Course guides
230105 - SAM - Sensors, Actuators and Microcontrollers in Mobile Robots

Last modified: 29/04/2020

Unit in charge: Barcelona School of Telecommunications Engineering
Teaching unit: 710 - EEL - Department of Electronic Engineering.

Degree: BACHELOR'S DEGREE IN ELECTRONIC SYSTEMS ENGINEERING (Syllabus 2009). (Optional subject).
BACHELOR'S DEGREE IN TELECOMMUNICATIONS SCIENCE AND TECHNOLOGY (Syllabus 2010). (Optional subject).
BACHELOR'S DEGREE IN TELECOMMUNICATIONS TECHNOLOGIES AND SERVICES ENGINEERING (Syllabus 2015). (Optional subject).

Academic year: 2020 **ECTS Credits:** 6.0 **Languages:** Catalan, English, Spanish

LECTURER

Coordinating lecturer: Sergio Bermejo Sánchez

Others:

PRIOR SKILLS

Analogue and digital electronics concepts. Microprocessors.

TEACHING METHODOLOGY

LEARNING OBJECTIVES OF THE SUBJECT

The subject gives an introduction to the mobile autonomous robotics wherein microcontrollers are a part of the strategies of control of the electronic system. The basic concepts of different types of sensors and actuadores of habitual use in robotics as well as the basic strategies of control are analysed including his achievement, with special emphasis on the adaptive and action¿reaction strategies of control. In the laboratory, a prototype of an autonomous robot will be mounted.

STUDY LOAD

Type	Hours	Percentage
Self study	98,0	65.33
Hours large group	26,0	17.33
Hours small group	26,0	17.33

Total learning time: 150 h

CONTENTS

1. Introduction to mobile autonomous robotics (2 hours)

1.1. Basic concepts

1.2. Design considerations

1.3. Parts of a robot

1.4. Robot control

2. Sensors (6 hours)

2.1. Concepts. Introduction

2.2. Types of sensors: Pressure/contact. Resistive position. Infrared. Light. Ultrasound. Magnetic

2.3. Signal conditioning. Basic circuits

2.4. Use of A/D and D/A converters

3. Actuators (4 hours)

3.1. DC Motors

3.2. Gears

3.3. Pulse Width Modulation (PWM)

3.4. Stepper motors

3.5. Servomotors

4. Microcontrolador architecture (8 hours)

4.1. Introduction

4.2. Blocks diagram

4.3. Memory

4.4. Input/output ports

4.5. Timers/counters

4.6. A/D conversion

4.7. Interrupts

4.8. Instruction set and addressing modes

5. Communications between systems (2 hours)

5.1. Serial line

5.2. Infrared and wireless connections

6. Control systems. Algorithms (4 hours)

6.1. Control basis and principles

6.2. Control systems and their stability

6.3. PID controllers

6.4. Introduction to adaptive control

6.5. Active learning based algorithms

6.6. Inductive learning in automatas

6.7. Reinforcement learning algorithms

7. Autonomous navigation (4 hours)

7.1. Basic requirements

7.2. Environment maps construction

7.3. Environment maps abstraction

7.4. Several architectures examples (neural nets, fuzzy logic, biological based...)

GRADING SYSTEM

The evaluation of the subject is obtained as a 100 % of a robotics project realised within the laboratory divided into diverse phases in a work continued along the course and his later presentation in public.

BIBLIOGRAPHY

Basic:
- Braünl, T. Embedded robotics: mobile robot design and applications with embedded systems. 3rd ed. Berlin ; Heidelberg: Springer, 2008. ISBN 9783540705338.
- Martin, F.G. Robotic explorations: a hands-on introduction to engineering. Upper Saddle River, N.J.: Prentice-Hall, 2001. ISBN 0130895687.
- McComb, G. Robot builder's bonanza. 5th ed. New York: McGraw-Hill, 2019. ISBN 9781260135015.

Complementary:
- Stewart, J.W.; Miao, K.X. The 8051 microcontroller: hardware, software and interfacing. 2nd ed. Upper Saddle River: Prentice Hall, 1999. ISBN 013531948X.

- Predko, M. Programming and customizing PICmicro microcontrollers. 2nd ed. New York [etc.]: McGraw-Hill, 2002. ISBN 0071361723.
- Everett, H.R. Sensors for mobile robots: theory and application. Wellesley, Mass.: AK Peters, 1995. ISBN 1568810482.
- Arkin, R.C. Behavior-based robotics. London: MIT Press, 1998. ISBN 0262011654.

RESOURCES

Other resources: