Munich Summer School of Applied Sciences 2020

Course description

- Course title: **Smart Vehicles**
- Hours per week: 20h/week, 2 weeks
- Number of credits allocated/ work load: a) 40 contact hours  
  b) 3 US credits recommended  
  c) 4 ECTS credits

Part 1 – Understanding the technical requirements for autonomous vehicles
Lecturer: Professor Krug and Professor Seng

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. Monitoring and interpretation of the environment around an autonomous vehicle is critical to the technology and 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 to 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 environmental monitoring and interpretation
• Different technologies for environmental modelling
• Imagine processing for autonomous driving vehicles
• Imagine processing using Matlab/Simulink

Part 2 – Realizing an autonomous driving vehicle.
Lecturer: 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):
• Introduction to microcontroller programming.
• Introduction to vehicle dynamics.
• Programming and simulating image processing algorithms.
• Defining simple manoeuvres and implementing them with the model car.
• Design of an algorithm that allows the model car to follow a line on the ground.
• Test and competition with the model car.
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 (Munich University of Applied Sciences).
- Prof. John Seng (California Polytechnic State University, San Luis Obispo)