Robust Path Planning for Automated Vehicles

Abstract:
Sensors used in advanced driver assistance systems (ADAS) relay information about the surrounding world objects – such as other vehicles and environment landmarks – in order for the vehicle to fulfill various safety and comfort functions (e.g. automatic emergency breaking or adaptive cruise control). Such functions rely on object information in order to trigger a safety-critical maneuver, therefore the accuracy of object representation must be extremely high such that neither missed nor false activations of the function are allowed to occur.

As the industry moves toward higher levels of autonomy, it becomes equally important for an intelligent system to sense and process information, not only from objects and obstacles, but also from available free paths or “drivable surfaces” to guaranty the integrity of maneuvers such as an automated lane change on the highway.

On this team, students will develop and implement a concept for stationary world representation that can track the availability and ensure the integrity of drivable surfaces by fusing information from various sensors (radar, video and point-cloud sensors). A key aspect of this solution is the development of a formal logic structure to track and update the confidence-level in the availability of drivable space, based on the input of various sensors with different properties.

Impact:
Automated driving requires that the intelligent system perceives the drivable corridors that are available for the vehicle and other traffic participants; and ensures the safety of the path planned for the ego vehicle. This leads to a paradigm shift from an obstacle-avoidance strategy (used in advanced driver assistance functions) to a more complex class of strategies which involves tracking and ensuring the drivable and not occupied surfaces surrounding the vehicle. This project contributes to the perception-aspects that will enable these advanced strategies.

Scope:
**Phase I BASELINE GOAL**

Translate a research level framework for ADAS to a production test system on similar but not identical technical stack (This will not be a 1:1 translation). Develop and validate additional functionality including a formal, high level concept for safety and confidence tracking of drivable surfaces surrounding the vehicle. Students will develop an appropriate validation / testing plan.

**Expected Final Deliverable**

The above software model will be implemented on a fork of Bosch software for assisted and automated driving. Testing/Validation will take place on a Bosch research vehicle in the Bosch facility.

**Stretch Goals and Details here: HIGH SUCCESS**

Formalizing a safety concept for tracking the confidence in space/surface availability given a multitude of sensors having a varying safety integrity levels.

**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.

<table>
<thead>
<tr>
<th>Project Area</th>
<th>Specific Skills</th>
<th>Likely Majors</th>
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<tbody>
<tr>
<td>Algorithm &amp; Software Development (2-3 Students)</td>
<td>Algorithm implementation and testing. Introductory Machine Vision concepts.</td>
<td>CSE/CS-LS, Robotics, Data Science, MIDAS</td>
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<tr>
<td>Perception &amp; Sensor Fusion (2-3 Students)</td>
<td>Modeling specific sensors Algorithm development</td>
<td>ECE/Robotics CSE</td>
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### Additional Desired Skills/Knowledge/Experience

Any of the following Skills, Knowledge or Experience would be valuable to the 2019 team. We don’t expect students to be familiar all or even most of these 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.

- C++/Python/Matlab
- Interest in Autonomous vehicle safety
- Machine Vision
- Team based coding development
- Multidisciplinary and cross-cultural team based engineering

### Location:

Most project work will take place on north campus with Bosch provided hardware. Periodically students will visit the Bosch Chassis Control Engineering campus located at Plymouth, Michigan. Transportation will be provided by MDP.

### Sponsor Mentor:

Aghapi Mordovanakis, PhD has been a developer at Bosch for the last ~2 years working on software and solutions for assisted and automated driving. Prior to that he had been a research scientist here at the University of Michigan in Biomedical Engineering and at the Medical School.

### Faculty Mentor

Prof. Brent Griffin

### Legal Requirements:

Citizenship Requirements
Due to hiring restrictions and system access needs, this project is open to US Citizens or Permanent Residents only

Intellectual Property Agreements / Non-Disclosure Agreement Requirements (please select)

- Students will sign an IP/NDA document that is unique to Robert Bosch LLC

Internship Information

- To be determined.

Company Information:
Bosch is a German multinational engineering and electronics company headquartered in Gerlingen, near Stuttgart, Germany. Bosch’s core operating areas are spread across four business sectors: mobility solutions, consumer goods (including household appliances and power tools), industrial technology (including drive and control) and energy and building technology. See link for more details

https://www.bosch-mobility-solutions.us/us/highlights/automated-mobility/