



**PROGRAM PROGRESS PERFORMANCE REPORT FOR  
UNIVERSITY TRANSPORTATION CENTERS**

**Submitted to:** US Department of Transportation,  
Research and Innovative Technology Administration

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

**Program Director:** Dawn Marshall, M.S.  
Project Director/Research Manager  
National Advanced Driving Simulator  
2401 Oakdale Blvd  
Iowa City, IA 52242  
Phone: 319-335-4774  
Fax: 319-335-4658  
Email: [dawn-marshall@uiowa.edu](mailto:dawn-marshall@uiowa.edu)

**Submitting Official:** Same as Program Director

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**Recipient Organization:** The University of Iowa  
5 Gilmore Hall  
Iowa City, IA 52242

**Recipient Identifying Grant Program No.:** 15701400

**Project/Grant Period:** 11/30/2016 – 9/30/2022

**Reporting Period End Date:** 9/30/2018

**Report Term or Frequency:** Semi-annual

**Signature of Submitting Official:** 

## 1. Accomplishments

### Research

The goal of SAFER-SIM is to study how road users, roadway infrastructure, and new vehicle technologies interact and interface with each other using microsimulation and state-of-the-art driving, bicycling, pedestrian simulators. The center uses simulation technology to address the following safety topics:

- *Automated vehicles technology*: assessing road users' responses to automated vehicles, augmented reality, and in-vehicle safety systems,
- *Connected vehicles technology*: assessing user responses to connected vehicles technology (e.g., V2V, V2P, I2B),
- *Vulnerable road users*: examining risk factors for pedestrian and bicyclist collisions with vehicles, including high-risk groups (e.g., transportation workers, children, and the elderly),
- *Roadway infrastructure design*: assessing how safely drivers, bicyclists, and pedestrians interact with roadway infrastructure designs,
- *Distributed simulation technology*: assessing real-time traffic conflicts between drivers, bicyclists, and pedestrians through connected simulators

SAFER-SIM has funded 25 research projects to date under the 2016 grant. The projects selected for funding last period have now started and are making progress. The newly funded and ongoing projects are listed below. One additional project was funded this period outside of normal funding cycle. This is a short term installation project at the University of Iowa led by Steve Baek. The project is *Driver360 - A Four-dimensional Scanning System to Better Understand Drivers*.

| Newly Funded Projects   |           |                      |
|---|-----------|----------------------|
| Research Project Title  | School(s) | Performance Period   |
| Driver360 - A Four-dimensional Scanning System to Better Understand Drivers | UI        | 5/14/2018-11/17/2018 |
| Ongoing Projects  |           |                      |
| Research Project Title  | School(s) | Performance Period   |
| Integrating Traffic Control Devices via Augmented Reality                   | UM        | 9/1/2017-11/30/2018  |
| To Trust or Not to Trust? A Simulation-based Experimental Paradigm          | UM        | 9/1/2017-5/31/2018   |
| Assessing the Impact of Smartphone Usage While Driving in Work Zones        | UPR       | 8/1/2017-7/31/2019   |

|  |        |                     |
|--|--------|---------------------|
| Using Simulation to Assess and Reduce Conflicts between Drivers and Bicyclists*  | UI, UM | 8/1/2017-12/31/2018 |
| Multi-modal Distributed Simulation Combining Cars, Bicyclists, and Pedestrians*  | UM     | 9/1/2017-8/31/2018  |
| Enhancing School Zone and School Bus Safety*   | UPR    | 8/1/2017-7/31/2019  |
| Risk Awareness and Perception Training using Virtual Reality (RAPT-VR)   | UM     | 6/1/2018-5/31/2019  |
| Protected Intersection Design for Safer Cycling  | UM     | 6/1/2018-5/31/2019  |
| Minimum time to situational awareness during transfer of control under varying levels of task load   | UM     | 6/1/2018-5/31/2019  |
| Development and Testing of an In-Vehicle Interface for Use in Automated Driving Contexts   | UM     | 6/1/2018-8/31/2019  |
| Human-Machine Interfaces to Convey Feedback in Automated Vehicles  | UI     | 6/1/2018-7/31/2019  |
| Extended Evaluation of Training Programs to Accelerate Hazard Anticipation Skills in Novice Teen Drivers   | UI     | 8/15/2018-2/14/2020 |
| Can Regenerative Braking Save Your Life? A Distributed Simulation Study  | UI     | 6/1/2018-6/30/2019  |
| Mobile Applications to Help Older Adults Make Safe Street-Crossing Decisions   | UI     | 5/21/2018-5/20/2019 |
| Developing an Open Source Multi-Agent Simulation Environment for Connected Autonomous Vehicles (CAVs)  | UW     | 6/1/2018-5/31/2019  |
| A Machine Vision Approach for Estimating Motion Discomfort in Simulators and in Self-Driving Vehicles  | UW     | 5/1/2018-9/1/2019   |
| Safely and Effectively Communicating Non-Connected Vehicle Information to Connected Vehicles through Field- and Driving Simulator-Based Research | UW     | 6/1/2018-5/31/2019  |
| Assessing Crash Risks of Evacuation Traffic: A Simulation-based Approach   | UCF    | 9/1/2018-12/31/2019 |
| Assessing the Effectiveness of Connected Vehicle Technologies based on Driving Simulator Experiments   | UCF    | 9/1/2018-8/31/2019  |

|   |         |                    |
|---|---------|--------------------|
| Evaluation of Managed Lane Facilities in a Connected Vehicle Environment                | UCF     | 9/1/2018-2/29/2020 |
| Evaluation of Safety Enhancements in School Zones with Familiar and Unfamiliar Drivers* | UPR, UM | 6/1/2018-5/31/2019 |
| <b>*Collaborative projects</b>  |         |                    |

Six projects have completed under the 2016 grant. Three projects have completed and submitted final reports. Three additional projects are complete with the final reports still in the review process. The six completed projects are below.

| <b>Completed Projects</b>  |                  |                          |
|--|------------------|--------------------------|
| <b>Research Project Title</b>  | <b>School(s)</b> | <b>TRID</b>              |
| Using Driver State Detection in Automated Driving                                  | UI               | In review                |
| Augmented Reality for Safer Pedestrian-Vehicle Interactions                        | UW               | In review                |
| Connected Vehicles (CV) Transition and Market Penetration                          | UCF              | <a href="#">01683413</a> |
| Multi-modal Distributed Simulation Combining Cars, Bicyclists, and Pedestrians*    | UI, UW           | In review                |
| Using Simulation to Assess and Reduce Conflicts between Drivers and Bicyclists*    | UCF              | <a href="#">01683411</a> |
| Enhancing School Zone and School Bus Safety*                                       | UCF              | <a href="#">01683412</a> |
| <b>*Collaborative projects still expecting additional reports from other sites</b> |                  |                          |

### Leadership Development

SAFER-SIM is recognized nationally and internationally as leaders in transportation safety research with particular distinction in applying simulation to safety problems. Developing the next generation of leaders in safety research and simulation methods is a key function of the center. Researchers and students gained valuable experience through SAFER-SIM work. This period, they continued representing the center at professional meetings and through scholarly endeavors to contribute to the advancement of simulation and road safety. This is achieved through the use of seminars, symposia, web-based discussions, and other communications opportunities open to the public.

This period SAFER-SIM researchers have shown leadership in their respective fields by participating on 34 panels and advisory committees, reviewing 29 journals, and holding 8 journal editorships. They have also submitted 1 article to peer-reviewed publications, 8 conference presentations and 2 book chapters.

#### *Panels & Advisory Committees*

- Member of TRB Standing Committee on User Information Systems (AND20) – (Dawn Marshall)
- Chair of TRB Human Factors of In-Vehicle Systems, AND20(1), Joint Subcommittee of AND20, AND10 – (Dawn Marshall)
- Member of TRB Ahead of the Curve, ABG20(6). Joint subcommittee of ABG10 and ABG20 – (Jacob Heiden)
- Member of TRB Standing Committee on Alcohol, Other Drugs, and Transportation (ANB50) – (Timothy Brown, Jaeyoung Lee)
- Member of TRB Standing Committee on Vehicle-Highway Automation (AHB30) – (Chris Schwarz)
- Member of TRB Standing Committee on User Information Systems (AND20) – (John Gaspar, Mohamed Abdel-Aty)
- Co-chair of TRB Standing Committee on Simulation and Measurement of Vehicle - and Operator Performance (AND30) (co-chair) – (Omar Ahmad)
- Member of TRB Section - Users Performance (AND00) – (Omar Ahmad)
- Member of TRB Standing Committee on Motorcycles and Mopeds (ANF30) – (Omar Ahmad)
- Great Plains Center for Agricultural Health Internal Advisory Committee (Reyes)
- UI Injury Prevention Research Center Executive Committee (Reyes)
- All-Red Clearance Intervals for Use with Flashing Yellow Arrows in the Left-Turn Application – TRB Eisenhower “Every Day Counts” Panel (Francis Tainter)
- Member of TRB AND50 Standing Committee on Traffic Control Devices (Mike Knodler)
- Member of TRB AHB25 Traffic Signal Systems Committee, 2013-2020 (Eleni Christofa)
- Member of TADD55 Task Force on Arterials and Public Health, 2015-2018 (Eleni Christofa)
- Member of TRB Standing Committee AHB45 Traffic Flow Theory and Characteristics (Eric Gonzales)
- Member of TRB Standing Committee AP060 Paratransit (Eric Gonzales)
- Applied Human Factors and Ergonomics (AHFE 2017-Present) Scientific Advisory Board. (Didier Valdés)
- Applied Human Factors and Ergonomics (AHFE 2017-Present) Scientific Advisory Board. (Benjamín Colucci)
- Panel Member of NCHRP Project (SN4811): Practices in One Lane Traffic Control on a Two-Lane Rural Highway (Benjamín Colucci)

- Member Best Paper Award TRB Committee AHB55 Work Zone Traffic Control (Benjamín Colucci)
- Member of the Advisory Committee of the Puerto Rico-State Transportation Innovation Council (STIC) (Benjamín Colucci)
- Member of the Advisory Committee of the US Virgin Island-State Transportation Innovation Council (STIC) (Benjamín Colucci)
- Latin American and Caribbean Consortium of Engineering Institution (LACCEI) (Benjamín Colucci)
- International Multi-Conference for Engineering, Education, and Technology Scientific Advisory Board (Benjamín Colucci)
- Co-Chair of the Traffic Enforcement Committee, International Road Federation. (Benjamín Colucci)
- Member of TRB Committee, AHB65 Operational Effects of Geometrics (Alberto Figueroa)
- Member, Committee on Highway Safety Performance (AND25) (2014-ongoing) (Mohamed Abdel-Aty)
- Member, Committee on Data, Analysis and Evaluation (ANB20) (2017 – ongoing) (Mohamed Abdel-Aty)
- Chair International Symposium on Accident Analysis and Prevention, Changsha, Sep 2018 (Mohamed Abdel-Aty)
- Scientific committee member, Road Safety on 5 Continents, Korea, May 2018. (Mohamed Abdel-Aty)
- Co-Chair, 5th International Symposium on Transportation Safety, Tongji University, Shanghai, China, Sep 24-26, 2017. (Mohamed Abdel-Aty)
- Co-Chair, Subcommittee on Transportation Safety Planning (ANB10(3)) (2018-ongoing) (Jaeyoung Lee)
- Member, Committee on Transportation Safety Management (ANB10) (2016-ongoing)

#### *Journal Editing*

- 2017 International Workshop on Materials Science and Mechanical Engineering (IWMSME 2017), Reviewer (Kearney)
- Accident Analysis and Prevention (reviewer, Reyes & O’Neal), (reviewer Kearney), (reviewer, Knodler and Christofa)
- ACM SIGGRAPH, Reviewer (Kearney)
- ACM Transactions on Applied Perception, Reviewer (Plumert)
- Advances in Civil Engineering, Reviewer (Kearney)
- Applied Ergonomics, reviewer (Samuel)
- Attention, Perception, & Psychophysics (reviewer, Vecera)
- Child Development Perspectives, Reviewer (Plumert)
- Ecological Psychology, reviewer (Plumert)
- Human Movement Science, Reviewer (Plumert)
- IEEE Transactions on Human-Machine Systems, reviewer (Kearney)

- IEEE Virtual Reality Conference 2018, Reviewer (Kearney, Plumert)
- International Journal of Digital Human (Stephen Baek, Editorial Board Member)
- Journal of Experimental Child Psychology (Editorial Board, Plumert), (Reviewer, Plumert)
- Journal of Experimental Psychology: Applied (Editorial Board, Plumert), (Reviewer, Plumert)
- Journal of Experimental Psychology: Human Perception & Performance (reviewer, Vecera)
- Journal of Human Factors, reviewer (Samuel)
- Journal of Virtual Reality and Broadcasting, reviewer (Kearney)
- Nature (reviewer, O’Neal)
- Public Library of Science One (reviewer, O’Neal)
- Spatial Cognition and Computation, Reviewer (Plumert)
- The 2nd Annual Workshop on Materials Science and Mechanical Engineering, Reviewer (Kearney)
- The American Society of Mechanical Engineers (ASME) Press, Reviewer (Kearney)
- the Research Foundation - Flanders (Fonds Wetenschappelijk Onderzoek - Vlaanderen, FWO), Reviewer (Kearney)
- Transportation Research Board Annual Meeting, Reviewer (Kearney)
- Transportation Research Part D: Transport and Environment (Christofa)
- Transportation Research Part F: Psychology and Behaviour, reviewer (Kearney)
- Transportation Research Record (Reviewer, Reyes & O’Neal), (reviewer, Knodler & Christofa)
- Transportation Science, reviewer (Samuel)

#### *Journal Editorships*

Dr. Mohamed Abdel-Aty

- Editor-in-Chief (July 2013 – present), Accident Analysis and Prevention, Elsevier

Dr. Jaeyoung Lee

- Academic Editor (May 2018 – present), Journal of Advanced Transportation, Wiley/Hindawi

Jodie Plumert

- Editorial Board, Journal of Experimental Psychology: Applied
- Editorial Board, Journal of Experimental Child Psychology

Shaun Vecera

- Visual Cognition (Associate Editor)

Steve Baek

- Editorial Board, International Journal of Digital Human

Eleni Christofa

- Guest Editor for Transportation Research Part C: Emerging Technologies Special Issue on “Trajectory-based Modeling, Design, Operation and Assessment of Road Transportation Systems.”



Benjamin Colucci

- Dimension Journal of the College of Engineers and Surveyors of Puerto Rico, Editor-in-Chief.

#### Education and Workforce Development

SAFER-SIM is dedicated to educating the next generation of safety professionals, building the transportation workforce for tomorrow, and fostering a vibrant community of researchers. SAFER-SIM consortium members continue to engage students of all levels in transportation, safety, and STEM (science, technology, engineering, and math).

Sites organize and participate in events focusing on students and members of the workforce. This center interacted with 1475 individuals this period at STEM fairs, school visits, county and state fairs. The National Advanced Driving Simulator hosted five high school interns during the spring, summer and fall terms. Other highlights below:

- 3 students graduated this period with degrees in transportation disciplines
  - Francis Tainter, University of Massachusetts Amherst, MS in Civil Engineering May 2018
  - Bryan Ruiz Cruz, University of Puerto Rico Mayaguez, MS in Civil Engineering, June 2018.
  - Johnathan Ruiz Gonzalez, University of Puerto Rico Mayaguez, MS in Civil Engineering, June 2018.
- 2 students found full time employment
  - Bryan Ruiz Cruz, June 2018, CMA Architects & Engineers LLC
  - Johnathan Ruiz Gonzalez, June 2018, CMA Architects & Engineers LLC
- The Science of Driving Curriculum was used in K-12 lessons with three Iowa schools
  - Bettendorf Middle School
  - Prairie Ridge Elementary
  - Muscatine Middle School
- The Global Road Safety course was taught in-person as a semester long undergraduate class at the University of Iowa to 8 students.
- Oral presentation of the driving simulator and its application to a group of UPRM students of the Geometric Design Class, May 24, 2018.
- Shannon Roberts presented concepts on Industrial Engineering and Human Factors to high school students who participated in the UMass Summer Engineering Institute on July 19. The students were also given a tour of the lab facilities, including the driving simulator
- Labs at the University of Iowa provided tours to university students
  - Institute of Industrial and Systems Engineers Regional Conference
  - Undergraduate Vehicle Systems Dynamics Course
  - Visiting Scholars from Pakistan
  - Iowa State Transportation Student Association
- Labs at the University of Iowa provided tours to K-12 students
  - St. Dominich's High School Computer Science
  - Newton High School Pre-calculus
  - Ron Bandy's Driver Education



- Junior Scholars Institute
- Women in Science and Engineering
- Perry Research Scholars Institute
- Secondary Student Training Program
- The portable simulator was used in a safety demonstration at an Iowa company and community events, and it was used to attract K-12 students to careers in transportation and STEM fields.
  - Iowa City Parks & Rec STEAM Fest
  - Anamosa STEM Festival
  - Jefferson County STEM Festival
  - 2018 Juneteenth Celebration
  - Barnyard Bash
  - Rollin Rally
  - STEM Day at the Johnson County Fair
  - Iowa State Fair
  - Highland STEM Night
  - South Slope Driver Training Presentation

#### Technology Transfer

SAFER-SIM will establish and promote consortium opportunities for research collaboration with industry, state, and local governments, and other organizations with an interest in transportation safety. The center will promote industrial investment in consortium universities' product development and commercialization activities and will provide highly-trained scientists for the industrial work force.

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. Organizations providing match funds for research projects are below:

- Florida DOT
- Aisin Technical Center of America
- AAA Foundation for Traffic Safety
- Toyota Collaborative Safety Research Center
- National Cooperative Highway Research Program

The University of Iowa worked with individuals from government and industry to discuss capabilities and transfer results in hopes of making impacts on commercial technology or public use. The following organizations visited the University of Iowa this period:

- |                                   |                         |
|-----------------------------------|-------------------------|
| ● MIE visitors from Hong Kong     | ● FHWA                  |
| ● Mechdyne                        | ● NHTSA                 |
| ● Ergan UC and Parkinson's Center | ● Iowa Board of Regents |

- Mobileye
- Aisin
- Iowa Bicycle Coalition
- Metrotech
- City of Iowa City
- Pharmacy faculty from Japan
- Iowa Association of Business and Industry
- Iowa City Chamber of Commerce Leadership Program
- Minister of Manitoba Infrastructure
- SmartEye
- John Deere
- Johnson County Advanced Manufacturing
- Volvo Group
- Bose Corporation

### Collaboration

Strong collaboration efforts will take place among consortium sites, within consortium sites, and with government agencies and industry partners. Collaboration at the center played an important role in reaching goals in all areas. Of the 25 projects funded, 4 are collaborative with multiple sites involved.

Further discussion on collaboration accomplishments in Section 2 - Participants & Collaborating Organizations

### Diversity

SAFER-SIM is committed to promoting diversity by supporting minority participation throughout our work and community outreach. A SAFER-SIM consortium member, 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. SAFER-SIM projects supported diverse students and interacted with diverse populations through community outreach. This period the center participated in 3 events focused on diversity and interacted with 110 underrepresented/minority individuals.

Below are those events:

- Women in Science and Engineering Tour
- 2018 Juneteenth Celebration
- Society of Women Engineers Tour

Seven research projects in the center involve 13 total underrepresented/minority students.

| <b>Projects involving diverse students</b>                  |             |                   |
|---|-------------|-------------------|
| <b>Research Project Title</b>                               | <b>Site</b> | <b># Students</b> |
| Augmented Reality for Safer Pedestrian-Vehicle Interactions | UW          | 0.5               |

|  |              |           |
|--|--------------|-----------|
| Safely and Effectively Communicating Non-Connected Vehicle Information to Connected Vehicles through Field- and Driving Simulator-Based Research | UW           | 0.5       |
| Assessing the Impact of Smartphone Usage While Driving in Work Zones   | UPR          | 2         |
| Enhancing School Zone and School Bus Safety  | UPR          | 2         |
| Evaluation of Safety Enhancements in School Zones with Familiar and Unfamiliar Drivers*  | UPR,<br>UM   | 2         |
| Human-Machine Interfaces to Convey Feedback in Automated Vehicles  | UI           | 1         |
| Extended Evaluation of Training Programs to Accelerate Hazard Anticipation Skills in Novice Teen Drivers   | UI           | 5         |
|  | <b>Total</b> | <b>13</b> |

### Result dissemination

Three technical reports from the center’s research projects have been completed and published on the federal databases online as the grant required. Three more projects have completed the technical report and are currently in the review process. 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. These summaries and webinars focus on recommendations, specifications, and guidelines for practitioners. Webinars for research projects have been scheduled for next reporting period. The final reports, summaries, and webinars can all be accessed through the research projects on the center’s webpage here: [http://safersim.nads-sc.uiowa.edu/research\\_new.php?searchTerm](http://safersim.nads-sc.uiowa.edu/research_new.php?searchTerm)

Journals publishing our work this period include:

- Simulation Modelling Practice and Theory

Books or other non-periodical, one-time publications publishing our work this period:

- Advancing Diversity, Inclusion, and Social Justice through Human Systems Engineering.
- Advances in Child Development and Behavior

Conferences featuring our work this period include:

- Transportation Research Board the 98th Annual Meeting
- Latin American and Caribbean Consortium of Engineering Institutions (LACCEI) Annual Meeting: “Innovation in Education and Inclusion
- Safety 2018 World
- Institute of Transportation Engineers Annual Meeting and Exhibit

- European Transport Conference
- ASCE International Conference on Transportation and Development

Outreach efforts continued in K-12 and college-related events and in local communities by sharing research and simulator technologies to enhance public understanding and increase interest in STEM education and transportation careers. The center interacted with 1475 individuals in the community during this period. Further description of the community partners is described Participants & Collaborating Organizations.

### Plans for next reporting period

Five projects are expected to complete during the next reporting projects.

| Projects Completing Next Period   |           |                      |
|---|-----------|----------------------|
| Research Project Title  | School(s) | Performance Period   |
| To Trust or Not to Trust? A Simulation-based Experimental Paradigm              | UM        | 9/1/2017-5/31/2018   |
| Multi-modal Distributed Simulation Combining Cars, Bicyclists, and Pedestrians* | UM        | 9/1/2017-8/31/2018   |
| Driver360 - A Four-dimensional Scanning System to Better Understand Drivers     | UI        | 5/14/2018-11/17/2018 |
| Integrating Traffic Control Devices via Augmented Reality                       | UM        | 9/1/2017-11/30/2018  |
| Using Simulation to Assess and Reduce Conflicts between Drivers and Bicyclists* | UI, UM    | 8/1/2017-12/31/2018  |
| <b>*Collaborative projects</b>  |           |                      |

### Webinars

Five webinars are currently planned for the next period. Additional webinars will be planned as more projects complete. The scheduled webinars are below:

| Title   | School(s) | Date       |
|---|-----------|------------|
| Using Driver State Detection in Automated Driving         | UI        | 10/30/2018 |
| Connected Vehicles (CV) Transition and Market Penetration | UCF       | 11/13/2018 |

|  |        |           |
|--|--------|-----------|
| Augmented Reality for Safer Pedestrian-Vehicle Interactions                    | UW     | 1/29/2019 |
| Multi-modal Distributed Simulation Combining Cars, Bicyclists, and Pedestrians | UI, UW | 2/12/2019 |
| Enhancing School Zone and School Bus Safety                                    | UCF    | 2/26/2019 |

*Request for Proposals*

A request for proposals for year-3 projects was released on October 16, 2018. Proposals are due November 30, 2018. Award Decisions will be made by March 31, 2019 and projects are expected to begin summer or fall term 2019. Received proposals will receive a minimum of three reviews conducted by the advisory board, site directors, and other researchers associated with SAFER-SIM. Conflicts of interest will be avoided by assigning each proposal to reviewers outside the institution of each principal investigator. Final funding decisions will be made during a spring meeting of the SAFER-SIM directors from all sites.

*Symposium*

SAFER-SIM Symposium will be held November 16-18, 2018 at the University of Massachusetts Amherst. The agenda includes campus and research facility tours and dinner on Friday, November 16<sup>th</sup>. Followed by professional speakers, simulation boot camp workshop, a virtual poster session, meetings and technical sessions on Saturday, November 17<sup>th</sup>. On Sunday, November 18<sup>th</sup>, a directors meeting and other activities are planned before the meeting adjourns at 11:30 am.

*Outreach*

SAFER-SIM consortium members will continue to engage students of all levels and community members in transportation, safety, and STEM (science, technology, engineering, and math).

**2. Participants & Collaborating Organizations**

Collaboration plays an important role in our center’s work. All five consortium sites collaborate regularly through director calls, meetings, and research. Four research projects are collaborative with more than one site. Additionally, the center has entered a collaborative agreement with the AAA Foundation for Traffic Safety. SAFER-SIM and AAAFTS will provide funds and researchers to address research questions on *How do driver knowledge, attitudes and beliefs of automated systems impact safety, performance, driver behaviors, trust and acceptance of these technologies?* The collaborative agreement includes 2 years of funding and a 2 phase research project with UI, UM, and AAAFTS.

Some highlighted examples of collaboration are below:

- UPR collaborated with University of Massachusetts Amherst to exchange simulations to analyze responses and subjects’ behaviors to changes in the road infrastructure

configuration, school zone speed limits, and roadway signage of drivers that are familiar and unfamiliar with the environment of school zones in Puerto Rico.

- Maria X. Rojas from UPR spent 8 weeks in Massachusetts from June to early August working on the simulated scenarios for this study on the UMass campus. During this time she successfully created 24 different drives for this experiment.
- The two graduate students worked with another Safer-Sim researchers (Kelvin Santiago) at UW-Madison for simulator scenario development. More specifically, they shared information regarding the use of Altia Design for creating images on the dashboard and the center stack in the driving simulator.

### **Organizations that have been involved as partners**

#### Financial

5 organizations are providing match funding for research projects.

- Florida DOT
- Aisin Technical Center of America
- AAA Foundation for Traffic Safety
- Toyota Collaborative Safety Research Center
- National Cooperative Highway Research Program
- Hyundai-Kia America Technical Center, Inc.

#### In-kind Support

6 organizations provided in-kind support through the organization of outreach events.

- Southeast Iowa STEM Region
  - Iowa City STEAM Fest (4/15/18)
  - Anamosa STEM Festival (4/26/18)
  - Jefferson County STEM Festival (4/26/18)
  - Iowa State Fair – (8/19/18)
- Kirkwood Community College
  - Rollin Rally (6/23/2018)
  - Workplace Learning Connection – Solon Mock Interviews (4/17/18), Regina Mock Interviews (5/4/18), Intern Coordination (summer and fall 2018)
- City of Fairfield, Iowa – Barnyard Bash (6/22/18)
- STEM Innovator – Student Pitch Day (5/1/18)
- South Slope – Company safety presentation (5/23/18)
- Hyundai Motor Group

#### Facilities

2 schools in Iowa shared their facilities with center staff for outreach events.

- Bettendorf Middle School (4/2/18)
- Prairie Ridge Elementary (4/20/18)

#### Personnel exchange

3 SAFER-SIM sites were involved with personnel exchanges.

- Student from UPR worked at UM over the summer
- Student from University of Arkansas worked at UW over the summer
- Metropistas, LLC received training from UPR

### **Other collaborators or contacts 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 professional backgrounds that span across many colleges throughout the universities. The variety of expertise within the consortium creates a collaborative environment to address safety issues from different perspectives. Some backgrounds include:

- Civil Engineering
- Industrial Engineering
- Computer Science
- Psychology & Brain Sciences
- Public Health
- Pharmacy
- Emergency Medicine
- Science Education
- Orthopedic Surgery

SAFER-SIM researchers also collaborate with contacts outside the UTC and in some instances outside the country. Presentations this period to contacts outside SAFER-SIM include:

- Tongji University, China, September 2018
- Central South University, August 2018
- Beijing Jiaotong University, May 2018
- Central South University, May 2018
- Changsha University of Science and Technology, May 2018
- Northwestern University, April 2018
- Oregon State University, May 2018
- TRB Novice Driver Crash Avoidance Meeting, August 2018
- Automated Vehicles Symposium, July 2018
- TRB Young Driver Subcommittee Meeting, June 2018
- Governor's Commission on the Future of Transportation: Listening Session on Autonomous Vehicles, May 2018
- National AVPG Community of Practice, June 2018
- Autonomous Vehicles and Access Management 2018 TRB National Access



Management Conference Madison, July 2018

- US Ignite ParaDrop Day, August 2018
- WisDOT Bureau of Structures Annual Meeting Madison, August 2018

### 3. Outputs

#### Publications, conference papers, and presentations

##### *Journal publications:*

- Rahman, M.H., Abdel-Aty, Lee, J., Rahman, M.S. (2018). Enhancing Traffic Safety At School Zones by Operation and Engineering Countermeasures: A Microscopic Simulation Approach, Submitted to the Simulation Modelling Practice and Theory

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

- Roberts, S. C. (in preparation). Automation and Racial Equity: How Human Factors 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*. CRC Press.
- Plumert, J. M., & Kearney, J. K. (2018). Timing Is Almost Everything: How Children Perceive and Act on Dynamic Affordances. In J.M. Plumert (Edited.), *Advances in Child Development and Behavior* (173 – 204), JAI.

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

- Rahman, M.H., Abdel-Aty, Lee, J., Rahman, M.S. (2018). Enhancing Traffic Safety At School Zones by Operation and Engineering Countermeasures: A Microscopic Simulation Approach, Submitted to the Transportation Research Board the 98th Annual Meeting.
- Saad, M., Abdel-Aty, M., Lee, J., and Cai, Q. (2019). Bicycle Safety Analysis at Intersections Using Crowdsourced Data. Transportation Research Board 98th Annual Meeting, Submitted.
- Castro, S., Cai, Q, and Abdel-Aty, M. (2019). Explore Contributing Geometric Factors and Land Use on Bicycle Activity and Safety at Intersections. Transportation Research Board 98th Annual Meeting, Submitted.
- Valdés, D., Colucci, B., Rojas, M., Colón, E., García, R. (2018) “Methodology for the Evaluation of School Zones in a Driving Simulator” Latin American and Caribbean Consortium of Engineering Institutions (LACCEI) Annual Meeting: “Innovation in Education and Inclusion.” July 2018.
- O’Neal, E.E. & Plumert J.M. (November, 2018). How do parents teach children to cross roads safely? A study of parent-child road-crossing in an immersive pedestrian simulator. Oral presentation accepted at the Safety 2018 World Conference in Bangkok, Thailand.
- Tainter, F., Fitzpatrick, C., Deliali, A. 2018. Using Driving Simulation to Model Motorist and Bicycle Interactions at Separated Bike Lanes. Institute of Transportation

Engineers Annual Meeting and Exhibit, August 20-23, Minneapolis, MN.

- Deliali, A., Christofa, E., Knodler, M., Tainter, F., Campbell, N., 2018. Using Driving Simulation to Assess Motorist and Bicycle Interactions at Separated Bike Lanes. European Transport Conference 2018, October 10-12, Dublin, Ireland. [accepted]
- Deliali, A., Christofa, E., Knodler, M., Tainter, F., Campbell, N., 2019. Assessing the impact of protected bicycle infrastructure on driver behavior. ASCE International Conference on Transportation and Development, June 9-12, Arlington, VA. [abstract to be submitted]

#### **Website(s) or other Internet site(s)**

<http://safersim.nads-sc.uiowa.edu/> - Center's website containing 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:

- 1437 total users, 1412 of those being new
- 2235 sessions
- 7608 page views

[https://www.youtube.com/channel/UCE8CN3JX8\\_mkAf8d8-UPzKQ](https://www.youtube.com/channel/UCE8CN3JX8_mkAf8d8-UPzKQ) - Center's YouTube channel containing webinar presentations and other videos related to our work. Webinars for projects funded under this grant will begin next period. Currently, the YouTube channel has videos from the Virtual Symposium held last period. Metrics from those videos are below:

- 4 videos
- 102 views
- +5 subscribers

<https://dataverse.harvard.edu/dataverse/safersim> - Center's data repository containing final data from research projects.

- 3 datasets

#### **Technologies or techniques**

- The two graduate students worked with another Safer-Sim researchers (Kelvin Santiago) at UW-Madison for simulator scenario development. More specifically, they shared information regarding the use of Altia Design for creating images on the dashboard and the center stack in the driving simulator.

#### **Inventions, patent applications, and/or licenses**

Nothing to report

## **4. Outcomes**

*Research Outcome*

The outputs of SAFER-SIM research projects will produce outcomes that affect the transportation system or its regulatory, legislative, or policy framework.

| Research Project  | Outcome  |
|---|--|
| Using Driver State Detection in Automated Driving                               | These results indicate that driver monitoring, particularly in the form of attentional maintenance that continuously provides feedback on driver state, can keep drivers engaged in the driving task during periods of automated driving and help drivers respond faster during takeover situations. |
| Augmented Reality for Safer Pedestrian-Vehicle Interactions                     | On average, cues were found to result in subjects detecting pedestrians sooner (in terms of distance). However, when the behaviors observed as a result of a cue were analyzed by group, no statistically significant difference was found.  |
| Connected Vehicles (CV) Transition and Market Penetration                       | The findings of this study could help car manufacturers design rear-end crash warning systems that enhance the effectiveness of the system's application under fog conditions.   |
| Multi-modal Distributed Simulation Combining Cars, Bicyclists, and Pedestrians  | Existing networking capabilities provided by the Unity game engine were used to make it possible for a pedestrian and driver on different locations to share a simulation environment.   |
| Using Simulation to Assess and Reduce Conflicts between Drivers and Bicyclists* | This study can help transportation agencies by identifying efficient ways to determine bicycle volume and by identifying critical factors for enhancing bicycle safety and improving bicycle infrastructure at intersections.  |
| Enhancing School Zone and School Bus Safety*                                    | The microsimulation experiment revealed that two-step speed reduction and decreasing the number of driveways can reduce the surrogate safety measures compared with the field condition. Also, crash risk is higher when a two-way left-turn lane is replaced with a raised median.                  |

*Leadership Development Outcome*

The outcome of leadership development in our center has led to the enlargement in the pool of trained transportation researchers and professionals.

- 3 students graduated
- 2 found full-time employment.

### *Education and Workforce Development Outcome*

The outcome of SAFER-SIM education and workforce development initiatives has led to increased number of requests at educational, work-related, and community events. This period, 1475 individuals in education, workforce, and the community were affected by the outreach work of the center

### *Technology Transfer Outcome*

The outcome of SAFER-SIM technology transfer results in the sharing of safety research and information with government and industry leading to public use or improved technologies. Sharing results with the community will lead to better understanding of transportation safety issues and improvements in safety. 5 outside organizations or agencies provided match funding this period. 20 organizations and agencies toured SAFER-SIM facilities.

## **5. Impacts**

### *Research Impact*

The impact of SAFER-SIM research projects will lead to a better understanding of road-user behavior and the advancement of simulation techniques and technologies in the following areas.

- Automated vehicles technology
- Connected vehicles technology
- Vulnerable road users
- Roadway infrastructure design
- Distributed Simulation Technology

Research funded from this center has led to 5 additional proposals to other agencies:

- What forms a mental model? Exploring how different consumer groups acquire knowledge about automated driving systems, AAA Foundation for Traffic Safety, \$250,000, 01/07/2019-12/31/2019, co-PI, subcontracting to Purdue University.
- Human Training and Interaction with Hybrid Autonomous Transportation Systems, National Science Foundation – Smart and Autonomous Systems, \$1,000,000, 02/01/2019-01/31/2022, co-PI with PI Wayne Burleson and co-PI Hossein Pishro-Nik.
- From driver to passenger: discovering and transforming the relationship between humans and driving automation systems, National Science Foundation – CAREER, \$615,000, 09/01/2019-08/31/2023, sole PI.
- Improving Safety in the New World of Driving Automation Systems, Johnson & Johnson WiSTEM2D Scholars Award Program, \$150,000, 09/01/2018 – 08/31/2021, sole PI.
- Rector, K. K. (PI) , Joseph K Kearney (PI), J. K., Plumert, J. M. (PI) CHS: Small: Ability-Based Mobile Technology to Help Older Pedestrians Make Safe Street Crossing Decisions, submitted to the National Science Foundation (\$499,954.00).

### *Leadership Development Impact*

The impact of leadership development among SAFER-SIM researchers and students will lead to improved research, and overall improvement in safety research using simulation.

### *Education and Workforce Development Impact*

The impact of SAFER-SIM education and workforce development creates curiosity in students and members of the transportation industry that will lead to advanced innovations and improved safety.

### *Technology Transfer Impact*

The impact of SAFER-SIM technology transfer results in the sharing of safety research and information with government and industry leading to public use or improved technologies. Sharing results with the community will lead to better understanding of transportation safety issues and improvements in safety.

## **6. Changes/Problems**

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

Two projects from University of Massachusetts are past their proposed end date. The PI and site director have been notified and are in the process of completing projects and submitting final reports. Two sites in a collaborative project received no-cost extensions and have a new end date of 12/31/2018. The collaborative project is *Using Simulation to Assess and Reduce Conflicts between Drivers and Bicyclists*. University of Iowa and University of Massachusetts Amherst received the no-cost extension. University of Central Florida completed their portion of the collaborative project on time.

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

Nothing to report.

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

Nothing to report

### **Change of primary performance site location from that originally proposed**

Nothing to report

## **7. Special Reporting Requirements**

Nothing to report