Course guides
230662 - CSAS - Custom Smart Adaptive Systems

Last modified: 29/04/2020

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

Degree: MASTER'S DEGREE IN ELECTRONIC ENGINEERING (Syllabus 2013). (Optional subject).
MASTER'S DEGREE IN ADVANCED TELECOMMUNICATION TECHNOLOGIES (Syllabus 2019). (Optional subject).

Academic year: 2020 **ECTS Credits:** 5.0 **Languages:** English

LECTURER

Coordinating lecturer: J. MANUEL MORENO ARÓSTEGUI

Others: JOAN CABESTANY MONCUSÍ, JORDI MADRENAS BOADAS

PRIOR SKILLS

Microprocessor-based digital design
C programming language

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Transversal:
1. TEAMWORK: Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.

2. EFFECTIVE USE OF INFORMATION RESOURCES: Managing the acquisition, structuring, analysis and display of data and information in the chosen area of specialisation and critically assessing the results obtained.

3. FOREIGN LANGUAGE: Achieving a level of spoken and written proficiency in a foreign language, preferably English, that meets the needs of the profession and the labour market.

TEACHING METHODOLOGY

- Lectures
- Laboratory classes
- Laboratory practical work
- Group work (distance)
- Oral presentations

LEARNING OBJECTIVES OF THE SUBJECT

Learning objectives of the subject:

Custom smart adaptive systems , as part of the well known "Intelligent system" approach, will permit to understand the different stages that constitute an electronic system able to gather an integrate raw data coming from a large number of sensing sources and integrate them into a high-level decision taking infrastructure. The methods presented provide the adaptive features that will permit the system to operate under changing or unknown conditions, or even in the presence of faults, by configuring autonomously its parameters or structure. Another major goal will consist in choosing the efficient implementation of the final system taking into account relevant features such as memory capacity and bandwidth, throughput and power consumption. Intelligent methodologies for the treatment of gathered data will be considered as part of the necessary step the for "automatic knowledge extraction" from data. The subject will present the principles of the respective parts, with a project integrating the whole chain for a given application.

Learning results of the subject:

- Ability to understand and differentiate the main building blocks constituting a smart adaptive system.
- Ability to apply feature extraction and selection as well as data fusion techniques in order to facilitate the implementation of decision tasks.
- Ability to analyse and implement adaptive methods able to solve signal processing tasks.
- Ability to choose a correct implementation alternative for an adaptive system, taking into account system constraints such as memory bandwidth and capacity, throughput and power consumption.
- Ability to develop techniques for the design, analysis and evaluation of electronic systems in applications such as automation, aerospace, energy distribution and generation, consumer electronics, biomedicine, etc.
- Ability to synthesize and solve problems related to the electronic engineering discipline, to apply learning techniques in complex and multiple contexts, to apply previous knowledge to new situations and contexts, as well as the ability to coordinate and work in a team.
- Ability to design electronic systems able to integrate raw data coming from sensors and construct a high-level decision infrastructure.

STUDY LOAD

Type	Hours	Percentage
Hours small group	13,0	10.40
Self study	86,0	68.80
Hours large group	26,0	20.80

Total learning time: 125 h

CONTENTS

1. Introduction

Description:
- Architecture of a smart adaptive system
- System components
- Main challenges in a smart adaptive system

Full-or-part-time: 9h
Theory classes: 2h
Laboratory classes: 1h
Self study : 6h

2. Feature extraction and selection

Description:
- Principal component analysis
- Linear discriminant analysis
- Independent component analysis

Full-or-part-time: 26h
Theory classes: 6h
Laboratory classes: 2h
Self study : 18h

3. Data fusion techniques

Description:
- Data averaging
- Data clustering
- Blind source separation

Full-or-part-time: 28h
Theory classes: 6h
Laboratory classes: 2h
Self study : 20h

4. Adaptive methods

Description:
- Supervised learning
- Unsupervised learning
- Evolutionary principles
- Self-healing methods

Full-or-part-time: 36h
Theory classes: 8h
Laboratory classes: 4h
Self study : 24h

5. Implementation principles

Description:
- Implementation alternatives
- Memory bandwidth and capacity
- System throughput
- Power consumption

Full-or-part-time: 26h
Theory classes: 4h
Laboratory classes: 4h
Self study : 18h

ACTIVITIES

LABORATORY

Description:
- Presentation of case studies.
- Artificial Neural Networks.
- Bio-inspired electronic systems

ORAL PRESENTATION

Description:
Presentation of a work group.

GRADING SYSTEM

Self-study group assessments: 50%
Laboratory assessments: 30%
Personal project: 20%

BIBLIOGRAPHY

Basic:
- Bishop, C.M. Pattern recognition and machine learning. New York: Springer, 2006. ISBN 978-0387310732.
- Floreano, D.; Mattiusi, C. Bio-inspired artificial intelligence: theories, methods and technologies [on line]. Cambridge, MA: MIT Press, 2008 [Consultation: 21/04/2020]. Available on: https://ebookcentral.proquest.com/lib/upcatalunya-ebooks/detail.action?docID=3338934. ISBN 9780262272858.

Complementary:
- Duda, R.O.; Hart, P.E.; Stork, D.G. Pattern classification. 2nd ed. New York: John Wiley & Sons, 2001. ISBN 978-0471056690.