

Message from the director

Welcome to a brand new issue of the CrIS Newsletter. We are proud to be reporting on our center's accomplishments during the last six months. It has been an active time both for me and for all our faculty, researchers and students at The Ohio State University and partner institutions.

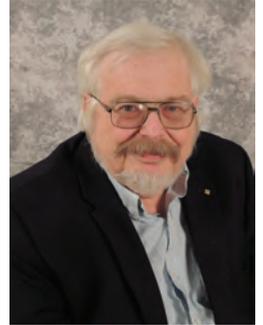
After the Transportation Research Board meeting, where we held our second dinner (now becoming a tradition!), I had a number of invitations to give presentations at different locations around the country on the research topics of CrIS UTC.. It was especially enjoyable to visit University of California-Riverside, where I also happened to view a number of posters on transportation issues prepared by students from University of California campuses.

In the last issue we reported on a number of new initiatives at the center. One such initiative was on the subject of smart cities and supported a project developing and testing on-demand, one-person or multiple-person automated shuttles on Ohio State's campus. The project, called SMOOTH, was funded mostly by the National Science Foundation, and the safety aspects were of interest. In the interim, it was announced that the City of Columbus had won the U.S. Department of Transportation's Smart City Challenge. The SMOOTH project will now be fulfilled within the city-wide award.

Finally congratulations go to Arda Kurt on his new appointment as research assistant professor in Ohio State's Department of Electrical and Computer Engineering.

Umit Ozguner

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95th Annual Transportation Research Board meeting attended by CrIS UTC representatives

CrIS UTC Director Umit Ozguner; investigators Abdollah Homaifar, Benjamin Coifman and Arda Kurt; and graduate student Peng Liu and post-doctoral researcher Balaji Ponnu Devanarayanan attended the Transportation Research Board (TRB) annual meeting, January 8-12, in Washington, D.C.

While there Peng Liu, Ohio State graduate student, presented his CrIS-sponsored research on recognizing dangerous driver behavior for improved safety. His presentation was entitled Classification of Highway Lane Change Behavior to Detect Dangerous Cut-in Maneuvers "It is helpful to talk to presenters with various research backgrounds and different research foci," says Liu. A presentation by Balaji Ponnu Devanarayanan was given at the TRB seminar on doctoral student research in transportation operations and traffic control.

"My TRB 2016 experience was a memorable one as it provided me an opportunity to attend sessions that were on the forefront of research on traffic operations," Ponnu Devanarayanan comments "It also provided me a platform to meet and interact with fellow doctoral students from all over the world and get to know their research. The conference paved way for meeting my past colleagues and professors from different parts of the world and reestablish connections with them." Graduate student attendees participated in committee meetings, which helped networking with researchers in their areas of research, and they were also able to take part in the committee activities that will be helpful for building successful careers in the future.



// Ponnu Devanarayanan presents at the TRB meeting

Following the annual Transportation Research Board meeting, representatives from the CrIS UTC attended the 2016 Annual CUTC Awards Banquet and Business Meeting, held January 9-11, also in Washington, D.C. CrIS UTC Director Umit Ozguner attended the center directors' meeting and CUTC Business Meeting/RETRC meeting.

The events were capped by the second annual CrIS UTC dinner on January 12 at a local eatery. Attendees included Umit Ozguner, Abdollah Homaifar and Arda Kurt, as well as family and friends of the CrIS UTC.



Columbus awarded in Smart City Challenge

Carla Bailo, Ohio State's assistant vice president for mobility research and business development led the way for the university's participation in Columbus' application to the U.S. Department of Transportation's Smart City Challenge. Here she reports out on the program's success.

"Columbus was selected from 78 mid-sized cities to receive \$40 million from the U.S. Department of Transportation (DOT) and \$10 million from Vulcan in the U.S. DOT Smart City Challenge. Beyond this grant, the Columbus community generated an additional \$90 million in public and private sector funding.

"The Ohio State University was vital to the proposal development which includes significant input and research of the Center for Automotive Research and CrIS UTC teams. There will be four pilot deployments of intelligent transportation, which include: autonomous shuttles in a commercial district; autonomous shuttles on the Ohio State campus; rapid transit bus service in underserved communities to provide access to jobs; and low speed platooning for urban logistics and delivery.

"All of these initiatives will include much of the research that has been done or will be done in the CrIS UTC, including pedestrian safety, collision avoidance, connected and autonomous vehicle technology, systems development, virtual testing in the driving simulator, public policy, urban planning and law. Several key faculty from CrIS will be integral to the project."

Carnegie Mellon University: Safety Summit

Umit Ozguner, CrIS UTC director, along with Ohio State graduate student Lauren Eichaker and University of Massachusetts-Amherst post-doctoral researcher Timothy Wright attended Carnegie Mellon University's Safety Summit in Washington, D.C., March 30-31. There Ozguner gave an overview presentation of Ohio State's Crash Imminent Safety Research and Education.

SUMMIT EXPERIENCES

Lauren Eichaker, Graduate Assistant, Ohio State University



// Eichaker

"I presented my injury biomechanics research at the University Transportation Center (UTC) Safety Summit held in Washington, D.C., in March 2016. There I described the injury mechanisms in lead vehicle stopped, and near-side impact crash scenarios. In the lead vehicle stopped group,

steering wheel contact caused the most severe injuries. Truck under-rides and complicated crashes accounted for more injuries than car to car collisions. In the near-side impact group, intrusion of impacting vehicle or the door of the case vehicle by the impacting vehicle caused a majority of the head injuries. Smart,

reactive braking technologies might decrease the severity of crashes in both of the analyzed scenarios. This event was an excellent opportunity for me to learn about research projects and findings from UTC-participating laboratories that conduct autonomous vehicle research. Because autonomous vehicle research is interdisciplinary, it is important to be able to learn about new and different perspectives from each research group. I was also able to network with laboratory members from other universities, as well as provide and receive valuable feedback about my research in a friendly, collaborative environment. ~

Timothy Wright, Postdoc, University of Massachusetts Amherst

"The CMU Safety Summit was an effective way to hear from members of academia, government and industry regarding current research goals related to transportation safety. It is not often where you can hear from all three perspectives and uncover areas of overlap and divergence. Demonstration Night was also an excellent experience, where I was able to network with other UTCs and obtain feedback regarding current research projects at University of Massachusetts and more broadly the CrIS UTC.

Read more: <http://go.osu.edu/CrISn13>

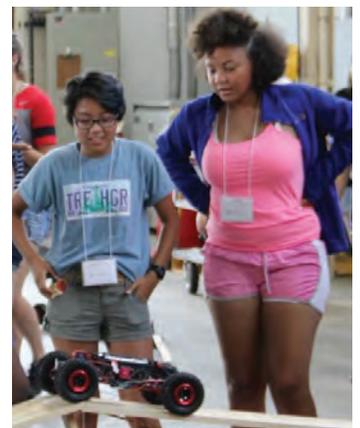
View presentations: <http://go.osu.edu/CrISn14>

Summer engineering campers program robots

Thirty-six high school sophomores and juniors from across the Buckeye state and beyond learned about the wide range of engineering majors offered by The Ohio State University, related careers and college life during a six-day residential camp hosted by the university's Women in Engineering program.

Sponsored by GM Foundation and Shell, WiE RISE is filled with hands-on activities, including learning how to program a Sparki robot to complete various challenges, a team design-build project to create a device capable of protecting an egg during a fall, a water purification challenge and creating a light-up LED display circuit. In addition, participants met current Ohio State engineering female faculty and students and learned more about college life.

As part of the program, doctoral students from the Center for Automotive Research's autonomous vehicle research group and CrIS UTC conducted a week-long laboratory project for the students. This year's group of female high school students learned how to use basic programming concepts in a block programming environment to design software for Sparki, an autonomous car-like robot. Intelligent vehicle concepts of navigation, sensor use, lane keeping, obstacle





avoidance, lane change and intersection handling were covered in laboratory exercises, culminating in a final competition in which the robots autonomously traversed an obstacle course

resembling a city driving scenario. Through all of this, the students were able to experience some of the highs and lows of engineering in a fun and fast-paced environment, with real knowledge gained for the future.

Among other activities, campers visited several research laboratories including the High Voltage Research Laboratory, Center for Automotive Research, as well as Ohio State Airport.

This is the third consecutive year CrIS UTC has supported the WIE RISE camp.

Moral Algorithms and Self-Driving Cars conference held

The Ohio State University's Center for Ethics and Human Values and its co-sponsors hosted a one-day conference on moral algorithms and self-driving cars on April 18. The conference discussed real issues faced by the smart vehicle community.

The development of autonomous vehicles requires humans to operationalize moral judgment. If vehicles are to make decisions that minimize harm in crash imminent situations, questions of what constitutes the minimization of harm need to be addressed. For example, 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 harm is caused or merely allowed to occur? Does it matter whether the harm that is caused is the instrument of avoiding the harm prevented 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, "moral algorithms," algorithms that resolve "tragic choices" in morally defensible ways, need to be developed.

The four sessions of the conference—current and near-future technological capabilities, moral values and constraints, psychological aspects of dilemmatic choice, and law and public policy—are available via video at <http://livestream.com/WOSU/MoralAlgorithms>

Ohio State event co-sponsors included the Center for Interdisciplinary Law and Policy Studies, Office of Research, Decision Sciences Collaborative, Center for Automotive Research and Crash Imminent Safety University Transportation Center.

READ NOW!

Article by CrIS UTC's Donald Fisher is in first issue of IEEE Transactions of Intelligent Vehicles, in-print for the first time



Title: Humans and Intelligent Vehicles: The Hope, the Help, and the Harm Authors: Donald L. Fisher, Maura Lohrenz, David Moore, Eric D. Nadler, and John K. Pollard.

Abstract: —Intelligent vehicles offer hope for a world in which crashes are rare, congestion is reduced, carbon emissions are decreased and mobility is extended to a wider population. As long as humans are in the loop, over a half century of research in human factors suggests that this hope is unlikely to become a reality

// Fisher

unless careful attention is paid to human behavior and, conversely, the potential for harm is real if little attention is given to said behavior. Different challenges lie with each of the two middle levels of automation which are the primary focus of this article. With Level 2 automation (National Highway Traffic Safety Administration), the driver is removed from always having to control the position and speed of the vehicle, but is still required to monitor both position and speed. Humans are notoriously bad at vigilance tasks, and can quickly lose situation awareness. Moreover, even if vigilant, the driver needs to interact with the vehicle. But voice-activated systems which let the driver continue to glance at the forward roadway are proving to be a potential source of cognitive distraction. With Level 3 automation (NHTSA), the driver is out of the loop most of the time, but will still need to interact with the vehicle. Critical skills can be lost over time. Unexpected transfers of control need to be considered. The surface transportation and aviation human factors communities have proposed ways to solve the problems that will inevitably arise, either through careful experimentation or extensions of existing research. Read the article here: <http://go.osu.edu/CrISn15>

Ohio State graduate student exchange

A group of CrIS UTC students visited the Ohio State intelligent vehicle laboratories July 14-22 as part of the second annual CrIS UTC summer camp.

On July 15 and 16 students from NCA&T, IUPUI and Texas Southern University had a chance to work at the Ohio State Driving Simulator Laboratory. Then, between July 18 and 22, the group worked on different automated and connected vehicle platforms, including the small-scale urban autonomy testbed SimVille, and full-scale vehicles equipped with drive-by-wire and dedicated short-range communication hardware.

The experiments included introductory exercises to familiarize the students with the player/stage simulation and vehicle/robot interfacing software and a tutorial on simple network connection, code compilation and execution in a Linux environment. Moreover, automated lateral (steering) control for road following based on GPS measurements, simulated and tested on small-scale mobile robots

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servicing as surrogate vehicles was completed. Communication-based conveying—vehicle-to-vehicle communication and automated longitudinal (throttle/brake) control—as well as communication-based traffic light scenarios—vehicle-to-infrastructure (V2I) communication and longitudinal control—were included as components of the program. Other areas of focus were in sensor-based obstacle detection,



processing and acting on LIDAR data, V2I and V2X intersection safety and efficiency experiments on a full-size vehicle with longitudinal automation.

Students involved were Peijia Tang and Saina Ramyar (Texas Southern University), Wensen Niu (North Carolina Agricultural and Technical State University), Wasif Javaid and Zhi Huang (Indiana University- Purdue University Indianapolis), and Lauren Eichaker, Menna El-Shaer, Peng Liu, Michael Vernier, and DongFang Yang (Ohio State).

Transportation Innovation Series: How intelligent vehicles will deal with all those human drivers

The University Transportation Center's central program office extended an invitation to Umit Ozguner, CrIS UTC director, to give a presentation on April 20 in the center's Transportation Innovation Series. The lecture was presented at the U.S. Department of Transportation headquarters in Washington, D.C., where it was also live-streamed to a wider audience.

"The presentation offered a brief review of 20 years of experience in dealing with crash imminent situations as self-driving cars have continued to develop," says Ozguner. "As the trend is now towards mixing self-driving cars with human driven ones, dangerous situations are expected to increase. It is hard to teach self-driving cars that they will encounter vehicles (driven by humans) which will not obey the rules, will not cooperate and may even act irrationally."

The presentation demonstrated recent research findings to address some of these problems. The focus of the CrIS UTC is to improve ground transportation safety through interdisciplinary research and development in the interplay of autonomous and intelligent vehicle systems, human factors and injury biomechanics. Research in this area includes developing advanced accident simulators, statistical modeling, analyzing past accidents and developing autonomous vehicles.

The research team includes over 20 faculty and researchers working at The Ohio State University and its partner universities at Indiana

University-Purdue University, North Carolina A&T State University, University of Massachusetts-Amherst and University of Wisconsin-Madison.

A video of the presentation may be viewed here: <http://go.osu.edu/CrISn16>

Recent publications

Gungor O., Chen F. and Koksalc 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. and 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. and 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., and Koksalc C. E. (September 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, January 2016). 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.

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.

Jing, J., Ozatay, E., Kurt, A., Michelini, J., Filev, D. and Ozguner, U. (2016) Design of a Fuel Economy Oriented Vehicle Longitudinal Speed Controller with Optimal Gear Sequence, Submitted for Decision and Control (CDC), IEEE.

Jing, J., Kurt, A., Redmill, K. and Ozguner, U. Vehicle Speed Prediction Using a Cooperative Method of Fuzzy Markov Model and Autoregressive Model. Ponnu, B., (2016) Impacts of Adjacent Lane Vehicles on the Speed-Spacing Relationship and Implications for Car-Following Models, Proc. The Transportation Research Board (TRB) 95th Annual Meeting.

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



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