Munich Summer School of Applied Sciences 2024

Course description

Course title: Smart Vehicles

Hours per week: 22h/week, 2 weeks

Number of credits allocated/ work load:
a) 44 contact hours
b) 3 US credits recommended
c) 4 ECTS credits

Part 1 – Understanding the technical requirements for autonomous vehicles
Lecturers: Professor Krug and Professor Birdsong

Short description:

This module of the course will introduce the basics of autonomous vehicles. An overview on the technical, legal and social aspects will be given. The technical aspects will be discussed in more detail to get a good understanding of the requirements of the sensor, actuator, and control units that are necessary for autonomous vehicles. Neural **network** fundamentals will be covered and the applications of machine learning to autonomous vehicles will be emphasized with camera-based sensors playing a major role. Therefore, a brief introduction about the basics of image processing for autonomous vehicles will be given.

Contents (Part 1):

- Overview of smart vehicles
- Autonomous driving vehicles and their contribution to sustainable mobility
- Overview on legal, social and technical aspects of autonomous driving vehicles
- Technical aspects of autonomous driving vehicles:
  - Sensors
  - Actuators
  - Processing Units
- The importance of Machine learning and neural networks
- Image processing for autonomous driving vehicles

- Image processing using simulated environment

Part 2 – Realizing an autonomous driving vehicle.

Lecturers: Professor Krug and Professor Birdsong

Short description:

This module of the course is based on the previous part. It has the aim to get some hands on practice to the theoretical base that is addressed in part 1.
A professional vehicle simulation environment will be used to setup a typical urban and countryside test track including traffic and typical elements of a scenery like pedestrians, traffic lights etc.
Within this environment the students will learn how to implement their own advanced driver assistant system (ADAS) functionality by using Matlab/Simulink and applying the knowledge they gained from part 1 of this course.
Additionally background information about the current status of ADAS is provided and a fully equipped research vehicle of the Hochschule München is presented.

Contents (Part 2):

- Configuration of a vehicle simulation software environment.
- Introduction to vehicle dynamics.
- Programming and simulating image processing algorithms.
- Defining an ADAS functionality from the consumer point of view.
- Transforming a consumer requirement into a ADAS functionality by implementing it in Matlab / Simulink.

Prerequisites:

Basic understanding of electrical engineering and programming principles. **Helpful**: Basic experience in microcontroller programming. Basic knowledge in control theory. Prior Matlab/Simulink experience will be helpful but is not required (part 2).

Objective of the course/learning outcome:

- To introduce students to smart vehicles in the area of autonomous driving cars.
- To introduce students to the programming of basic control algorithms that are appropriate for image processing that is used for autonomous driving vehicles and give them a hands-on example.

Recommended reading: Course material will be provided by the teachers.

Assessment methods: 100% project work (incl. final presentation)

Language of instruction: English

Names of lecturers:

- Prof. Markus Krug (HM)
- Prof. Charlene Birdsong (California Polytechnic State University, San Luis Obispo)