



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

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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 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

SAFER-SIM funded seventeen (17) new projects last period, which are now active. The center has funded sixty (60) projects total – fifty-nine (59) research and (1) outreach – under the FAST Act. Thirty-four (34) projects remain active and twenty-six (26) projects are complete. All project information can be found on the [SAFER-SIM website](#). Active projects are listed on the Transportation Research Board’s [Research in Progress \(RIP\) Database](#).

Year	Funded/Inactive	Projects Active	Projects Complete	Total Projects
Y1	0	0	9	9
Y2	0	2	14	16
Y3	0	15	3	18
Y4	0	17	0	17
Total	0	34	26	60

SAFER-SIM completed five research projects this period. These projects have submitted final reports to required entities and have uploaded final datasets in our [Harvard Dataverse](#). The last four projects listed below completed last period, but final reports were not posted on TRID until this period

Projects Completed this Period	TRID
The Impact of Driver’s Mental Models of Advanced Vehicle Technologies on Safety and Performance	01739685
The Influence of Unmanned Aerial Systems on Driving Performance	01742289
Physics-Based Sensor Models for Virtual Simulation of Connected and Autonomous Vehicles	01754652
Determining the Effect of Smartphone Alerts and Warnings on Older-Adult Street-Crossing Behavior	01737138
Using Simulation to Assess and Reduce Conflicts between Drivers and Bicyclists	01744746
Assessing Crash Risks of Evacuation Traffic: A Simulation-based Approach	01737141
Assessing the Effectiveness of Connected Vehicle Technologies based on Driving Simulator Experiments	01736330
A Machine Vision Approach for Estimating Motion Discomfort in Simulators and in Self-Driving Vehicles	01736329
Multi-modal Distributed Simulation Combining Cars, Bicyclists, and Pedestrians	01738477

Researchers have been successful securing external grants building off SAFER-SIM work:

1. UCF – The Statewide Regional Evacuation Study Program (SRESP) -Update: Phase 1 Florida Behavioral Study
 - Funding Agency: Northeast Florida Regional Council
 - Amount: \$100,000
 - Duration: October 15, 2020-March 15, 2021.

- Traffic data analysis done under the [SAFER-SIM project](#) significantly helped to understand certain aspects of hurricane evacuation and associated congestion that will be investigated in the above project
2. UCF – Impacts of Electrified Sharing Economy on Transportation and Energy Systems
 - Funding Agencies: Office of Energy Efficiency and Renewable Energy, US Department of Energy (subcontracted from Argonne National Laboratory)
 - Amount: \$90k
 - This project builds off previous [SAFER-SIM work](#)
 3. UI – Multisensory Integration in Collision Judgments with Central Vision Loss”
 - Funding Agencies: National Institutes of Health, National Eye Institute
 - Amount: \$181,827
 - Duration: 10/1/2020 – 9/31/2023
 - External funding builds off lessons learned from past [SAFER-SIM project](#)
 4. UM – A field study to examine driver use of Adaptive Cruise Control.
 - This project involves a field study on an instrumented vehicle to examine drivers use of Adaptive Cruise control and errors committed under varying system conditions. This work aligns with a past [SAFER-SIM project](#).
 5. UW – CPS: TTP Option: Medium: Identifying, characterizing, and shaping multi-scale cyber-human interactions in mixed autonomous/conventional vehicle traffic
 - Funding Agency: National Science Foundation
 - Amount: \$1.2 million
 - Duration: Four-year project
 - The very infrastructure that was funded by the [SAFER-SIM project](#) will be augmented under the NSF project to anchor the simulation component of the NSF project led by Professor Soyoung Ahn.

The University of Wisconsin had two teams of researchers and students win awards on their SAFER-SIM-related work this period.

1. Aaron Young and Dan Negrut have been co-authors on a first prize poster at the Computing in Engineering event organized at the University of Wisconsin-Madison. The poster had to do with model predictive control for autonomous vehicles.
2. Jay Taves, Aaron Young, Asher Elmquist, Radu Serban and Dan Negrut have received the third prize for a poster in the same competition. The poster featured the SynChrono simulation framework.

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)	10
Book chapters	0
Edited books	0
Conference papers, posters, and symposia	5
Paper/poster awards	2

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. Some invited presentation highlights include:

- Walter Guo of University of Central Florida presented at the Argonne National Laboratory Energy Systems Division Weekly Seminar – “Paving the way for an electrified mobility system”
- Michelle Reyes of University of Iowa presented at the mid-year meeting of the Transportation Research Board Young Driver Subcommittee – “Effect of COVID-19 Pandemic on Young Driver Crashes in Iowa”
- Joe Kearney of the University of Iowa presented “The Effectiveness of Smartphone Warnings and Alerts on Pedestrian Road Crossing” at the Texas Statewide Pedestrian Safety Forum organized by the Texas Pedestrian Safety Coalition
- University of Massachusetts researchers presented "Leveraging UAS Technology: From First flight to Speed Data Collection." At the North/West Passage Pooled Fund Study Annual Technician's Webinar
- University of Puerto Rico researchers Benjamín Colucci, D. Valdés, C. López del Puerto, A. Figueroa Medina & R. Sotomayor-Irizarry shared “Educational Module to Increase Engineering Students’ Knowledge of Highway Work Zone’s TTC Plans” at the 2020 American Society for Engineering Education (ASEE) Virtual Conference. June 22-26, 2020.
- Dan Negrut from University of Wisconsin Madison presented at the Association of Transportation Safety Professionals Traffic Records Forum on CAV data for safety and law enforcement

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. A highlight this period includes a meeting sponsored by SAFER-SIM that showcased the shared interest and value of using simulation as tool to advance safety:

- Dan Negrut and Radu Serban organized the Machine-Ground Interaction Consortium meeting at the University of Wisconsin-Madison. At this meeting, Negrut gave a talk on the topic of autonomous vehicle simulation. SAFER-SIM was listed as a project sponsor. Agenda for the event is accessible [here](#). 54 organizations attended the meeting including:
 - Amazon
 - Caterpillar Inc.
 - Hong Kong University of Science and Technology
 - Jet Propulsion Laboratory
 - John Deere
 - Johns Hopkins University
 - Massachusetts Institute of Technology
 - Mitsubishi Electric Research Labs
 - National Science Foundation

- US Army Engineering Research and Development Center

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

Leadership Development Performance Metric	Result
Invited presentations	23
Invited papers	0
Invited workshops	2
Grant review panels	7
Advisory committees	56
Journal editing	60
Leadership positions in professional organizations	16
SAFER-SIM webinars	10
Professional awards	0

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).

SAFER-SIM developed an [online resource](#) last year 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 home from COVID-19. An additional 193 scouts started the resource this period with 225 more scouts successfully completing all requirements. In total 810 scouts have used this resource and 479 have completed all requirements.

Following the success of the Traffic Safety Merit Badge, 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. 201 scouts have started the resource, and 95 have successfully completed all 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	9
Book chapters w/ student authors	0
Conference posters and papers w/ student authors	4
Paper/poster awards w/ student authors	2

Graduate students working on and supported by SAFER-SIM related projects	43
Undergraduate students working on and supported by SAFER-SIM related projects	18
Student attendance and presentations at the SAFER-SIMposium	0
Transportation-related M.A. and PhD theses	4
Curriculum modules developed	4
Student Internships	4
Presentations to student groups or classes	4 presentations 30 students
# Schools visited and # students present	0
# Career fairs visited and # of attendees	0
Summer institutes and programs and # of students participating	1 institute 20

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 10 webinars this period with 361 registrants – 231 from academia, 69 from industry, and 74 from government.

Webinar	Date	Registrants	Archived Views
Assessing the Impact of Smartphone Usage While Driving in Work Zones	4/14/2020	34	34
Enhancing School Zone Safety: Case Studies in Puerto Rico using Driving Simulation	4/28/2020	22	42
Mobile Applications to Help Older Adults Make Safe Street-Crossing Decisions	5/12/2020	32	28
Designing an Informative Interface for Transfer of Control in Level 2 Automated Driving System	6/23/2020	59	N/A
Evaluation of Safety Enhancements in School Zones with Familiar and Unfamiliar Drivers	7/7/2020	20	47
The Influence of Unmanned Aerial Systems on Driving Performance	7/21/2020	38	20
The Impact of Driver’s Mental Models of Advanced Vehicle Technologies on Safety	8/4/2020	83	22

and Performance			
The benefits of training and interface design for Advanced Driver Assistance Systems and Partial Driving Automation	8/11/2020	25	N/A
A Wizard-of-Oz experimental approach to study the Human Factors of Automated vehicles: Platform and methods evaluation	8/18/2020	21	N/A
Physics-Based Sensor Models for Virtual Simulation of Connected and Autonomous Vehicles	9/1/2020	27	38
		361	231

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

- [Study says parents’ teaching style can be instrumental in helping children learn how to safely cross busy roads](#) – Iowa Now (**press release**)
- [This is just a test: University of Iowa puts rural autonomous driving through its paces](#)- The Gazette
- [We Take an \\$80 Million Driving Simulator for a Spin](#)- Car and Driver
- [University of Iowa ramping up automated vehicle testing on local rural roads](#)- ADS for Rural America
- [University of Iowa researchers study effects of cannabis on driving](#)- The Daily Iowan
- [NADS provides national leadership on COVID-19 research protocols](#)- Iowa Technology Institute
- [UI researchers using virtual reality to study ways children cross streets](#)- The Daily Iowan

Usual lab tours were halted this period due to COVID-19. Our center still reached stakeholders from government, academia, and industry through online efforts. Individuals from public, private, and nonprofit sectors attended webinars this period, including some highlighted organizations below:

- U.S. Department of Transportation
- National Highway Traffic Safety Administration
- National Transportation Safety Board
- Transport Canada
- Alaska DOT
- Massachusetts DOT
- Michigan DOT
- Texas DOT
- AAA Foundation for Traffic Safety
- Uber Advanced Technologies Group
- Research Institute of Highway, Beijing, China
- Hanyang University
- Ohio State University
- University of Washington

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	10
Registrations for webinars	361
Views of archived webinar content	231
Press releases for SAFER-SIM related research	1
Media requests	7
Tours of facilities	0
Website traffic	4836 users 10,158 sessions 17,700 pageviews
Patents filed	0
DOT requests for presentations or proposals related to SAFER-SIM	0
Practitioner attendance at events	69
Number of improved or new simulation technologies, software, methods, or processes	9

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 biennial SAFER-SIMposium has been postponed twice due to COVID-19, though interaction and collaboration has continued through monthly round table meetings. A virtual symposium is planned for spring 2021 and again in the autumn of 2021 if an in-person meeting is still not feasible.

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

Collaboration Performance Metric	Result
Attendance at the SAFER-SIMposium	0
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	14
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	0
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-six (26) diverse students were involved in twenty-eight (28) SAFER-SIM projects this period.

Some diversity highlights from this period are:

- Shannon Roberts authored “Racial Equity and the Future of Work” that was published in Architecture + Design: <https://doi.org/10.1080/24751448.2020.1705711>
- Shannon Roberts attended the UMass “Black in STEM” event with black professors, black undergraduate students, black graduate students, and allies on August 5. There were approximately 115 people in attendance.
- Shannon Roberts & Jennifer McDermott both sat on a panel for the Spaulding-Smith Fellows program, which is for underrepresented graduate students in STEM, on August 18. There were approximately 20 students in attendance in addition to 5 other faculty of color.

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	2
# U/M students at attended events	135
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 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.

Shannon Roberts from University of Massachusetts Amherst is involved on the BTSCR panel for BTS-01: Guidance for Employer-Based Behavioral Traffic Safety Programs for Drivers in the Workplace. She provides guidance for the contractor in terms of how drivers will respond to traffic safety programs.

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?

New projects as well as some ongoing projects funded by SAFER-SIM have been delayed due to COVID-19. Data collection is slowly resuming, and projects will move forward through adapted protocols and procedures. The center will continue progressing toward final reports from projects. Online webinars and online outreach will continue. 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 New this period	Washington D.C.	In-kind support
Lee Engineering New this period	Phoenix, AZ	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 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.

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	6	10	6
Registrations for webinars	200	361	200
Views of archived webinar content	150	231	150
Press releases related to SAFER-SIM	1	0	1
Media requests	10	7	10
Tours of facilities	10	0	10
Website traffic	3,000 users 5,000 sessions 8,500 pageviews	4,836 users 10,158 sessions 17,700 pageviews	3,000 users 5,000 sessions 8,500 pageviews
Patents filed	1	0	1
DOT requests for presentations or	1 per year	1	1 per year

proposals related to SAFER-SIM			
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. Cai, Q., Abdel-Aty, M., Castro, S., 2020. Explore effects of bicycle facilities and exposure on bicycle safety at intersections. *International Journal of Sustainable Transportation*, 1-12. <https://doi.org/10.1080/15568318.2020.1772415>
2. Abdel-Aty, M., Wu, Y., Saad, M., & Rahman, M. S. (2020). Safety and operational impact of connected vehicles' lane configuration on freeway facilities with managed lanes. *Accident Analysis & Prevention*, 144, 105616. <https://doi.org/10.1016/j.aap.2020.105616>
3. Yue, L., Abdel-Aty, M., Wu, Y., Yuan, J., & Morris, M. (2020). Influence of pedestrian-to-vehicle technology on drivers' response and safety benefits considering pre-crash conditions. *Transportation Research Part F: Traffic Psychology and Behaviour*, 73, 50-65. <https://doi.org/10.1016/j.trf.2020.06.012>
4. Yue, L., Abdel-Aty, M., Wu, Y., Zheng, O., & Yuan, J. (2020). In-depth approach for identifying crash causation patterns and its implications for pedestrian crash prevention. *Journal of Safety Research*, 73, 119-132. <https://doi.org/10.1016/j.jsr.2020.02.020>
5. Chung, W., Abdel-Aty, M., Park, H. C., Cai, Q., Rahman, M. H., Gong, Y., & Ponnaluri, R. (2020). Development of Decision Support System for Integrated Active Traffic Management Systems Considering Travel Time Reliability. *Transportation Research Record*, 0361198120905591. <https://doi.org/10.1177%2F0361198120905591>
6. O'Neal, E. E., Zhou, S., Jiang, Y., Kearney, J. K., & Plumert, J. M. (2020). Let's cross the next one: Parental scaffolding of prospective control over movement. *Child Development*. <https://doi.org/10.1111/cdev.13457>
7. Pradhan, A. K., Pai, G., Radadiya, J., Knodler Jr, M. A., Fitzpatrick, C., & Horrey, W. J. (2020). Proposed Framework for Identifying and Predicting Operator Errors When using Advanced Vehicle Technologies. *Transportation Research Record: Journal of the Transportation Research Board*. <https://doi.org/10.1177%2F0361198120938778>
8. Ganesh Pai, Sarah Widrow, Jaydeep Radadiya, Cole D. Fitzpatrick, Michael Knodler & Anuj K. Pradhan (2020) A Wizard-of-Oz experimental approach to study the human factors of automated vehicles: Platform and methods evaluation, *Traffic Injury Prevention*, <https://doi.org/10.1080/15389588.2020.1810243>
9. Renski, H. C., Smith-Doerr, L., Wilkerson, T., Roberts, S. C., Zilberstein, S., & Branch, E. H. (2020) Racial Equity and the Future of Work. *Technology | Architecture + Design*. <https://doi.org/10.1080/24751448.2020.1705711>
10. A Elmquist, D Negrut, "Methods and Models for Simulating Autonomous Vehicle Sensors",

Conference papers and presentations

1. Christofa, E., Deliali, A., and Knodler, M. 2020. Driver Performance in the Presence of Bicycle Infrastructure. 20th Swiss Transport Research Conference, 13–14 May [online].
2. Subramanian, L. D., O’Neal, E., Plumert, J. M., & Kearney, J. K. (2020). Using Simulation to Assess Right-Hook Conflicts Between Bicycles and Cars at Protected and Unprotected Intersections. Proceedings of the 2020 EUROPE VR Driving Simulation Conference. September 2020
3. Benjamín Colucci. Technical Poster entitled Lessons Learned and Future of the Decade of Action for Road Safety 2011-2020, Strategic Highway Safety Plans and Vision Zero Initiatives presented with Eng. Lynnette Alicea from CSA Group during the ITE 2020 Virtual Annual Meeting. August 13, 2020.
4. J. Taves, A. Elmquist, A. Young, R. Serban, D. Negrut, “Synchrono: A Scalable, Physics-Based Simulation Platform for Testing Groups of Autonomous Vehicles and/or Robots”, ASME-MSNDC, St.Louis, MO, Aug 2020
5. D. Negrut, R. Serban, A. Elmquist, J. Taves, A. Young, A. Tasora, S. Benatti, "Enabling Artificial Intelligence Studies in Off-Road Mobility Through Physics-Based Simulation of Multi-Agent Scenarios." NDIA Ground Vehicle Systems Engineering and Technology Symposium. Aug 2020.

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	4,836	15,461
New Users	4,363	15,461
Sessions	10,158	29,208
Page Views	17,700	65,342

[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	20	90
Views	10,382	22,114
Subscribers	34	122

[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	39	346
Tweet Impressions	9,262	67,438
Followers	13	150

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

Metric	This Period	Lifetime
Datasets	5	24
File Downloads	3472	5806

3.4 New methodologies, technologies or techniques

Projects funded by SAFER-SIM developed or improved on the following technologies this period:

1. UCF – Infrastructure Placement – Walter Guo Currently, we are developing a new agent-based simulation framework based on Repast Symphony to better capture the dynamic decision making of vehicles and V2I.
2. UM – Visual Clutter - The research team developed a software package for eye-tracking video analysis, object identification, and integration with eye-tracking trace. The software is currently under internal testing by student interns.
3. UM – Visual Clutter - The research team is developing another software package for virtual driving scenarios using computer simulation to accommodate the disruption of COVID-19 on in-person driving simulation. This software package is related to another SaferSim project on Horizontal Curve Deflection Angle Analysis that is reported separately.
4. UPR - 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.
5. UW - Chrono::Sensor provided for public use within Chrono: <https://github.com/projectchrono/chrono>, directly developed under “Physics-Based Sensor Models for Virtual Simulation of Connected and Autonomous Vehicles”
6. UW - SynChrono provided for public use within Chrono: <https://github.com/projectchrono/chrono>, directly developed under “Physics-Based Sensor Models for Virtual Simulation of Connected and Autonomous Vehicles”
7. UW – Detailed Ped Vehicle Interactions - A by-product of the current research project is that the data processing methodologies developed are showing promising results in vehicle movement classifications that can be implemented on existing vehicle detection systems. Once details of the methodologies are finalized and streamlined, we will explore potential implementation of the approach with an industry partner we have collaborated with in the past.

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 495 times.

[Online Traffic Safety Merit Badge](#) – 810 Scouts have started the materials and 479 have completed the requirements. More information in [Section 1.2.3](#).

Metric	This Period	Lifetime
Scouts Started	193	810
Scouts Completed	225	479
# of Scouting Councils	69	202
# of Scouting Districts	105	300
# of Scouting Troops	109	393

[Online Engineering Merit Badge](#) – 203 Scouts have started the materials and 95 have completed the requirements. More information in [Section 1.2.3](#).

Metric	This Period	Lifetime
Scouts Started	201	201
Scouts Completed	95	95
# of Scouting Councils	67	67
# of Scouting Districts	92	92
# of Scouting Troops	114	114

[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	34	374
Campaigns Sent	15	99
# Opens	1392	5,793

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	9	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	2	1

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

1. UCF – Zaki - A prototype for the pedestrian mobility behavior is developed in matlab and is being, currently, on selected real data sets
2. UCF – Managed Lane - This study has major implications for improving managed lanes (MLs) by recommending the optimal CV lane configuration and market penetration rate for each design. Hence, recommending the managed lane as connected vehicle lane might have essential benefits of the transportation road network for the expressways of United States. On the other hand, one of the biggest issues facing CVs popularization associates it with the market penetration rate (MPR). For the policy point of view, this study provides useful insight for the management of CV MPR as managed-lane CV technologies in terms of CV transition period.
3. UCF – Infrastructure Placement – Walter Guo Currently, we are developing a new agent-based simulation framework based on Repast Symphony to better capture the dynamic decision making of vehicles and V2I.
4. UM – Visual Clutter - The research team developed a software package for eye-tracking video analysis, object identification, and integration with eye-tracking trace. The software is currently under internal testing by student interns.
5. UM – Visual Clutter - The research team is developing another software package for virtual driving scenarios using computer simulation to accommodate the disruption of COVID-19 on in-person driving simulation. This software package is related to another SaferSim project on Horizontal Curve Deflection Angle Analysis that is reported separately.
6. UPR - 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.
7. UW - Chrono::Sensor provided for public use within Chrono: <https://github.com/projectchrono/chrono>, directly developed under “Physics-Based Sensor Models for Virtual Simulation of Connected and Autonomous Vehicles”
8. UW - SynChrono provided for public use within Chrono: <https://github.com/projectchrono/chrono>, directly developed under “Physics-Based Sensor Models for Virtual Simulation of Connected and Autonomous Vehicles”
9. UW – Detailed Ped Vehicle Interactions - A by-product of the current research project is that the data processing methodologies developed are showing promising results in vehicle movement classifications that can be implemented on existing vehicle detection systems. Once details of the methodologies are finalized and streamlined we will explore potential implementation of the

approach with an industry partner we have collaborated with in the past.

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

1. UW - There were more than 50 companies that attended our consortium meeting on September 29 – October 1. They were interested, among other things, in the software infrastructure for AVs, which has been extensively developed with SAFER-SIM funding.

Number of projects that reach adoption, implementation or deployment

1. UW - The Chrono::Sensor simulation infrastructure has been deployed for public use.
2. UW - The SynChrono simulation infrastructure has been deployed for public use.

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.

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 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:

Performance Measure	Target	Result
Expected reductions in crashes from implemented policy, practice, regulation,	Not yet determined	Not yet realized

rulemaking or legislation		
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. UCF – Hurricane Evac - Through road traffic automation and connectivity developed in this project, the interactions between vehicles will be analyzed, and possible severe conflicts and consequent collisions can be avoided through proactive safety information dissemination. We expect this approach for road safety will lead to a significant reduction in crashes during emergency events like highway evacuations.
2. UCF – Connected Veh - The estimate effectiveness of Connected Vehicle technology for fog-related crash is around 34.6%. In Florida, around 40 fatal crashes happened each year during fog. Thus, around 14 ($40 * 34.6\% = 14$) fatal crashes are expected to be benefited from the technology.
3. UCF/AAAFS - This research is going to better understand the safety perception of non-driving road users on advanced vehicle technologies. Education efforts can be better directed to improve the safety of transportation system based on this research.
4. UW - This research could help reduce certain types of crashes through supporting automated vehicle safety evaluations but we are unable to quantify the number.

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

1. UCF – Hurricane Evac - The proposed CAV approach will provide a mechanism for informing drivers about the safety conditions during evacuation scenarios and henceforth will guide them through the necessary information for better trip planning and thereby avoiding hazardous traffic.
2. UW - This research could help reduce certain types of traffic conflicts and help relieve congestion through supporting automated vehicle safety evaluation, but we are unable to quantify the number.

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 has been affected by COVID-19. All activities involving human subjects were suspended in the spring. Additionally, other types of face-to-face interactions were interrupted. Summer and fall internships were cancelled. Facility tours were halted. Our symposium was postponed twice. On-line formats for all these activities have been developed and have or will soon resume.

Progress on projects continued by performing tasks that do not require in-person contact or human subjects in a simulator. We did 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 need access to our labs to continue our research as our research generally requires human contact. Some labs have returned to human subjects data collection, while some have not due to subject populations in high risk categories for COVID-19 or space or equipment limitations that make risk mitigation untenable. As we gradually return to our labs, we are taking additional measures to minimize risk. These include sanitizing surfaces anyone touches before and after use, limiting in-person interactions to the fewest possible, limiting time in shared spaces, and requiring face masks and shields when face-to-face interactions take place. Many procedures that were previously conducted in-person, such as informed consent or surveys have been moved to online platforms. Additional participant screening has been implemented with reminders to participants to reschedule appointments if they are experiencing symptoms of COVID-19. So far, we have seen no substantial change in our ability to recruit and enroll participants, though these measures have increased the resources needed to conduct a study involving human subjects.

While continue to take measures to keep working, our research activity has been interrupted. Some projects are returning to activity, while others are still experiencing delays. If additional waves of the virus over the winter and spring prompt additional suspensions of human-subjects research or restrictions to access to our labs then additional delays will occur. We have had sixteen (16) projects formally ask and receive extensions due to COVID-19. Some of these projects were in progress and in the second half of their performance period and were involved in collecting human-subjects data. Other projects requested an extension due to projected delays in data collection with human subjects. We will continue to work with investigators manage the effects of delays on their projects and find innovative solutions should additional delays occur.

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