COURSE DETAILS

" CONTROL ARCHITECTURES FOR AUTONOMOUS DRIVING "

SSD ING-INF/04

DEGREE PROGRAMME: AUTONOMOUS VEHICLE ENGINEERING (MOVE)
ACADEMIC YEAR 2022-2023

GENERAL INFORMATION – TEACHER REFERENCES

TEACHER: STEFANIA SANTINI
PHONE: 081-7683914
EMAIL: STEFANIA.SANTINI@UNINA.IT

GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE: CONTROL ARCHITECTURES FOR AUTONOMOUS DRIVING
MODULE: CONTROL SYSTEMS FOR AUTONOMOUS GROUND VEHICLES
SSD OF THE MODULE: ING-INF/04
YEAR OF THE DEGREE PROGRAMME: I
SEMESTER: I
CFU: 6

REQUIRED PRELIMINARY COURSES (IF MENTIONED IN THE COURSE STRUCTURE "REGOLAMENTO")

None

PREREQUISITES (IF APPLICABLE)

Basic knowledge of analysis of continuous-time and discrete-time linear dynamical systems. Software tools for analysis and simulation of dynamical systems.

LEARNING GOALS

The course is intended to provide general knowledge about the design of current and next-generation control architectures for autonomous vehicles. Namely, it provides skills for designing intelligent ground vehicles, and related innovative applications in ITS and focuses on design, modeling, and control of highly interactive cyber-physical systems. In so doing, it integrates the expertise and attitude of modern industrial engineering topics (i.e., vehicles) with recent advances in ICT (i.e., AI/Control)

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)

Knowledge and understanding

The course provides the methodological tools to provide the bases of theory, methodology and technology for the development of intelligent algorithms for achieving autonomous and semi-autonomous driving functionalities.

The teaching is structured in such a way as to develop the skills needed for designing, developing and testing control systems for autonomous vehicles in the automotive and railway market. Particular attention is paid to proposing practical experiences of the concepts learned

Applying knowledge and understanding

The module delivers ability and tools needed to apply the knowledge in practice, fostering the ability to use methodological tools to design and develop control architectures for autonomous and semi-autonomous driving. To this aim, the course also hosts lectures and seminars with experts from the industrial field..

COURSE CONTENT/SYLLABUS

- General Principles
    - Introduction to System Dynamics
    - Linear and Nonlinear Control Fundamentals
- Vehicle Control for autonomous and semi-autonomous driving
    - Trajectory planning and guidance
    - ADAS (Advanced Driving Assistance Systems)
    - Autonomous Driving Architectures leveraging sensors for environment detection
    - Adaptive Cruise Control (ACC)
- Cooperative Control for Autonomous Connected Vehicles
    - Cooperative Adaptive Cruise Control (CACC)
    - Internet-of-Vehicles (IoV) for Intelligent Transport Systems (ITS)
    - Networked cooperative control for connected autonomous cars/trains via V2X (Vehicle-to -Vehicles or Vehicle-to-Infrastructure) communication (e.g., via wireless networks or 4G/5G)
    - Platooning and Virtual coupling
    - I-ADAS at intersections
    - Cooperative Intersection Crossing
- Technologies for the development of smart vehicles in automotive and railway
    - Model-Based Control Design fundamentals
    - Modeling, Simulation and Test Methods for SIL and HIL validation of ADAS and autonomous driving strategies
    - Co-simulation platforms for evaluating the impact of smart and connected vehicles in homogenous and mixed traffic scenarios

READINGS/BIBLIOGRAPHY

Textbooks:

- Thor I. Fossen, Sensing and Control for Autonomous Vehicles: Applications to Land, Water and Air Vehicles (2017) Edition, ISBN-13: 978-3319553719, Springer International Publishing;
- J.J. E Slotine; Weiping Li, Applied nonlinear control, ISBN 0-13-040890-5. Prentice Education Ltd., 2005;
- Radovan Miucic, Connected Vehicles: Intelligent Transportation Systems (2019) 10.1007/978-3-319-94785-3 Springer International Publishing;

Lecture notes available on the teachers' websites.

TEACHING METHODS

The teaching activities will be organized as follows: a) lectures for about 50% of the total hours, b) practical exercise in the classroom based on software Matlab (https://www.mathworks.com/). The final part of the Course activities follows a Challenge Based Learning (CBL) approach where students, divided in teams, are encouraged to take advantage of the learned tools to successfully tackle and solve a real problem posed by the latest technological developments in the field of intelligent and connected transport systems.

EXAMINATION/EVALUATION CRITERIA

a) Exam type:

Exam type	
written and oral	
only written	
only oral	X
project discussion	X
other	

b) Evaluation pattern:

The evaluation of the module is obtained according to the scores achieved by the student in the discussion of a project during the oral exam.

The final grade of the course is formulated by the Examination Committee as mean of the judgment of the two modules that have equal weight.