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Autonomous Driving: Wrong Way Indicators

Two Sentence Elevator Pitch:
Honda has a focus on innovative safety technologies rooted in our shared goal of a collision-free society that drives us every day to pursue the next breakthroughs. Students on the Honda team will enhance the V2V safety systems concentrating on identifying and avoiding wrong way collisions.

Abstract:
In the U.S. more than 350 people die in wrong way collisions each year, more are seriously hurt. Resulting collisions are typically head-on and have a higher mortality rate than other types of collisions. For years, Honda has been leading the way in the Active Safety realm by introducing such technologies as our Collision Mitigation Braking System and Lane Keep Assist System. To be effective these systems must identify a dangerous situation with sufficient time to implement a safety response.

Current systems are based radar and visual cameras technologies. After investigating the current state of knowledge in wrong way collisions, the student team will develop an improved prototype V2V (vehicle-to-vehicle) system that more effectively indicates danger to the driver. The focus will be on earlier identification of danger by incorporating new/different sensors to the current hardware platform, as well as developing improved system level and detection algorithms.

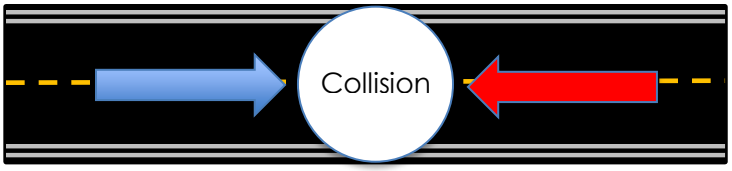
Impact:
The increasing power of autonomous systems have the potential to make driving even safer by reducing human error. On-board passive systems for maintenance in lane are already common, and are recommended by the National Highway Traffic Safety Administration (NHTSA) when purchasing a new car. As technology improves, systems are moving from passive, alert the driver based systems, to actively controlling the position of the vehicle. Research shows that the vast number of vehicle crashes are tied to human error.

Deliverable

Minimum Viable Product Deliverable (Minimum level of success)

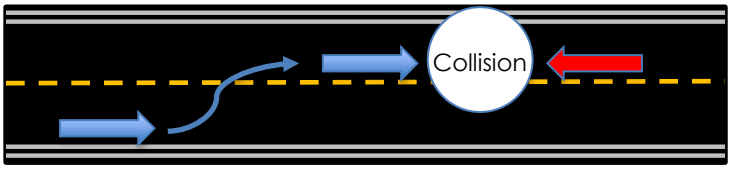
Deliver a prototype capable of generating the appropriate BSM (basic safety message) to the other vehicle with sufficient time for a safe avoidance mechanism to be implemented. The MVP (minimum viable product) test case is the following:

- Two vehicles, each traveling at 30 mph



Expected Final Deliverable (Expected level of success)

The expected final deliverable will be based on a straight, two-lane, two-way road with two vehicles approaching each other head-on. In this case, the car indicated by the blue arrow will have improperly drifted or changed into the red arrow's lane. Students will be challenged to demonstrate a system that is feasible for higher speeds and shorter time before impact drifting between lanes.



The system will trigger the on-board system to take action in warning the driver of each vehicle involved. This may consist of audible, visual (Heads-up Display/Instrument Panel/Mirror), or haptic (shaking the seat or steering wheel) feedback in order to provide situational awareness to the driver(s).

Stretch Goal Opportunities: one or more of the following

- Refine hardware selection for space/weight/cost/availability (if applicable)
- Develop unique algorithms to address one or more of the following edge cases: higher velocity, signal interference, curvature of road, and anomaly detection.

Student Skills:

MDP Sponsored Projects are both a professional and academic learning experience for students. By participating in this program, students are actively preparing for graduate school and a professional career. As part of the experience, MDP expects professional behavior. To best prepare you for future professional opportunities, your experiences on this MDP team will be very broad. In addition to key technical skills that you will bring to the team, you will engage deeply in the self-directed learning of new and important concepts, demonstrate flexibility, collaboration, and cooperation, and develop strong professional communication skills. This also means that you will need to be able to work outside of your traditional area of study in the true multidisciplinary nature of our projects. You won't always be able to anticipate how your skills and expertise will be used, so the MDP Sponsored Project will challenge you to grow and develop as a professional.

Project Area	Specific Skills	Likely Majors
Intermediate or Advanced Machine Vision Algorithms (2-2 Students)	Prior coursework and/or practical experience in Machine Vision	ROB (MSE), EE (MS/MSE) or students with prior experience/coursework in Machine Vision.
Programming (3- 4 Students)	Solid programming skills. The project will run in C/C++. Students should have a strong commitment to learning basic Machine Vision techniques.	CS (BSE)/CS(BS-LSA)
Embedded Systems (2 - 3 Students)	Sensor Integration and Design; basic coding	CE (all) , EE (all)

Additional Desired Skills/Knowledge/Experience

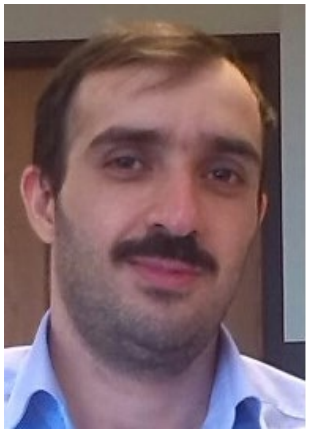
Any of the following Skills, Knowledge, Experience, Interest or Outlook, would be valuable to the 2020 team. We don't expect students to be familiar all or even most of the technical items, but strong candidates will have familiarity or experience with *some* of them ***and a positive attitude to learn what is necessary as the project gets underway.***

Please highlight your experience with any of the items on this list in your personal statement on the application:

- Honda has a strong consensus culture we highly value effective teamwork
- Experience on team-based engineering projects
- Specific knowledge of C/C++ coding language
- For Programming roles: Completion of EECS 281 or equivalent with high grade
- DSRC (dedicated short-range communications) experience
- Previous experience with other (non DSRC) communication technologies
- If you have completed any of the following courses please be sure to highlight these in your personal statement: EECS 455, 460, 464, 467, 473, 477, 550
- Comfortable working in a Linux based environment
- Familiarity with socket programming, network programming, OS concepts (multithreading), NS3 would be helpful
- Rapid prototyping experience

Location:
Honda has a new R&D Center located in Ann Arbor. We will provide the students with hardware and space to work (MDP will provide transportation to the facility). Faculty mentor meetings and development work will take place on campus.

Sponsor Mentor:



Hossein Mahjoub
Automotive Research Engineer

Hossein Nourkhiz Mahjoub received his B.S. and M.S. degrees in electrical engineering (systems communications) from the University of Tehran, Tehran, Iran, in 2003 and 2008, respectively. He is currently working toward a Ph.D. degree in electrical engineering at the Department of Electrical and Computer Engineering, University of Central Florida, Orlando, FL, USA. He had more than nine years of work experience in the telecommunications industry before starting his Ph.D. degree in 2015. His research interests include wireless channel modeling, stochastic systems analysis, and vehicular ad hoc networks.

Executive Mentor

Shigenobu Saigusa
Chief Engineer, Honda Research

Faculty Mentor
Kayvan Najarian, Ph.D.
The focus of Dr. Najarian's research is on the design of signal/image processing and machine learning methods to create computer-assisted clinical decision support systems that improve patient care and reduce the costs of healthcare. Dr. Najarian's lab also designs sensors to collect and analyze physiological signals and images, focusing on creating decision support systems to manage traumatic brain injuries, traumatic pelvic/abdominal injuries and hypovolemia. He serves as the Editor-in-Chief of Biomedical Engineering and Computational Biology and the Associate Editor of two other journals in the field of biomedical informatics.

Legal Requirements:
Citizenship Requirements:

- □ This project is open to all full-time students on the UM Ann Arbor campus.

Intellectual Property Agreements / Non-Disclosure Agreement Requirements

- □ Students will sign standard University of Michigan IP/NDA documents

Summer Project Activities (please select one)

- □ Students will be guaranteed an interview for a 2020 internships. Internships will be located at various Honda facilities in Ohio and LA. The interviews will take place in early 2020 at the Honda R&D Office in Ann Arbor.
- □ A summer stipend to continue work in Ann Arbor may be available.

Company Information:
Located in Ann Arbor, MI, the Honda Automobile Technology Research Group performs pre-competitive cooperative research with other automakers, the U.S. government and universities on advanced automotive safety. The group also identifies and researches future connected and mobility technologies.
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