doerr, L., Zilberstein, S., Renski, H., Branch, E. H., & Wilkerson, T. (2019). Automation, work, and racial equity: How human systems engineering can shape the future of work. In R. D. Roscoe, E. K. Chiou, & A. R. Wooldridge (Eds.), Advancing Diversity, Inclusion, and Social Justice through Human Systems Engineering (pp. 191-214). Boca Raton, FL: CRC Press.

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 this period are below:

Metric	This Period	Lifetime
Total Users	4011	9641
New Users	3938	9641
Sessions	6992	16,392
Page Views	11,515	39,219

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	18	72
Views	4709	11,427
Subscribers	24	94

SAFER-SIM Dataverse - data repository containing final data from research projects.

Metric	This Period	Lifetime
Datasets	6	23
File Downloads	404	2334

3.4 New methodologies, technologies or techniques
Projects funded by SAFER-SIM developed or improved on the following technologies this period:
1. The VR simulation code was made in four levels: (i) Set up the VR environment to reflect an

urban city context with commercial and residential buildings (ii) Include a pedestrian pathing system to add pedestrian avatars along sidewalks in the scenario (iii) Modify traffic flow patterns with different vehicle speeds and vehicle gaps between subject runs (modification to the original code supplied by Dr. Kearney from University of Iowa), and (iv) Incorporate a counter of subject runs and a counter of vehicle-pedestrian collisions and is shown on a display board for the subject to be aware of the number of runs and crashes in the experiment.

2. A project established a new capability in a lab to run "wizard of Oz" experiments where a participant drives our full simulator and the experimenter can control a second virtual vehicle in the same world.

3. Data reduction protocols for eye data and driving measures.

4. The research team is currently finalizing a software package for eye-tracking video analysis, object identification, and integration with eye-tracking trace.

5. Developing a new agent-based simulation framework based on Repast Simphony to better capture the dynamic decision making of vehicles and V2I.

6. Ongoing work (1) new Chrono::Sensor module and (2) sensor models for producing realistic data for testing autonomous vehicle control algorithms. For Chrono::Sensor, the focus is creating a framework for users to test, with software-in-the-loop, various safety critical scenarios involving automated vehicles. For (2), the focus is exploration, development, and implementation of sensor models that seek to produce synthetic data with appropriate noise, distortion, and degradation.

3.5 Inventions, patent, and/or licenses
Nothing to report

3.6 Other products
Simulation Boot Camp Videos – The online videos have been viewed 478 times. The boot camp was translated into an in-person workshop at the Road Safety & Simulation conference. More information in 1.2.2.

Online Traffic Safety Merit Badge – 617 Scouts have started the materials and 254 have completed the requirements. More information in Section 1.2.3.

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.

4. Outcomes
SAFER-SIM included 3 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	8	5

Stakeholders who adopt, implement or deploy SAFER-SIM research findings or technologies through policy, practice, regulation, rulemaking or legislation	2	1	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. The distributed simulation project is laying the groundwork for future studies using connected driving simulators.
2. The tool will help increase the quality and the outcomes of video-related research in simulators and self-driving vehicles and hence significantly improve the technologies and the safety
3. The VR simulation code was made in four levels: (i) Set up the VR environment to reflect an urban city context with commercial and residential buildings (ii) Include a pedestrian pathing system to add pedestrian avatars along sidewalks in the scenario (iii) Modify traffic flow patterns with different vehicle speeds and vehicle gaps between subject runs (modification to the original code supplied by Dr. Kearney from University of Iowa), and (iv) Incorporate a counter of subject runs and a counter of vehicle-pedestrian collisions and is shown on a display board for the subject to be aware of the number of runs and crashes in the experiment.
4. This project established a new capability in our lab to run "wizard of Oz" experiments where a participant drives our full simulator and the experimenter can control a second virtual vehicle in the same world.
5. Data reduction protocols for eye data and driving measures.
6. The research team is currently finalizing a software package for eye-tracking video analysis, object identification, and integration with eye-tracking trace.
7. we are developing a new agent-based simulation framework based on Repast Simphony to better capture the dynamic decision making of vehicles and V2I.
8. Ongoing work (1) new Chrono::Sensor module and (2) sensor models for producing realistic data for testing autonomous vehicle control algorithms. For Chrono::Sensor, the focus is creating a framework for users to test, with software-in-the-loop, various safety critical scenarios involving automated vehicles. For (2), the focus is exploration, development, and implementation of sensor models that seek to produce synthetic data with appropriate noise, distortion, and degradation.

Stakeholders who adopt, implement or deploy SAFER-SIM research findings or technologies through policy, practice, regulation, rulemaking or legislation
1. The developed tool will improve machine vision research in cars and simulators

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, book chapters, and presentations at conferences, meetings, and other avenues.

4.4 Improved processes, technologies, techniques and skills in addressing transportation issues
Highlighted in technology transfer outputs above.

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 Road Safety & Simulation conference hosted by the University of Iowa this period was a global gathering of professionals and involved direct training opportunities via workshops along with presentations and panels. 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 3 performance measures related to impacts in our technology transfer plan:

Performance Measure	Target	Result
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. Through the proper connectivity approach developed in this proposal, the interactions between pedestrians and other road-users will be analyzed, and potential conflicts and consequent crashes can be avoided through warning information dissemination. We expect this proactive approach for safety will lead to a significant reduction in crashes between pedestrians and other road-users.
2. Evacuation Policy: Drivers can be warned about the impending crash risk and be enforced to reduce speed. Evacuation declarations can account for potential crash risks of the evacuation process, and strategies such as phased declaration of evacuation orders can be adopted. Modeling Practice: Researchers and practitioners should adjust model parameters when using micro-

simulation tools for simulating evacuation traffic. Traffic Management: Agencies can recommend the use of in-vehicle ACC system as it can potentially reduce the number of crashes during evacuation. From the simulation experiments it is found that during evacuation about 49% of traffic collisions can be reduced at a 25% market penetration of ACC-equipped vehicles.

3. We expect our alerts will help older adults make safer and more informed street-crossing decisions.
4. The results of this project can be used to guide decisions on bicycle infrastructure implementation both at the intersection and the segment level for safer multimodal operations.
5. Virtual testing and simulation of autonomous and connected vehicles allow safe and cost-effective testing of autonomous vehicles and algorithms before physical testing and before deployment. Furthermore, accurate models and simulation of the various sensors present on autonomous vehicles as well as accurate virtual representation of the environment enable effective development of autonomous driving systems.

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

1. The connectivity approach will play an essential role in informing pedestrians about the safety conditions of the shared-space facility and henceforth will provide them with the necessary information for their trip planning and thereby avoiding hazardous traffic.
2. The results of this project can be used to guide decisions on bicycle infrastructure implementation both at the intersection and the segment level for safer and more efficient multimodal operations.
3. The results of this project can be used to develop guidelines for protected intersection design to reduce conflicts and ensure efficient multimodal operations.
4. Virtual testing and assessment allow safe evaluation of current and proposed autonomous in various environments and scenarios and can be used to inform policy, regulations, and legislation.
5. If the tool is used widely by researchers it can improve transportation research at different levels by understanding the patterns and trends in traffic, how that can be improved by future in-vehicle technologies and assistance system.

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
While the direction of the research hasn't changed, the center will still be affected by COVID-19. All activities involving human subjects have been suspended. We have continued our work by performing tasks that do not require in-person contact or human subjects in a simulator. We have done this by coordinating remote computer access to allow researchers to continue development, data analysis, and writing activities. However, processing speed reduces dramatically using this method and remote access is sometimes interrupted.

We will need eventual access to our labs to continue our research. Our research generally requires human contact. When we are able to return to our labs, we will need to take additional measures to sanitize the surfaces anyone touches. We may also need to develop other protocols and precautions. There may be additional participant screening and certainly additional equipment procedures. All of this will affect our ability to recruit and enroll participants and the increase the resources needed to conduct a study involving human subjects.

While we take measures to keep working, our research activity has indefinitely been interrupted. This has already delayed some projects and will delay others. We have had 6 projects formally ask and receive 6-month extensions due to COVID-19. They are all projects that were in progress and in the second half of their performance period and were involved in collecting human subjects data. We expect several rounds of extension requests as we move through this crisis and beyond. Delays in current projects will cause delays in following projects. If we are able to return to our labs over the summer or in the fall and a second wave of the virus requires a second suspension of human subjects research the delays will be compounded. The full extent of the delays and effects on resources is unknown at this time.

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