Course guide
205241 - AVP - Autonomous Vehicle Programming

Last modified: 02/04/2024

Unit in charge: Terrassa School of Industrial, Aerospace and Audiovisual Engineering
Teaching unit: 707 - ESAII - Department of Automatic Control.

Degree: BACHELOR'S DEGREE IN AUDIOVISUAL SYSTEMS ENGINEERING (Syllabus 2009). (Optional subject).
BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2009). (Optional subject).
BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Optional subject).
BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Optional subject).
BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Optional subject).
BACHELOR'S DEGREE IN TEXTILE TECHNOLOGY AND DESIGN ENGINEERING (Syllabus 2009). (Optional subject).
BACHELOR'S DEGREE IN AEROSPACE TECHNOLOGY ENGINEERING (Syllabus 2010). (Optional subject).
BACHELOR'S DEGREE IN AEROSPACE VEHICLE ENGINEERING (Syllabus 2010). (Optional subject).
BACHELOR'S DEGREE IN INDUSTRIAL DESIGN AND PRODUCT DEVELOPMENT ENGINEERING (Syllabus 2010). (Optional subject).
BACHELOR'S DEGREE IN INDUSTRIAL TECHNOLOGY ENGINEERING (Syllabus 2010). (Optional subject).

Academic year: 2024 **ECTS Credits:** 3.0 **Languages:** English

LECTURER

Coordinating lecturer: Morcego Seix, Bernardo

Others:

TEACHING METHODOLOGY

The theoretical part of the course is developed through lectures including theoretical sessions imparted with the aid of presentations. The applied part is developed with a project-based approach but adapted to the specific traits of the course.

LEARNING OBJECTIVES OF THE SUBJECT

The main objective of the course is to acquire a hands-on, panoramic view of the problems and (programmed) solutions in the control system of an autonomous vehicle.
Some aspects of this overview are treated in depth. Consequently, there are sub-objectives derived from the main one, which are: to create a functional ROS module in a complex software project, to distinguish and classify the problems in autonomous vehicle guidance and to deal with an introductory problem from other knowledge areas, such as computer vision, artificial intelligence or computer control.

STUDY LOAD

Type	Hours	Percentage
Self study	45,0	60.00
Hours large group	30,0	40.00

Total learning time: 75 h

CONTENTS

Module 1: Introduction to AV

Description:
1.Autonomous vehicles (definition, autonomy levels, examples, controversies)
2. General description of the AV Control Architecture
3. Sensors and actuators

Related activities:
1

Full-or-part-time: 2h
Theory classes: 2h

Module 2: Programming environment

Description:
4.Linux OS
5. ROS

Related activities:
2

Full-or-part-time: 16h
Theory classes: 1h
Self study : 15h

Module 3: AV Problems and solution

Description:
6. Guidance problems
7. Navigation problems
8. Control problems

Related activities:
1,2,3

Full-or-part-time: 57h
Theory classes: 27h
Self study : 30h

ACTIVITIES

1. Theory lectures

Description:
Exposition of the subject theory contents.

Specific objectives:
Knowledge transfer, creation of a conceptual reference frame, solving questions and generating interest about the subject.

Material:
Slide compilations and handouts at Atenea
General bibliography of the subject

Delivery:
This activity is evaluated together with activity 2 and 3.

Full-or-part-time: 6h
Theory classes: 6h

2. Lab project

Description:
Students, in groups, follow the instructions to program one of the blocks that make up the control system of an autonomous vehicle. These sessions take place at the lab. A complete, functional program architecture of the autonomous vehicle is given and the objective is to add a new module to this architecture each group.

Specific objectives:
Proper application and programming of problem identification and solving.

Material:
Project instructions at Atenea
Simulation software (ROS)
Lab experimental platforms
Course handouts and notes

Delivery:
Programs, working simulations and working experiments.

Full-or-part-time: 55h
Self study: 35h
Theory classes: 20h

3. Final demonstration

Description:
Each group explains its project and carries out an experimental demonstration of the behavior of its programmed block.

Specific objectives:
Assess the knowledge acquisition of activities 1, 2.
Refine student assessment within group from the evaluation in activity 2.

Material:
Lab experimental platforms
Presentation assets

Delivery:
Proper working of the programmed block.
Answers to the questions posed during the presentation.

Full-or-part-time: 14h
Theory classes: 4h
Self study: 10h

GRADING SYSTEM

Project assessment – planning: 25%
Project assessment – code development: 25%
Project assessment – presentation: 25%
Project assessment – demo: 25%

BIBLIOGRAPHY

Basic:
- Yurtsever, Ekim [et al.]. "A survey of autonomous driving: common practices and emerging technologies". IEEE Access [on line]. 2020, vol. 8, p. 58443-58469 [Consultation: 02/11/2022]. Available on: https://ieeexplore-ieee-org.recursos.biblioteca.upc.edu/document/9046805.- Badue, Claudine [et al.]. "Self-driving cars: a survey". Expert Systems with Applications [on line]. 2021, vol. 165, p. 113816 [Consultation: 02/11/2022]. Available on: https://www-sciencedirect-com.recursos.biblioteca.upc.edu/science/article/pii/S095741742030628X#bib1.