Course Title: In-Vehicle Networks

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:

Understanding and using in-vehicle networks is a critical challenge today as automotive systems continue to grow into connected and automated vehicles. This course is designed to help engineers, technicians, and managers to understand and use various in-vehicle technologies and integrate them into products and services they are required to work with or develop. Emphasis will be placed on the CAN bus. Students will get a solid grounding in the technology and applications of CAN.

Lab Projects Description:

Lab Project 1: Data acquisition of CAN bus messages of interest from an OBD-II port: Steering angle, Accelerator Pedal, Brake Pedal, etc.

Lab Project 2: Querying the OBD-II port for vehicle diagnostics information.

Course Learning Objectives:

- Differentiate the various types of in-vehicle protocols and networks by type, characteristics, and applications
- Describe the architectures of applications using the CAN bus
- Configure and develop experimental test plans for experimental work
- Perform experiments according to test plans
- Connect to an OBD-II port and extract CAN bus messages of interest
- Query an OBD-II port for some vehicle diagnostics information
- Articulate some current and future applications of in-vehicle networks

Course Content/Syllabus:

Online Component (throughout one week):

The course 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 automotive communications and their main protocols and networks. This is followed by main applications, network characteristics, and tools. You will spend time on generating your own ideas about the role of protocols and networks in several use cases. 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
    - Automotive Communications: Protocols & Networks
    - Main Protocols: CAN, LIN, FlexRay, Ethernet, 802.11, Bluetooth
    - Use Cases (Main applications)
    - How to physically tell networks apart
    - Network Characteristics (speed, wiring, bandwidth, antennas, etc.)
    - Tools: Hardware, software

Graded Assignment
- Detailed set of questions on main protocols and networks, use-cases, characteristics, and tools.

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 the CAN protocol and network including an introduction to automotive distributed systems. You will then be exposed to practical aspects of CAN such as ID databases and reverse engineering of CAN IDs. You will also get an overview of OBD-II protocols. Day 1 will end with a comprehensive assignment and completing a laboratory project.

Topics:
- CAN: Controller Area Network
- CAN Network Stacks

- Automotive Distributed Systems, testing, test plans.
- CAN-ID Design databases
- Reverse engineering CAN-IDs
- OBD-II Introduction
- OBD-II Protocols

Graded Assignment
- Prepare a summary of OBD-II.
- Preparation and discussion of a test plan to perform lab project 1.

Laboratory Project 1
- Data acquisition of CAN bus messages of interest from a OBD-II port: Steering angle, Accelerator Pedal, Brake Pedal, etc.

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 in-depth coverage of OBD-II diagnostics followed by a case study. You will then be exposed to the details of other important in-vehicle networks. You will also get an overview of OBD-II protocols followed by 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:
- OBD-II Diagnostics: Modes, PIDs
- Case Study: Sending OBD-II Data to the Cloud: AWS Server
- Other Protocols and Networks: CAN-FD, SDRC, BroadR-Reach (Ethernet), FlexRay, Bluetooth

Graded Assignment
- Summary, comments, and possible improvements to the case study.
- Preparation and discussion of a test plan to perform lab project 2.

Laboratory Project 2
- Querying the OBD-II port for vehicle diagnostics information.
- 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.