

Wavelet Transform Applied to Engineering

ECTS: 3 ECTS

COORDINATOR: María Elena Domínguez Jiménez (elena.dominguez@upm.es)

UNIVERSITY WHERE THE COORDINATOR IS: UPM

HAVE YOU GIVEN PERMISSION TO RECORD YOUR CLASSES? Yes.

SUBJECT CONTENTS

1. Fourier Theory: Fourier series. Continuous Fourier Transform and Discrete Fourier Transform. Shannon sampling theorem. Application to lineal systems and digital filters.
2. Wavelet Transform. Multiresolution analysis. Scale equation. Design of wavelets.
3. Wavelet families used in Engineering. Orthogonal wavelets. Daubechies' Wavelets.
4. Implementation of the Discrete Wavelet Transform by means of filter banks:
 - Wavelet Transform of finite signals (Mallat's Algorithm).
 - Types of edge extensions.
5. Wavelet packets. Two-dimensional wavelets.
6. Wavelet applications: Signal compresión, noise extraction, singularity detection.

METHODOLOGY

Theoretical classes will be alternated with practical examples, in order to learn the computer applications of Fourier Transform and Wavelet Transform. For the theoretical part we will follow the book written by the professor of the course; for the practical part, we will use software packages for wavelets (preferably the Matlab Wavelet Toolbox).

LANGUAGE USED IN CLASS: Spanish

IS IT COMPULSORY TO ATTEND CLASS? Students can attend via conference system

BIBLIOGRAPHY

- M. E. Domínguez, G. Sansigre: "*Transformada wavelet básica para ingenieros*", (2006) ISBN: 84-689-8331-4.
- C. Gasquet, P. Witomski, *Fourier Analysis and Applications: Filtering, Numerical Computation, Wavelets.*, Springer (1998).
- G. Strang, *Wavelets and Filter Banks*, Wellesley-Cambridge (1996).
- M. V. Wickerhauser, *Adapted Wavelet Analysis from Theory to Software*, IEEE Press (1994).

SKILLS

Basic:

CG1: To have knowledge that provide a basis or opportunity for originality in developing and / or applying ideas, often within a research context, knowing how to translate industrial needs in terms of R & D in the field of mathematics Industrial.

CG3: To be able to integrate knowledge in order to state opinions using information that even incomplete or limited, include reflecting on social and ethical responsibilities linked to the application of their knowledge.

CG4: To have the ability to communicate the findings to specialist and non-specialist audiences in a clear and unambiguous way.

CG5: To have the appropriate learning skills to enable them to continue studying in a way that will be largely self-directed or autonomous, and also to be able to successfully undertake doctoral studies.

Specific:

CE3: To determine if a model of a process is well made and well mathematically formulated from a physical standpoint.

CE5: To be able to validate and interpret the results, comparing them with visualizations, experimental measurements and functional requirements of the physical engineering system.

Modelling specialization

CM1: To be able to extract, using different analytical techniques, both qualitative and quantitative models.

WILL YOU BE USING A VIRTUAL PLATFORM? No.

WILL YOU BE USING ANY SPECIFIC SOFTWARE? Yes, we will be using Matlab Wavelet Toolbox.

CRITERIA FOR THE 1ST ASSESSMENT OPPORTUNITY

Throughout the course, theoretical and practical exercises will be proposed to the students. They will solve them and deliver them in electronic format; afterwards, they will expose their solution to the teacher, who may ask them some questions about it.

The quality of the presentation and the correction of the answers will be assessed. Mathematical rigor and application of the concepts taught in the course will also be assessed.

CRITERIA FOR THE 2ND ASSESSMENT OPPORTUNITY

To those students who have not passed the previous assessment, they will be given the opportunity to take a final exam, consisting of a theoretical and practical task that encompasses several concepts learned throughout the course. Students will have some days to develop and submit their solution to the teacher, who also may ask them some questions on it.

Correction will be assessed, and especially the assimilation and application of those concepts that students in first call had not acquired enough.
