Michigan Alliance for Greater Mobility Advancement

Course Title: Introduction to Autonomous Vehicles

Course Length: 2 days with a prior online component, online and in-person

Time Online: 6.5 hours

Time in Class: Day 1: 6.5 hours, Day 2: 7 hours (includes labs)

Time in lab: Day 1: 2 hours, Day 2: 2 hours

Class Size: Minimum 7 / Maximum 12

Price Per Student: $2,535.00

Location: Genesee County *or* Company Site

Course Description:

The race has begun to have a fully autonomous car. Although the completely autonomous car does not exist yet, commercial vehicles with various levels of automation do exist while others are in the research and development phases. In this course you will get an introduction to various technologies associated with autonomous vehicles while focusing on vision based perception systems.

Lab Projects Description:

Lab Project 1: Performing data acquisition: images and CAN bus messages.

Lab Project 2: Lane following using a simulator.

Course Learning Objectives:

- Differentiate the components of autonomous vehicles: perception, localization, planning, control
- Articulate the various types of sensors in the perception system and the concept of sensor fusion
- Configure and develop experimental test plans for experimental work
- Perform experiments according to test plans
- Perform data acquisition of images synchronized to CAN messages of interest
- Simulate a lane following controller
- Differentiate the various AV platforms
- Articulate the role of neural networks and Deep Learning in autonomous driving

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Course Content/Syllabus:

Online Component (throughout one week):

The courser begins with a one week online component to be completed prior to classroom instruction. On this week, you'll take a Pre-Assessment to get a baseline of your understanding

of the course material. After detailed information on the course, you will get a thorough overview of the main AV components (perception, localization, planning, and control) and the SAE AV classification. This is followed by an overview of sensors, sensor fusion, and deep learning. You will spend time on generating your own ideas about the role of AV platforms in the development of autonomy. This component will end with a comprehensive assignment to be completed before the classroom instruction.

Topics:

- Knowledge Pre-Assessment
    - Welcome, Course schedule, Course collaboration tools, Learning objectives, Course syllabus.
    - Instructor, Training and delivery methodology, Assignments, Laboratories, Grading and completion criteria.
    - Introduction to course
    - Main components: perception, localization, planning, & control
    - SAE automation classification
    - Computer vision
    - Range sensors
    - Sensor fusion, deep learning
    - Control paradigms
    - Tools: Hardware, software, AV platforms

Graded Assignment

- Detailed set of questions on perception, sensor fusion, control paradigms and AV platforms.

Day 1:

On day 1 we review the online content material, answer your questions, and discuss the graded assignment of the online component. You will then get an in-depth coverage of control paradigms, by wire systems, and perception systems. You will then be exposed to control behaviors such as lane detection and following and object detection and avoidance. You will also get an introduction to V2X communications. Day 1 will end with a comprehensive assignment and completing a laboratory project.

Topics:

- Review of control paradigms

- By wire systems
- Perception system: Vision, LiDAR, Radar, ultrasonics
- Autonomous vehicle platforms
- Lane detection & following
- Object detection & avoidance
- V2X communications
- Applicable standards: ISO, IEEE, SAE

Graded Assignment

- Read, comment, and summarize a paper on AV platforms.
- Preparation and discussion of a test plan to perform lab project 1.

Laboratory Project 1

- Performing data acquisition: images and CAN bus messages.

Day 2:

On day 2 we review the day 1 material, answer your questions, and discuss the graded assignment and lab project of day 1. You will then get an overview of neural networks, deep learning, world representation, and path planning. You will then get an introduction to Functional Safety for autonomous vehicles, work on a graded assignment, and complete lab project 2. Day 2 will end with a course summary, main takeaways, a post-assessment, and a course assessment.

Topics:

- Neural Networks and Deep Learning
- World representation, path planning
- Functional safety in autonomous vehicles.

Graded Assignment

- Further research and report on AV platforms.
- Preparation and discussion of the procedure for completing lab project 2.

Laboratory Project 2

- Lane following using a simulator.
- Course Summary and Wrap-up
- Course Takeaways

Knowledge Post-Assessment

- Course Assessment

MAGMA short courses are held on a rolling basis, based on industry demand. Please complete this **short form** to express interest for yourself, or your organization.