

Message from the director

I always claim that generating the first of a new product is easier than the second. Preparing for the first always comes with enthusiasm and excitement. It is the second that shows true dedication, true commitment. So it is with great pleasure, I introduce the second newsletter of Ohio State's Crash Imminent Safety University Transportation Center (CrIS UTC). Again we report on our accomplishments as a team, the research being done, meetings participated in and papers presented at international meetings or published in esteemed journals.

Our joint research with industry—including Toyota, Ford, DURA and others—has continued, and the insights those collaborations have provided us have enriched our work on the UTC projects. All member universities of CrIS UTC greatly value such collaborations with industry and look forward to their expansion.

The second issue of our newsletter will introduce you to new faculty at Ohio State in the transportation area, highlight one of our research projects, outline two new seed grants we initiated and provide glimpses of recent events.

Enjoy!

Umit Ozguner

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CrIS UTC welcomes new Center for Automotive Research faculty



// Bilin Aksun Guvenc

Among three new faculty welcomed by the Center for Automotive Research (CAR), two have expertise in intelligent transportation systems (ITS). Professors **Levent Guvenc** and **Bilin Aksun Guvenc** come to Ohio State from Turkey where both were faculty at Istanbul Okan University and Istanbul Technical University. Together, they led a highly successful Automotive Control and Mechatronics Research Center of Excellence funded by the European Union at Istanbul Technical University. This husband-wife team are aligned with CrIS UTC and will bring expertise to many of our research endeavors. Bilin's specialties are in automotive control systems—primarily vehicle dynamics controllers, such as electronic stability control, adaptive cruise control, cooperative adaptive cruise control and collision warning and avoidance systems. She also has expertise in 'Smart Cities.' Levent's specialties are in vehicle active safety, vehicle systems and their control, cooperative automated mobility, atomic force microscopy (AFM at nanometer levels) and robotics.



// Levent Guvenc

The pair have worked on many interesting projects, both individually and together. Levent has undertaken research on automation systems, hardware-in-the-loop simulation, helicopter stability and control, automated parking, lane keeping assistance, driver attention monitoring, rollover avoidance, driver adaptive assistance systems, hybrid electric and fully electric vehicles, automated driving and cooperative mobility. Bilin has worked on semi-active suspension control of a light commercial car, driveline modeling and experimental identification, low cost adaptive cruise control simulators and automated driving projects. Together, they have worked on projects involving active chassis control, steering control, automated vehicles and cooperative mobility. They also jointly participated in the 2011 Grand Cooperative Driving Challenge with Team Mekar (partnering with CAR's Control and Intelligent Transportation Research laboratory), where they placed fifth in the individual vehicle category and seventh overall.

Currently, Bilin is working on projects involving fault diagnosis, detection and isolation (FDI), autonomous vehicles for the elderly and Smart Cities. Levent is working on projects involving cooperative automated mobility and advanced driver assistance systems.



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CrIS UTC director honored

CrIS UTC director Umit Ozguner was honored at the 53rd Conference on Decision and Control in Los Angeles, California, on December 15, 2014. Ozguner was recognized for the many significant contributions he has made over a long and distinguished career in the fields of large scale systems, decentralized control, intelligent transportation systems and autonomous vehicles. He has been one of the pioneers in creating new courses and laboratories in the control curricula and has mentored younger researchers in their career development. He has more than 400 publications and has advised over 25 students on their doctoral studies. Ozguner has been awarded The Ohio State University College of Engineering Lumley Research Award on several occasions.

Previous Center for Automotive Research faculty member and colleague of Umit Ozguner, Stephen Yurkovich, participated in his recognition ceremony.

“I consider Umit to be the architect of the control and systems group at Ohio State in electrical engineering; through his leadership – both professionally and socially – he was instrumental in the group’s rise to national prominence.”

Stephen Yurkovich
Professor, University of Texas Dallas
Professor Emeritus at The Ohio State University

Intelligent Transportation Society World Congress

The Intelligent Transport Systems Society 21st World Congress was held September 7-11, 2014 in Detroit, Michigan. It was hosted by the Intelligent Transportation Society of America (ITS America) in partnership with European Road Transport Telematics Implementation Coordination (ERTICO) and Intelligent Transportation Systems Asia-Pacific. Thousands of transportation professionals from around the world attended the World Congress, which offered various events, demos, exhibitions, tours and speakers on a variety of IT related topics.

Several CrIS UTC students attended the World Congress, sponsored by DENSO International America, Inc. Michael Vernier, Emrah

Adamey, Guchan Ozbilgin and Christian Bruns, all doctoral students advised by Umit Ozguner, found that walking the expo floor was helpful in discovering new technologies coming to market. They visited various booths and witnessed demonstrations of products from industry leaders in intelligent transportation as well as live vehicle demonstrations. They found the DENSO booth especially interesting, as it closely aligned with their research interests. DENSO’s booth highlighted new V2X equipment, new obstacle detection using a combined radar and camera sensor and two separate simulators to explore new cockpit information systems.

One week prior to the opening of the World Congress, Umit Ozguner, CrIS UTC Director, attended the Eighteenth Annual Meeting of the International Task Force on Vehicle-Highway Automation (ITFVHA) on September 6, 2014 in Farmington Hills, Michigan. This workshop brought together 75 leaders in the field of intelligent transportation to examine and discuss issues such as industry and government perspectives on automated vehicles and future developments.

Miniproposals awarded funding

A key goal of CrIS UTC is to foster the development of the next generation of transportation research leaders by providing opportunities for faculty who traditionally work outside the field of ground transportation. Another outlet by which engages these leaders is through research and leadership opportunities for early career faculty members.

As part of this mission, the Ohio State group held its first **request for proposals for miniprojects on crash imminent safety** on new or advanced topics not extensively being investigated. The request for proposal was open to researchers affiliated with partner universities—Indiana University-Purdue University Indianapolis (IUPUI), University of Massachusetts, North Carolina Agricultural and Technical State University and University of Wisconsin) not currently receiving CrIS UTC funding.

Two proposals were selected for funding: **Benjamin Coifman**, associate professor, Departments of Civil, Environmental and Geodetic Engineering and Electrical and Computer Engineering, The Ohio State University, “Safety Implications of Traffic Dynamics in Congested Freeway Traffic” and **Jiang Zheng**, computer and information science, IUPUI, “Analyzing and Mining Big Data of Driving Videos for Crash Avoidance.” These projects will both be considered

as subprojects under CrIS UTC's project seven, technology enhancements to improve precrash safety.

Ohio State's President Michael V. Drake visits the Center for Automotive Research



The Ohio State University's 15th president, Michael V. Drake, visited the university's Center for Automotive Research (CAR) on Monday, November 24, 2014. During his tour Dr. Drake saw firsthand the innovative research happening at CAR, from internal combustion engines to a semiautonomous vehicle ride at the center's new CAR West, where CrIS UTC is located.

Highlighted project: "Cognitive Attention Models for Driver Engagement in Intelligent and Semiautonomous Vehicles"

As vehicle systems become more autonomous, human drivers engage in other activities and tasks—in other words, drivers disengage from the driving situation. The focus of project three (John Lee, University of Wisconsin; Don Fisher, University of Massachusetts; Abdollah Homaifar, North Carolina Agricultural and Technical State University; David Woods, Ohio State) is to improve human cognitive modeling in order to more accurately describe the human-machine interfaces that take place in precrash scenarios. This project develops a cognitive attention model that provides a fundamental understanding and analysis capability for driver attention.

The model will be used to understand how drivers respond to vehicle to vehicle (V2V) and vehicle to infrastructure (V2I) information cues in precrash scenarios. It has been shown that there are disrupting effects of in-vehicle glances on hazard anticipation when compared with drivers who glance continuously at the roadway. The development of in-vehicle systems that were able to detect latent threats could help reduce the risk of in-vehicle glances on hazard anticipation. It was also found that trained drivers had fewer and shorter in-vehicle glances than untrained drivers.

Those working on project three have also been developing a computational model of attention to investigate re-engagement that is specifically designed to handle situations where multiple sensors and algorithms assess anomalies and risk at multiple temporal and spatial scales. These methods have been successful in detecting distraction as well as reduced alertness associated with fatigue and other impairments. Machine learning algorithms investigated include Bayesian networks, support vector machines (SVM), eye steering correlation and random forest. The investigation considered the applicability, accuracy and computational speed of these methods. This simulation of attention can be used for designing warnings and automation to facilitate re-engagement. It can also be used as a critical measuring tool to assess the effectiveness of re-engagement under different conditions, and with different types of responses to precrash risk assessment.

Stanley Chien presents at the Intelligent Transportation Systems Conference

CrIS UTC's Stanley Chien, from the Transportation Active Safety Institute (TASI) at Indiana University-Purdue University Indianapolis (IUPUI), presented a paper at the Intelligent Transportation Systems Conference (ITSC14) in Qingdao, China. Chien's paper "Obtain a Simulation Model of a Pedestrian Collision Imminent Braking System Based on the Vehicle Testing Data" was written with professor Yaobin Chen, TASI, and Bo Tang, IUPUI graduate student.

Forward pedestrian collision imminent braking (CIB) systems have proven to be of great significance in improving road safety and protecting pedestrians. Since pedestrian CIB technology is not mature, the performance of different pedestrian CIB systems varies significantly. Therefore, the simulation of a CIB system needs to be vehicle specific. The CIB

simulation can be based on the component sensor parameters and decision making rules. Since these parameters and decision rules for on the market vehicles are not available outside of vehicle manufacturers, it is difficult for the general research communities to develop a good



CIB simulation model based on this approach. To solve this problem, this study presents a new method for developing a pedestrian CIB simulation model using pedestrian CIB testing data. The implementation was in the software PreScan. The simulation results demonstrate that a pedestrian CIB simulation model developed using this methodology could reflect the behavior of a real vehicle equipped with pedestrian CIB system.

The conference took place October 8-11, 2014, and included a variety of presentations, tutorials, short courses and workshops. A copy of the paper can be found on the CrIS UTC website at www.citr.osu.edu/cris.

Student activities

Guchan Ozbilgin, graduate student in the Department of Electrical and Computer Engineering, represented CrIS UTC at Ohio State's Graduate Engineering Research Colloquium (GERC) on October 6, 2014. GERC is a research event for Ohio State graduate students and as a graduate preview program for prospective students at The Ohio State University. Ozbilgin presented a poster "Using Scaled Down Testing to Improve Full Scale Intelligent Transportation," co-authored with Umit Ozguner and Arda Kurt.

Junbo Jing participated in the Center for Automotive Research (CAR) PechaKucha presentation preliminary seminar contest on October 28, 2014. PechaKucha 20X20 is a simple presentation format where 20 images are shown, each for 20 seconds, while the presenter talks about the images. Jing's presentation on autonomous vehicles was chosen as one of the top two presentations and he went on to represent CAR at the multiunit final presentation round on November 5, 2014.

Conference in Vienna

CrIS UTC center director Umit Ozguner, professor Fusun Ozguner and graduate student Sarah Al-Shareeda attended the Third International Conference on Connected Vehicles and Expo (ICCVE 2014) in Vienna, Austria November 3-7, 2014. The conference brings together experts and policymakers from around the world to present the latest innovations and advances on connected vehicles; forecast trends and opportunities; and discuss policy, economics and social implications (iccve.org). The conference included demonstrations, exhibits, workshops, feature summits, industry forums, exhibits, tours and tutorials. Umit Ozguner was a keynote speaker for the conference. He spoke in the industry forum "Transportation big data: opportunities and challenges. Applications? Who will benefit most?"

Additionally, Fusun Ozguner and Al-Shareeda presented a paper during the conference, "Secure Pairwise Key Establishment in Vehicular Networks." Al-Shareeda is a 2012 Fulbright Science and Technology Award Fellow pursuing doctoral studies in the Department of Electrical and Computer Engineering at Ohio State.

Arda Kurt presents at Transportation Research Board's 94th annual meeting

The Transportation Research Board (TRB) held its 94th annual meeting January 11-15, 2015 in Washington D.C. Several members of CrIS UTC were in attendance. Arda Kurt, CrIS UTC research scientist, presented a poster at the annual meeting entitled "Automated Vehicle and Intelligent Transportation Research at The Ohio State University." Kurt's poster described the Control and Intelligent Transportation Research Group (CITR) lab at the Center for Automotive Research (CAR), which includes several faculty members, fulltime researchers, visiting scholars and a graduate student working together to conduct a wide variety of research activities related to intelligent transportation systems (ITS). CITR specializes in research focusing on automated vehicles, and has built a series of automated vehicles and mobile robots for a wide range of projects since the 1990s. Currently, CITR houses a fleet of vehicles that range from manually driven to fully automated, and these are used in autonomy and coordination studies focusing on safety, efficiency and comfort. Kurt's poster highlighted CrIS UTC as one of CITR's research projects, and gave examples of some of the work in which CrIS UTC is involved. CrIS UTC works on precrash safety aspects of fully and partially automated vehicles and human drivers. This involves advanced driver assistance systems (ADAS) development, supported by DURA Inc., and testing/evaluation, supported by Toyota Technical Center. Also, automated/coordinated vehicles as cyber-physical systems with verifiable security and safety implications, supported by National Science Foundation; control theoretic optimal driving systems for better fuel economy, supported by Ford Motor Company; and validation/verification in model based control systems for airplanes, supported by NASA. The poster showed an assortment of initial designs, preliminary results, testing methodologies and near final results from the aforementioned projects.

Architecture transportation studio course collaboration

Jason Sudy, lecturer in the College of Engineering's Knowlton School of Architecture, is teaching a studio course on driverless vehicles beginning in January 2015. These studio courses typically enlist the help of a client in order to help define the scope and focus of the course, giving students a real world experience. Professor Umit Ozguner and CrIS UTC will partner with this course by being the client in this new collaboration between the Center for Automotive Research and the Knowlton School of Architecture.

Recent Publications and presentations

Tian, R., Li, L., Yang, K., Chien, S., Chen, Y., Sherony, R. (June 2014) "Estimation of the Vehicle-Pedestrian Encounter/Conflict Risk on the Road Based on TASI 110-Car Naturalistic Driving Data Collection," in Proceedings of 25th IEEE Intelligent Vehicles Symposium, pp. 623-629, Dearborn, Michigan.

Li, X., Sun, Z., Kurt, A., Zhu, Q. (June 2014) "A Sampling-Based Local Trajectory Planner for Autonomous Driving Along a Reference Path," in Proceedings of 25th IEEE Intelligent Vehicles Symposium, pp. 376-381, Dearborn, Michigan.

Ozibilgin, G., Kurt, A., Ozguner, U. (June 2014) "Using Scaled Down Testing to Improve Full Scale Intelligent Transportation," in Proceedings of 25th IEEE Intelligent Vehicles Symposium, pp. 655-660, Dearborn, Michigan.

Liu, P., Kurt, A., Ozguner, U. (October 2014). "Trajectory Prediction of a Lane Changing Vehicle Based on Behavior Estimation and Classification." Submitted to Intelligent Transportation Systems, 2014 17th International IEEE Conference on IEEE.

Adamey, E., & Ozguner, U. (2014). "Multi-MSA Multitarget Tracking and Surveillance: A Decentralized Approach." to appear in IEEE Transactions on Systems, Man and Cybernetics.

Kurt, A. (2014). "Discrete-State Encoding in Hybrid-State Systems for Intelligent Vehicle Control and Estimation." to appear in IEEE Transactions Intelligent Transportation Systems. IEEE.

Kurt, A., Liu, P., Ozguner, U. (2014). "Crash-Imminent Scenarios and Driver Models for Safety Evaluation in Vehicular Automation." Poster presentation at 2014 TRB Automated Vehicles Symposium, July 2014, California. //

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