

**Michigan State University
College of Engineering; Dept. of Electrical and Computer Eng.
ECE 480 Capstone Design Course Project Charter**

Team 8: Advanced Driver Assistance System

Sponsoring Company/ Organization:



Continental AG - Advanced Driver Assistance Systems (ADAS)

Contact Information:

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9AM –10PM including weekends on mobile.
Text messages are nice, no voice mail setup on mobile phone.

Background Information:

Continental AG is a Tier One supplier to Automotive OEMs in North America and worldwide committed to realizing “Vision Zero,” a mobility future with zero fatalities, zero injuries, and zero accidents. The ADAS business unit concerns itself with in vehicle driving environment sensors (such as radar and cameras) and integration into systems which realize functions ranging from Blind Spot Alert and Automated Emergency Braking to Highly Automated Driving.

Controlled testing and data collection are required to support ADAS product development and evaluation. And as ADAS systems become more advanced, such scenarios require many different targets be observed by the system and referenced independently by a second reliable method (commonly called ground truth). There are several methods for collecting ground truth data and among them Differential GPS (DGPS) is an industry standard.

DGPS applies at least two traditional GPS receivers with one a stationary base and one or more additional targets. The known stationary base is used to identify the inaccuracies which are common to all receivers, driving the traditional $\pm 25\text{m}$ raw

GPS signal accuracy as low as $\pm 1\text{cm}$. Adjusting the geo-location settings on a mobile phone to use “GPS only” while looking at a map will showcase the impact of not receiving the most basic atmospheric distortion offsets computed by local cell phone towers.

Commercial DGPS systems are expensive and are not used in all evaluations of ADAS vehicle performance. Furthermore, it is not possible to collect DGPS for real world scenarios where the subject vehicle quickly moves out of range of the base station. An inexpensive system for which the “stationary base” can instead be mounted in the moving host vehicle and create relative measurements in the $\pm 10\text{cm}$ range to multiple similarly outfitted chase vehicles is desired to proliferate the availability of reliable ground truth measurements and more fully support the development of increasingly complex functions.

Business Case:

Continental AG supplies parts and services to OEMs, it does not develop and sell test equipment. The ADAS engineering team sees an opportunity to save several hundred thousand dollars in equipment costs for required testing and an opportunity to apply ground truth to support data collection in even more scenarios. Improvement in test equipment availability and applicability impacts the entire industry (OEMs, government, and suppliers). A low-cost technology could capture and create significant new business from the entire industry where current DGPS systems are not being used.

The most significant barrier to entry into the traditional DGPS market is data quality certification. It is likely that certification and associated liability drives unit costs so high. Forgoing certification and using a liability disclaimer may exclude application in final product tests. However, such certification is required for only a small fraction of vehicle testing leaving millions of miles of OEM and supplier testing open to a more affordable and dynamic alternative.

Project Intellectual Property Considerations:

There are no intellectual property considerations. Continental development teams would like the option to purchase such a product.

Opportunity Statement:

Commercial DGPS systems are expensive and are not available for use in all evaluations. Furthermore, it is not possible to collect DGPS for real world scenarios where the subject vehicle quickly moves out of range of the base station. An inexpensive system for which the “stationary base” can instead be mounted in the moving host vehicle and create relative measurements in the $\pm 10\text{cm}$ range is desired.

The team will research DGPS and readily available GPS components (chips, Arduino boards, mobile phones/tablets, etc.) and design an inexpensive system to achieve a reliable $\pm 10\text{cm}$ accurate mobile GPS enabled system. Ideally the problem can be solved with off-the-shelf components and a limited proof of concept can be built,

programmed, and tested. If the system cannot be realized with an off-the-shelf board, the deliverable shall be the design and verification of an expansion board for an Arduino, RaspberryPi, or other single board computer such that the Bill of Materials (BoM) is driven to a minimum cost. In either case, the result shall be achievable in the normal 13 week semester.

All projects will be delivered to the ADAS Advanced Engineering team. In the event of a hardware design, the team will be expanded to include members of the ADAS Hardware and Test and Validation teams. Any functioning system designs will also be shown to the Test and Validation and Algorithm Engineering teams.

Deliverables:

The team shall deliver:

- A technology survey indicating which technologies were investigated and the expected performance if applied to the stated GPS application.
- One of:
 - A tablet application utilizing two identical tablets (and therefore identical GPS antennas) connected on a wireless network.
 - A limited proof of concept created from off-the-shelf parts which is programmed and tested.
 - The design and verification of an expansion board for an Arduino, RaspberryPi, or other inexpensive single board computer.
 - Any other inexpensive solution shown to work
- Design, verification, and validation documentation of the solution.

Goals:

The primary goal is a document outlining available possibilities for a relative GPS system, the expected performance of each and a documented design recommendation (4 weeks).

The remainder of the project shall be spent following the design recommendation in pursuit of a functioning system and/or gathering data from multiple HW implementations to further narrow the field of possible designs (9 weeks).

Scope:

The project is expected to address the feasibility of an inexpensive relative GPS measurement system with $\pm 10\text{cm}$ accuracy requirement. The scope of investigations should follow a path of minimal effort to achieve a functioning system. Once a feasible technology is identified, remarks on remaining options are expected to be brief and a system implementation effort initiated to fully test feasibility. Such a progression may appear as follows:

- A tablet application utilizing two identical tablets (and therefore identical GPS antennas) and a wireless network.

- A limited proof of concept created from off-the-shelf parts which is programmed and tested.
- The design and verification of an expansion board for an Arduino, RaspberryPi, or other single board computer.
- Optional - Any other inexpensive solution.

The team shall use off-the-shelf hardware where possible in pursuit of a rapid prototype.

Continental will support the purchase of inexpensive equipment which the team does not wish to retain at the conclusion of the project.

Constraints:

Continental hardware expenditures shall not exceed \$500, and this amount shall serve as the definition of inexpensive where it appears in this document. This amount may be exceeded (as in the case of multiple tablets) but requires management approval.

All Continental supplied hardware must be ordered by Continental. Continental will not reimburse student paid expenses.

Project Team: (Completed once semester begins)

Name	Responsibility

Faculty Advisor: (Assigned by ECE Dept . based on project requirements)
