AutoDrive Challenge™

An Autonomous Vehicle Collegiate Competition

COMPETITION OBJECTIVES

SAE International (SAE) and General Motors (GM) have designed and will now implement a hands on engineering design and technology focused collegiate competition with emphasis on autonomous driving and the associated technologies to provide a professional development and educational experience for undergraduate and graduate students enrolled at selected universities. The overarching goals of the competition will include:

1) Providing a hands on engineering collegiate competition for university students to demonstrate a wide range of exciting and challenging opportunities in the rapidly expanding field of engineering systems for automated driving. The keen focus on real-world applications of sensing technologies, computing platforms, software design implementing advanced computation methods such as computer vision, pattern recognition, machine learning, artificial intelligence, sensor fusion and autonomous vehicle controls will provide a great diversity of educational and research opportunities for the participating student teams.

2) Building and implementing a STEM compatible competition that facilitates university student teams to demonstrate full autonomous driving through a phased approach including areas such as object detection (perception), categorization (classification) and full autonomous operation.

TECHNICAL OBJECTIVES

AutoDrive Challenge™ will be a three-year collegiate competition to develop and demonstrate an autonomous driving passenger vehicle using the Chevrolet Bolt provided by GM.

The technical goal of the competition is to navigate an urban driving course in an automated driving mode at a level of functionality indicated in the SAE (J3016) level 4 definition.

SAE level	Name	Narrative Definition	Execution of Steering and Acceleration/ Deceleration	*Monitoring* of Driving Environment	Fallback Performance of *Dynamic Driving Task*	System Capability *(Driving Modes)*
***Human driver* monitors the driving environment**						
0	**No Automation**	the full-time performance by the *human driver* of all aspects of the *dynamic driving task*, even when enhanced by warning or intervention systems	Human driver	Human driver	Human driver	n/a
1	**Driver Assistance**	the *driving mode*-specific execution by a driver assistance system of either steering or acceleration/deceleration using information about the driving environment and with the expectation that the *human driver* perform all remaining aspects of the *dynamic driving task*	Human driver and system	Human driver	Human driver	Some driving modes
2	**Partial Automation**	the *driving mode*-specific execution by one or more driver assistance systems of both steering and acceleration/ deceleration using information about the driving environment and with the expectation that the *human driver* perform all remaining aspects of the *dynamic driving task*	**System**	Human driver	Human driver	Some driving modes
***Automated driving system* ("system") monitors the driving environment**						
3	**Conditional Automation**	the *driving mode*-specific performance by an *automated driving system* of all aspects of the dynamic driving task with the expectation that the *human driver* will respond appropriately to a *request to intervene*	System	**System**	Human driver	Some driving modes
4	**High Automation**	the *driving mode*-specific performance by an automated driving system of all aspects of the *dynamic driving task*, even if a *human driver* does not respond appropriately to a *request to intervene*	System	System	**System**	Some driving modes
5	**Full Automation**	the full-time performance by an *automated driving system* of all aspects of the *dynamic driving task* under all roadway and environmental conditions that can be managed by a *human driver*	System	System	System	**All driving modes**

Complexity of the driving scenarios will increase each year from simple straight line lane following with non-dynamic objects to higher speed driving and the inclusion of dynamic objects. Each year's competition will include autonomous driving elements on a specified course. The chart below provides a roadmap highlighting the year by year competition's technical goals. Further details will be provided in each year's Competition Rules.

Year 1 (Concept Selection)	Architecture Definition Sensor & Computing Platform Selection Paper Study, also leverage simulation Simple Missions: i.e. straight road, lane following, object detection and avoidance, no dynamic objects
Year 2 (Concept Refinement)	Algorithm Development More Complex Missions: i.e. Multiple lane change, a dynamic object (pedestrian)
Year 3 (Concept Validation)	Validate the Design Automated driving of the course More Complex Missions: i.e. Turnabouts, U Turns, Moving objects (Bicycles), higher speed

Technical Design Elements are to include the following;

- Sensor/Computer Platform Development
- Sensing (Perception & World Modeling)
- Mission Planning
- Behavior
- Motion Planning
- Control & Diagnostics
- Functional Safety
- Actuation (via interfaces to provided vehicle)

There will be opportunity for each team to research, develop, and demonstrate significant technology advancements above what the Competition Rules require.

In order to simplify the task of actuating the vehicle's controls, the Organizing Committee plans to deliver a vehicle that will not require modifications to the propulsion, brake, steering or safety systems to achieve the competition objectives.

COMPETITION SCHEDULE

2016	2017	2018	2019	2020
• **Quarter 3 (Summer/Fall)**	• **Quarter 1 (Winter)**	• **Quarter 2 (Spring)**	• **Quarter 2 (Spring)**	• **Quarter 2 (Spring)**
• RFP Release to Universities	• RFP Proposals Due	• Year 1 AutoDrive Challenge Competition	• Year 2 AutoDrive Challenge Competition	• Year 3 AutoDrive Challenge Competition
• **Quarter 4 (Fall)**	• Selected Universitites Notified	• End of Competition year 1	• End of Competition year 2	• End of Competiton year 3
• Virtual Workshop - RFP and Competition Q&A Session	• **Quarter 2 (Spring)**	• Year 2 Rules released	• Year 3 Rules Released	
	• Universities announced	• **Quarter 3/4 (Summer/Fall)**	• **Quarter 3/4 (Summer/Fall)**	
	• Start up funding and competition document package delivered to teams	• Workshop Year 2 Rules Training	• Workshop Year 3 Rules Training	
	• Year 1 Rules released	• GRA Funding Distributed	• GRA Funding Distributed	
	• Team Mentors assigned			
	• **Quarter 3/4 (Summer/Fall)**			
	• GRA Funding Distributed			
	• Signed competition documents returned to SAE and GM			
	• Workshop - Year 1 Rules Training			
	• Competition vehicles donated			

DEADLINES

Submission Deadline for Completed AutoDrive Intent to Apply	*October 3, 2016 at 5 p.m. Eastern Standard Time*
Submission Deadline for AutoDrive Challenge™ Completed Proposal	*February 1, 2017 at 5 p.m. Eastern Standard Time*

PROPOSAL DOCUMENTS

The AutoDrive Challenge™ proposal process is broken down into two documents: The Academic Cooperation Document and the University Letter of Support. Each proposal will be independently evaluated by the organizing committee. Only one submission per university is permitted.

INTENT TO APPLY

Universities who are intending to submit an AutoDrive Challenge™ Proposal are asked to let the organizing committee know in an email by October 3, 2016 to Allison.Hostetler@sae.org . The email must have the university's name in the subject line with an intent to submit in the body of the email. This is not binding but will allow the committee to have an idea of applicant universities. The formal proposal is due February 1, 2017. The committee will choose up to 10 University Teams for the AutoDrive Challenge™ Competition.

1.) ACADEMIC COOPERATION DOCUMENT

Universities are to use the following outlined points below for writing their AutoDrive Challenge™ Academic Cooperation Document. Each Academic Cooperation Document must include responses to all of the topics. All submissions must be written in English and shall be no longer than a maximum of 25 pages. Final proposals submitted must have a faculty advisor signature at the end of the document acknowledging and approving the submission.

1. Executive Summary: Summarize in one page single spaced, why your team should be selected to participate in AutoDrive Challenge™ Collegiate Competition.

2. University Information

a. Current Curriculum, Research & Academic Calendar

- Include a listing of the general curriculum education requirements to obtain an engineering degree and a listing of any autonomous vehicle related classes and their summary.

- Describe any specific autonomous research areas including: sensing, mission planning, behavior, artificial intelligence, functional safety, control, image processing, computer vision, pattern recognition, machine learning, sensor fusion, and autonomous vehicle controls.

- The complexity of this hands on engineering design competition requires many hours dedicated to the project by students and faculty. Discuss how your university will award credit for the team's participation and work on the AutoDrive Challenge™. (*i.e.*, independent study credits, senior projects, or classes taught on the subject of autonomous vehicle aspects).

- Attach your current academic calendar or a projected academic calendar for 2017 and note if the university is planning any significant modification to the academic structure (i.e. quarters to semesters).

b. Competition Faculty Advisor

- Describe the experiences of the named program faculty advisor that will be the university team's leader supporting the AutoDrive Challenge™ program. Provide any industry experience, past and current academic responsibilities, and any other supporting information about them that demonstrates their ability to provide support and knowledge of autonomous systems to the competition team. Please note this faculty advisor will supervise the team's funded graduate student. More than one faculty advisor can be assigned to the team.

c. Subsidized Graduate Research Assistant (GRA)

- Describe how you will identify the type of graduate student you would select and how you would structure the roles and responsibilities of the Engineering (or related field) Graduate Research Assistant (GRA) (details on funding below in *ORGANIZING COMMITTEE SUPPORT TO TEAMS*)

d. Team Assembly

- In commitment to lifelong learning and well-rounded educational experiences for student participants, in hands on engineering design competitions, it is highly recommended that university teams utilize other academic disciplines to make them successful in all areas of the challenge. Please feel free to highlight any existing key collaborations across multidisciplinary academic departments.

- Describe how your team would address student rotation through the entire three-year competition. Discuss your team's progression and succession plan and how it will handle member transitions.

3. University Team Facilities

- Describe the university's plan to provide the AutoDrive Challenge™ students having a dedicated work area for the Chevrolet Bolt EV, lab space to establish simulation and the ability to provide or install a Level 2 charging station with capabilities for the minimum of a 40amp 240-volt vehicle charger.

- Describe the university's plan to provide the AutoDrive Challenge™ students with a limited access control area for AutoDrive Challenge™, specifically for donated IP and other donated sponsor/company deliverables to be secured and used for

the team only. Describe the university's current approach to controlling access to research IP and other confidential property.

- Describe the University's plan to provide the team with a safe area for the vehicle during development of autonomous operating modes. Detail your plan for development or expansion of the existing plans that will comprehend autonomous driving, development, and testing.

4. University Safety Practices

- Safety is the highest priority for the AutoDrive Challenge™ competition. Autonomous driving vehicles pose unique challenges when it comes to safety. Provide any operational safety plans you currently have in place at your university and how they would apply to this autonomous competition, specifically. Since the competition is based on an electric vehicle include discussion of high voltage safety training or procedures currently in place.

5. University Team Funding

- Teams may need to fundraise above what the competition will provide them to cover certain expenses. Provide any previous fund raising or sponsorship solicitation for other collegiate projects that were successful as examples.

6. University Partners or Conflict(s) of Interest

- Do you foresee any conflict(s) of interest arising within your University if selected to participate in the AutoDrive Challenge™? Consider current relationships with other industry partners or research projects or agreements that might preclude your participation in the AutoDrive Challenge™ ? (i.e. grants, research partnerships)

7. Additional Considerations

- Discuss if not mentioned in another category other considerations that would make your university a successful competitor in the AutoDrive Challenge™ competition. (You can also include any previous collegiate competition experiences and successes you had in those events)

2.) UNIVERSITY LETTER OF SUPPORT

Please include a formal letter of support signed by an academic administrator. The signer can be your dean or other high level academic administrator. They must include their title in the letter's signature line. They must acknowledge that they are agreeing to meet the requirements as described in the section below (*UNIVERSITY SUPPORT TO TEAMS),* as well as the commitment from the university to the team/faculty advisor/project in the following areas:

- Acknowledgement of commitment for the three-year competition.
- Ability to sign Nondisclosure Agreements and necessary Legal Support to review and approve any necessary competition documentation.

- Ability to provide funds above what GM and SAE International have designated for the AutoDrive Challenge™ (i.e. additional funding for the full time GRA above the donated funds if necessary).

PROPOSAL SUBMISSION INSTRUCTIONS

The two PDF files, the Academic Cooperation Document and University Letter of Support, need to be emailed to Allison.Hostetler@sae.org and received no later than *5:00 p.m. Eastern Standard Time (U.S.) on February 1, 2017*.

EVALUATION & NOTIFICATION

An AutoDrive Challenge™ selection committee will review submitted university proposals and provide recommendations to the Organizing Committee for a final decision. Universities submitting a proposal will be notified of a decision (either accepted or rejected into the AutoDrive Challenge™ Competition) by March 1, 2017. Both the Dean of Engineering and faculty advisor(s) of accepted schools will receive an official acceptance letter from the committee.

Any teams accepted into the competition who do not wish to participate must inform the organizing committee in writing no later than March 15, 2017.

Accepted teams will be invited to attend the official announcement event in April 2017.

ORGANIZING COMMITTEE SUPPORT TO TEAMS

AUTONOMOUS PROGRAM STARTUP FUNDING

- The Organizing Committee will provide startup funding of $30,000 to the accepted universities for the AutoDrive Challenge™ Competition. Additional funding will be provided to the teams for travel to competition events, workshops, and vehicle shipping. Teams will also receive various product's related to autonomous driving from AutoDrive Challenge sponsors for the competition.

VEHICLE DONATION FROM GM

- AutoDrive Challenge™ Teams will receive a donated Chevrolet Bolt EV from GM for use in the competition. In addition, GM confidential information about the vehicle will be provided to accepted teams for use ONLY in the competition.

- A Vehicle Donation Agreement with GM will need to be signed prior to receiving the vehicle, and the Chevrolet Bolt EV will be supplied with a State of Michigan salvage title. If accepted into AutoDrive Challenge™ your university accepts full and complete responsibility to ensure compliance with federal, state and local laws regarding roadworthiness and/or any Rebuilt Title requirements.

GRADUATE ASSISTANT (GRA) FUNDING

- The Organizing Committee will be providing $36,000 each academic year over the three-year competition cycle to the university to be used to offset costs associated with one full-time Engineering GRA for the AutoDrive Challenge™ Competition. The full time GRA will serve the

team in such areas as technology development, and exploring the systems engineering approaches for the team's autonomous vehicle over the three-year program.

GM MENTORS

- AutoDrive Challenge™ teams will be assigned a GM employee as a team mentor. The mentor's role is to:
    - Help teams with project management and engineering problem solving
    - Acclimate teams to the GM Advanced Technical Work Process
    - Serve as a team advocate to the Organizing Committee and a counselor to the team.

- Please note the GM Mentor is not a full time team member but will serve in more of an advisory role for project planning and safety monitoring.

NON-DISCLOSURE AGREEMENT

- Each participating Team Member, Faculty Advisor and Graduate Research Assistant will be required to sign a Non-Disclosure Agreement (NDA) with General Motors *(and potential other AutoDrive Challenge™ Sponsors)* prior to being added to the official roster of the AutoDrive Challenge™ Team. Please note that Faculty Advisors must ensure that all members of their official team roster are NDA signers and eligible to sign based on all terms and conditions in the agreement. The Organizing Committee will provide more information to those universities that submit an intent to apply on the additional details, scope, and application of the NDA.

UNIVERSITY SUPPORT TO TEAMS

TRAVEL

- By being accepted into the AutoDrive Challenge™ the university will be acknowledging that the students and faculty advisor(s) will need to travel during the academic year for competition requirements, including to workshops and the culminating spring event each year. The university, students, and faculty will need to make prior arrangements regarding their academic obligations in each absence.

ACADEMIC CREDIT

- The complexity of this hands on engineering design competition requires many hours dedicated by students and faculty to the project. The Organizing Committee recommends that universities provide various ways in which student team members (from the various academic disciplines) can be rewarded recognition for their participation and work on the AutoDrive Challenge™. Note this can be a part of their senior design project, an independent study, or an elective towards their degree.