

Message from the director

It is a pleasure to be back at the helm as director of the Crash Imminent Safety UTC. I would like to repeat my thanks to Professor Keith Redmill, who provided leadership during my two months of retirement. As we continue our research, education and service mission, I am sure this effort will have given him the experience to help out more in developing the UTC and take on other important roles.

This newsletter covers autumn and winter of the 2015-16 academic year. This begins the third year of activity and I am truly proud of all we have accomplished during our first two years. The accomplishments were evident during the technical presentations at our annual meeting, where attendees heard both from project leads and a number of graduate students.

The center has initiated new activities in three areas: cybersecurity, smart cities and moral algorithms. Minor support has allowed for funding one student in cybersecurity—advised by two of CrIS/Center for Automotive Research faculty—, and some hardware support for the smart cities activity. Additionally the smart cities activity received external support with a grant from the National Science Foundation to develop a first-mile, last-mile platform of on-demand small vehicles for the mobility impaired. We hope such grants will help new interest areas related to crash imminent safety to develop. The third new activity area, moral algorithms, is in support of a conference being organized on the ethical/moral aspects of real-time decision making in automated vehicles. See page three for more information.

Please contact us for more information on all topics in this newsletter

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CrIS UTC annual meeting held

The CrIS UTC annual meeting was held in Columbus, Ohio September 24-25, 2015. The meeting was attended by over 50 participants from member universities, industry, government and other academic and research institutions. The plenary speakers included Tim Johnson, senior executive at the U.S. Department of Transportation and director of the Vehicle Research and Test Center (VRTC) and Rini Sherony, senior principal engineer at Toyota's Collaborative Safety Research Center (CSRC). CrIS UTC students and faculty presented 16 talks which highlighted their current research findings and progress. The meeting included a business session along with an Internal Advisory Board meeting for the faculty while graduate students had several demonstrations and interactive sessions at the CAR West facility. The meeting provided an opportunity to receive feedback and direction from the center membership and other interested professionals. Professionals interested in attending future CrIS UTC annual meetings to hear about latest research developments should contact the CrIS UTC Program Manager at 614-292-5141 or crisutc@osu.edu.

Automated (driverless) valet systems under development

Center for Automotive Research's Control and Intelligent Transportation Research Laboratory members are collaborating with DURA Automotive Systems, a Tier 1 supplier, in developing advanced safety and autonomy solutions. Having worked on a prototypical lane departure warning safety system with DURA in 2014 and early 2015, Ohio State researchers are currently building an automated valet solution for completely driverless parking. The developed system will automate the steps from valet drop-off to valet pick-up in a conventional parking scenario, navigating and parking into a parking spot (head-in, tail-in, or parallel parking) fully autonomously, and coming back to pick up the driver when commanded from a mobile application. The current development vehicle, using Ohio State software algorithms to plan and follow paths and observing its environment for safe navigation, will be demonstrated at Intelligent Transportation Society of America's Annual Meeting in California this summer. To see this technology in action, navigate to the following link: go.osu.edu/CrISn1.



Ozguner wins IEEE ITS Outstanding Research Award

Reprinted from Department of Electrical and Computer Engineering.

Ohio State Electrical and Computer Engineering Professor Emeritus Umit Ozguner was recently honored for his important contributions to the field of intelligent transportation systems (ITS).

The Institute of Electrical and Electronics Engineers (IEEE) presented Ozguner with the Intelligent Transportation Systems Society's "Outstanding Research Award" earlier this fall. He also received a \$1,000 cash prize. Winners were announced at the IEEE ITS Conference held September in the Canary Islands.

By winning, Ozguner now follows his own mentor, Robert Fenton, who pioneered ITS research at Ohio State throughout the 1960s to the 1990s. The first-ever IEEE ITS Outstanding Research Award was presented to Fenton in 2006. Ohio State is now the only university to have two professors win the award.

"Professor Fenton and his team certainly put Ohio State on the map for autonomous ground vehicles," Ozguner said. "Getting to be the second name listed from Ohio State certainly makes me proud." He was also quick to share the spotlight.

"This is a team effort. So many, many graduate students have contributed through the years," Ozguner said. "Some, like Professor Keith Redmill and Arda Kurt, still continue leading the way at Ohio State, in autonomous and intelligent vehicles."

As an Ohio State professor for more than two decades, Ozguner focused much of his career on the intelligent control of large, decentralized systems, automotive control, intelligent vehicle highway systems and vibration damping in flexible structures. After retiring from his faculty position in May [2015], Ozguner said he planned to remain active in research. Remain active, indeed. The IEEE award marks the second honor he has earned since stepping down. Ozguner was among a short list of winners in the National Science Foundation's "Smart City" intelligent transportation research award in September.

Fenton was on-hand at Ozguner's retirement party earlier this year, praising the professor for his work.

"I've been a long term observer of automated highway and its latest manifestation in self-driving cars," Fenton said. "Since I retired 20 years ago, I have closely followed what he has been doing. He has done an absolutely magnificent job with his research in that area." According to IEEE, the ITS awards were established to recognize, promote and publicize major research contributions and application innovations that have made a real-world impact in the field. Find more information at: <http://its.ieee.org/itss-awards/>.

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Middle school outreach at the Columbus Academy

This past autumn one of the CrIS UTC graduate students, Danielle Fredette, volunteered to give a lesson to the fifth grade class at Columbus Academy.

On Wednesday morning, October 21, 2015, Fredette addressed about 80 fifth grade students, whose teacher, Anita Candler, had been assigning nonfiction articles about autonomous vehicle technology and policy as part of their reading class this year.



The lesson included an overview of autonomous vehicle technology, with videos and pictures of the autonomous vehicle work that is going on at Ohio State as well as videos about the university's driving simulator and SimVille development laboratory. The students eagerly participated in an interactive activity where they had to categorize aspects of hypothetical vehicles into categories of autonomous, semi-autonomous/connected and conventional using a Venn diagram. They also learned about the logical tool of if-else statements in programming autonomous vehicle logic through another interactive activity.

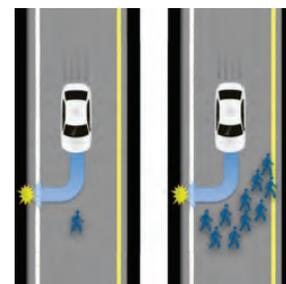
These students were very engaged in this material and many indicated interest in pursuing engineering later in life. The hope is that this lesson alerted them to some of the challenges that still remain in autonomous vehicle development, informed them about local opportunities in autonomous vehicle research at Ohio State and sparked their interest even more toward engineering.

Conference on Moral Algorithms and Self-Driving Cars

Reprinted from The Ohio State University's Center for Ethics and Human Values

The Center for Automotive Research, the Center for Ethics and Human Values and other co-sponsors will present a one-day Conference on Moral Algorithms and Self-Driving Cars on April 18, 2016 at the Ohio State University.

The "Trolley Problem," first developed by philosopher Philippa Foot in 1967, was presented as an abstract puzzle for those interested in moral theory. It is a thought experiment that



invites us to evaluate the moral permissibility of acts that avoid harm to a larger group of people by imposing harms on a smaller group of people who, absent such actions, would not be threatened. Recently it has become the object of serious psychological and neurological research as scientists explored how people actually make choices in these situations and how they evaluate them retrospectively.

The issues raised by the Trolley Problem can no longer remain the preserve of moral philosophy and psychological research. The development of autonomous vehicles requires us to operationalize moral judgment. If vehicles are to make decisions that minimize harm in crash imminent situations, questions arise regarding what constitutes the minimization of harm. Under what conditions is it permissible to cause harm to some in order to avoid harm to others? Are the numbers of victims and the severity of harm all that matters morally or does it matter, also, whether humans cause the harm or merely allow it to occur? Does it matter whether the harm caused is the instrument of avoiding the harm we prevent or merely an unintended side-effect? These questions can no longer be confined to the seminar room. They arise in the laboratory as intelligent systems are designed to make decisions formerly left to humans. To address these situations, there is need to develop moral algorithms—algorithms that resolve tragic choices in morally defensible ways.

Conference website:

<https://cehv.osu.edu/events/moral-algorithms-conference>

CrIS UTC researcher Donald Fisher featured speaker at Volpe



Volpe, The National Transportation Systems Center, U.S. Department of Transportation has a mission to improve transportation by anticipating and addressing emerging issues and advancing technical, operational, and institutional innovations across all modes. A member of the CrIS UTC leadership group, Donald Fisher, PhD, from University of Massachusetts Amherst has been serving as a faculty fellow at Volpe during the past two years and was recently appointed as a principal

technical advisor in the Division of Surface Transportation Human Factors.

Fisher, an Engineering Research Psychologist and former head of UMass, Amherst, Mechanical and Industrial Engineering Department, recently presented the third talk in Volpe's Beyond Traffic 2045: Reimagining Transportation speaker series entitled, User and machine: Secrets to a Harmonious Marriage. Fisher's talk explores the vision of manufacturers with the desires of the driving public and addresses the challenges and benefits to finding a compatible future. The presentation may be viewed on Volpe's website: go.osu.edu/CrISn12.

North Carolina A&T State University's first driving simulator study

The Autonomous Control and Information Technology (ACIT) Institute located at North Carolina Agricultural and Technical State University (NCA&T) fosters interdisciplinary work to carry out research and education in autonomous control engineering and its applications. The technology transfer role of the institute includes workshops, seminars and demonstration projects designed to move new technologies from the laboratory to industry as well as education on these technologies. The institute has greatly benefited from funding for research obtained from federal agencies such as the U.S. Department of Transportation. The support from these agencies helps to sustain both graduate and undergraduate students at the institute.

The Crash Imminent Safety-University Transportation Center project has been of tremendous impact to the ACIT Institute. Collaboration has been fostered through bi-weekly teleconferences with the team at The Ohio State University on driver behavior modeling, and discussions with team at the University of Massachusetts, Amherst (UMass) on cognitive attention modeling.

With great support and collaboration from Professor Donald Fisher and members of the Human Performance Laboratory of University of Massachusetts, the first-ever driving simulator study was completed at the ACIT Institute. The study investigated the effects of auditory and visual warnings and the participant's anticipation of latent hazards while performing this task.

A team of summer undergraduate research assistants from the Electrical and Computer Engineering Department at NCA&T were of tremendous assistance in this study.

Meet the team:

NCA&T UNDERGRADUATE RESEARCH ASSISTANTS



Keyur Vaidya

I am an undergraduate student studying computer engineering. I am in my senior year scheduled to graduate in December 2015.

My experience working at the ACIT Institute has been a great one. I have had the pleasure of working with this team since autumn 2014. My senior

design project was on the detection and mitigation of driver visual distraction using a GP3 eye-tracker (from Gazepoint Technologies) on the Realtime Technologies Inc. (RTI) driving simulator. I worked with three other undergraduates on this project. We had full access to the driving simulator as well as tremendous support from the graduate students working on the transportation research. The work this summer was exciting. The data collection task was somewhat difficult and time consuming; however, running participants on the simulator with eye tracking was a lot of fun.

After I graduate, I plan to go to graduate school starting Spring 2016. I hope to pursue a PhD in Computer Engineering at one of the nation's top universities.



Xuyang Yan

I am an undergraduate transfer student from China. I am a senior majoring in Electrical Engineering.

This summer, I had a very pleasant experience being involved in research at the ACIT institute, particularly

working with the driving simulator.

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My work this summer introduced me to research and gave me great exposure in reviewing literature as well as technical writing. Working on the team has broadened my horizons and increased my depth of thinking.

I hope to pursue graduate studies upon completion. This summer research experience has given me the urge and confidence to pursue graduate studies. Working with the graduate students exposed me to a wealth of experiences and ideas, boosting my excitement about life in graduate school.

NCA&T GRADUATE RESEARCH ASSISTANTS



Allan Anzagira

I am a second-year doctoral student in electrical engineering. I received my bachelor's degree in electrical/electronic engineering from Kwame Nkrumah University of Science and Technology (KNUST), Ghana. I am currently working in the project titled "Cognitive Attention Models for Driver

Engagement in Semi-autonomous and Intelligent vehicles."



Saina Ramyar

I am a second year doctoral student in electrical engineering at North Carolina A&T State University. I received my bachelor's and master's degrees from Ferdowsi University of Mashhad (FUM), Iran. I am currently working on the project titled "Driver Models for both human and autonomous vehicles."

Working at ACIT Institute has opened up many doors for me. My background was in control of renewable energy systems, but here I started to learn and use different machine learning techniques which are very interesting yet completely different from what I already knew. During my first year, I submitted four papers as a main or co-author.

External Advisory Board meeting review

This year's CrIS UTC External Advisory Board (EAB) meeting was held in conjunction with the Center for Automotive Research's External Advisory Board meeting. The CAR portion of the meeting took place in the morning followed by lunch and a display of various experimental vehicles and an autonomous scooter demonstration. The scooter, overseen by graduate students, made a circular path around the CAR parking lot.

EAB members are composed of from representatives of the automotive industry, State of Ohio and the insurance industry. During the meeting the current state of the CrIS UTC with regards to research, facilities and education/outreach activities was discussed. The meeting was facilitated by Ron Burton from the Transportation Research Center.



Central Ohio American Society of Civil Engineers Members learn about research

December 17, 2015 Arda Kurt, senior research associate, CrIS UTC and Center for Automotive Research gave a talk to the Central Ohio Section of the American Society of Civil Engineers at The Ohio State University's Fawcett Center.

The talk focused on the recent developments, ongoing trends and future implications of automated/connected heavy duty vehicles. Various factors driving the development of vehicle automation were discussed, including safety and efficiency. Different levels of automation, possible technologies and an overview of cost versus benefits were outlined. The talk included research and implementation examples from around the world and comparisons with corresponding automation technologies in passenger vehicles, including the ongoing research at the Crash-Imminent Safety UTC, were used to emphasize the importance of automated fleet/commercial traffic.

Recent Publications and presentations

Gungor O., Chen F., Koksai C. E. (June, 2015). Secret Key Generation via Localization and Mobility, IEEE Transactions on Vehicular Technology, Volume 64, Issue 6, pp 2214-2230.

Venkatraman, V., **Lee, J. D.**, Schwarz, C. W., Gunarathne, P. (n.d.). Benefits estimation of collision warning systems: Development of crash risk scales using what-if modeling techniques. Society of Automotive Engineers.

Samuel, S., Romoser, R.E., Knodler, M., **Fisher, D.L.** (2015, in press). Evaluating spillover effects on forward roadway glance durations. Presented at the meetings of the Road Safety and Simulation Conference, Orlando, FL.

Basciftci Y. O., Chen F., Weston J., Burton R., **Koksai C. E.** (Sept. 2015). How vulnerable is vehicular communication to physical layer jamming attacks? Proceedings of IEEE Vehicular Technology Conference, VTC 15, September 6-9, 2015, Boston, MA.

Ponnu, B., **Coifman, B.** (2015). Speed-Spacing Dependency on Relative Speed from the Adjacent Lane: New Insights for Car Following Models, Transportation Research Part B. Vol 82, 2015, pp 74-90.

Liu, P., Kurt, A., **Redmill, K., Ozguner, U.** (January, 2016). Classification of Highway Lane Change Behavior to Detect Dangerous Cut-in Maneuvers. Accepted to appear in Proceedings of TRB 2016 Annual Meeting.

Samuel, S. and **Fisher, D. L.** (in press). Minimum time to Situation Awareness in Scenarios Involving Transfer of Control from the Automation. Accepted for presentation at the 95th Annual Meeting of Transportation Research Board. Washington, D.C., January.

Anzagira, A., Ramyar, S., Yan, X., Agana, N., **Homaifar, A., Fisher, D.L.** (2016) Effect of Visual and Auditory Warnings on Latent Hazard Anticipation while Engaged in a Mock Cellphone Task. (Accepted) Transportation Research Board 95th Annual Meeting.

Gibson, M. C., **Lee, J. D.**, Venkatraman, V., & Price, M. (in press). Situation awareness, scenarios, and secondary tasks: Measuring driver performance and safety margins with highly automated vehicles. Society of Automotive Engineers. //

