VNIVERSITAT DE VALÈNCIA

Course Guide
44278 Digital filtering

COURSE DATA

Data Subject	
Code	44278
Name	Digital filtering
Cycle	Master's degree
ECTS Credits	3.0
Academic year	2022 - 2023

Study (s)

Degree	Center	Acad. year	Period
2199 - M.D. in Electronic Engineering	School of Engineering	1	First term
3131 - Electronic Engineering	Doctoral School	0	First term

Subject-matter

Degree	Subject-matter	Character
2199 - M.D. in Electronic Engineering	1 - Digital signal processing	Obligatory
3131 - Electronic Engineering	1 - Complementos de Formación	Optional

Coordination

Name	Department
AMOROS LOPEZ, JULIA CARMEN	242 - Electronic Engineering
MUÑOZ MARI, JORDI	242 - Electronic Engineering

SUMMARY

In this course you will be disclosed to the student optimal and adaptive signal processing. This type of processing is critical in time-variant environments where the system must optimize an a priori defined criteria. Major adaptive algorithms and their different structures and applications are given. The course ends with the description of the Kalman filter.

This is a mandatory course, which is taught in the first semester of the Master in Electronic Engineering. The total teaching load is 3 ECTS. The workload for the student is 75 hours over the semester, of which 30 are on-site and 45 correspond to individual work.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

Other requirements

It is recommended that students know the basic theory of digital signal processing in addition to base statistics and probability. Otherwise, they will be provided with a series of tutorials to follow the course.

OUTCOMES

2199 - M.D. in Electronic Engineering

- Students should apply acquired knowledge to solve problems in unfamiliar contexts within their field of study, including multidisciplinary scenarios.
- Students should be able to integrate knowledge and address the complexity of making informed judgments based on incomplete or limited information, including reflections on the social and ethical responsibilities associated with the application of their knowledge and judgments.
- Students should communicate conclusions and underlying knowledge clearly and unambiguously to both specialized and non-specialized audiences.
- Students should demonstrate self-directed learning skills for continued academic growth.
- Take into account the economic and social context in engineering solutions, be aware of diversity and multiculturalism and ensure sustainability and respect for human rights and equality between men and women.
- Diseñar un sistema, componente o proceso que cumpla unas especificaciones desde diferentes puntos de vista: electrónico, económico, social, ético y medioambiental.
- Demostrar una comprensión sistemática de un campo de estudio y el dominio de las habilidades.
- Realizar un análisis crítico, evaluación y síntesis de ideas nuevas y complejas.
- Ser capaz de fomentar, en contextos académicos y profesionales, el avance tecnológico, social o cultural dentro de una sociedad basada en el conocimiento.
- Capacidad para proyectar, calcular y diseñar productos, procesos e instalaciones en todos los ámbitos de la Ingeniería Electrónica y en particular los de tratamiento de la señal, sistemas digitales y de comunicaciones y electrónica industrial.
- Capacidad para el modelado matemático, cálculo y simulación en todos los ámbitos relacionados con la Ingeniería Electrónica y campos multidisciplinares afines. En especial los de tratamiento de la señal, sistemas digitales y de comunicaciones y electrónica industrial.
- Conocer las técnicas avanzadas de análisis de datos.

- Capacidad de analizar, especificar y diseñar sistemas de tratamiento digital de señales desde su concepción hasta su implementación en sistemas hardware de tiempo real..

LEARNING OUTCOMES

Once developed this course the student will have sufficient evidence and the ability to establish the advantages and disadvantages of the different technological alternatives for filtering signals. Filtering may be used for stationary signals optimal both from the point of view as temporal frequency and adaptive filtering for non-stationary situations or problems which need an adaptive scheme.

DESCRIPTION OF CONTENTS

1. Optimal digital filtering

UNIT 1
1.1 Optimal Linear Estimation.
1.2 Normal equations. Solution.
1.3 Optimal FIR Filters.
1.4 Linear Prediction (backward / forward).
1.5 Optimal IIR filters.

2. Adaptive Filtering

UNIT 2
2.1 Problems of optimal filters.
2.2 adaptive filters. LMS structures.
2.3 Variants of the most widespread LMS.
2.4 Variations in the frequency domain.
2.5 Volterra filters. Median filters.
2.6 RLS.
2.7 Kalman Filter.
2.8 Applications.
2.9 Other types of advanced digital filtering.

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	15,00	100
Laboratory practices	15,00	100
Study and independent work	10,00	0
Readings supplementary material	5,00	0
Preparation of evaluation activities	5,00	0
Preparing lectures	5,00	0
Preparation of practical classes and problem	10,00	0
Resolution of case studies	10,00	0
TOTAL	**75,00**	

TEACHING METHODOLOGY

The teaching methods employed in the development of the course are the following:

a) Theoretical activities.

Expository development of matter with the student's participation in the resolution of specific issues.

b) Practical activities.

Solving practical problems.

c) Student's personal work.

Description: Out-of-classroom development of problems as well as the preparation of classes and exams (study). This task will be performed individually and try to promote self-employment.

We will use e-learning platforms (Aula Virtual) to support communication with students; Aula Virtual will be used to access the course materials used in class, as well as solving problems and exercises.

EVALUATION

The evaluation of the course will be conducted by performing a test that will take the form of an individual examination or group work about the contents of the subject.

REFERENCES

Basic

- Fundamental of Adaptive Filtering, Ali Sayed, Wiley, 2003.
- Adaptive Filter Theory, Simon Haykin, Prentice Hall, 1996.
- Tratamiento Digital de Señales. Principios Algoritmos y Aplicaciones. / John G. Proakis, Dimitris G. Manolakis, Prentice Hall, 2008.
- Introduction to Random Signals and Applied Kalman Filtering. Rober Grover, Patrick Hwang, Wiley 1992.
- Statistical and Adaptive Signal Processing: Spectral Estimation, Signal Modelling, Adaptive Filtering & Array Processing. D. Manolakis, V.K. Ingle, S.M. Kogon. Artech House 2005.
- Advanced Digital Signal Processing, John G. Proakis, Dimitris G. Manolakis, McMillan, 1992.

Additional

- Adaptive Signal Processing, Bernard Widrow, Samuel D. Stearns, Prentice Hall, 1985.