Universidad Zaragoza

Academic Year/course: 2024/25

69703 - Biomedical signal and image processing

Syllabus Information

Academic year: 2024/25
Subject: 69703 - Biomedical signal and image processing
Faculty / School: 110 - Escuela de Ingeniería y Arquitectura
Degree: 633 - Master's Degree in Biomedical Engineering
ECTS: 6.0
Year:
Semester: First semester
Subject type: Compulsory
Module:

1. General information

The main objective is to provide students with the fundamentals and basic tools for the analysis and study of signals and images, as well as for their application to signal and image processing, with a special focus on biomedical applications. It also introduces the bases for other more advanced subjects specific to signal or image processing.

2. Learning results

- To be able to understand the origin and generation mechanisms of biomedical signals and images.
- To be able to characterize biomedical signals in the time/space domain and in the frequency domain, as well as to transform signals between the different domains and choose the most appropriate domain for each problem.
- To be able to understand and perform typical medical signal and image processing tasks, such as filtering, conditioning, event detection, parameter estimation, segmentation.

3. Syllabus

MODULE 1: Biomedical signals and imaging.

- Biomedical signals and signals. Origin and examples.
- Bioelectrical signals: generic aspects; action potential.
- Medical imaging and imaging (modalities). Origin and examples.

MODULE 2: SIGNALS

- Mathematical representation of deterministic signals in time or space domain. Discrete time (vectors, sequences), continuous time (functions).
- Basic transformations of signals.
- Measures and features from signals (histogram, averages, energy, power, dot products).
- Frequency domain signal representation. Fourier transforms and their properties.

MODULE 3: SYSTEMS

- General aspects of systems: characterization, properties, connection.
- Linearity and invariance: convolution and impulse response; frequency response.
- Implementation: continuous-time (differential equations) and discrete-time (finite difference equations, FIR and IIR systems).
- Sampling.
- Z-Transform, rational transfer function.

4. Academic activities

- Theoretical sessions (40 hours)
- Laboratory practice sessions (5 sessions of 2 hours)
- Teaching assignments (assignments outside class hours with associated deliverables: problem solving, mini-projects, self-assessment reports) (30 hours)
- Study and personal work (65 hours)
- Assessment tests (5 hours)

5. Assessment system

The subject is preferably oriented towards a **mixed system** of evaluation in which the following items are considered:

- **T1**: Teaching assignments. 20% of the grade The suitability of the solutions, the quality of the documents provided and the attitude and proactivity in the development of the tasks will be taken into account.
- **T2**: Laboratory practices. 20% of the grade The evaluation of the practices will be carried out taking into account the quality of the associated reports and the performance of the students.
- **E**: Exam grade. 60% of the grade Final exam**(FE**) and partial exam**(PE**).

In the final exam **EF** (date of official call) the whole subject is assessed (all theoretical and practical contents). By default the exam grade **E** is directly the **EF** grade **(E=EF**).

Towards the middle of the term there will be a partial **EP** exam that will assess the contents seen so far. The **EP** grade will only influence the **E** exam grade if the following two circumstances occur simultaneously: 1. **EF** >4; 2. **EP** > **EF** . In that case, instead of obtaining **E** as **E** = **EF** , we will apply **E** =(1/3)* **EP** +(2/3)* **EF** .

In this **mixed system** context, the subject can only be passed with a minimum grade of 5 out of 10 in item**T2** and 4.5 in item **E**.

Alternatively, there is also a **simple system** based exclusively on a single overall final test in the two official calls for exams. The overall test will consist of 2 parts **EF**(60% of the grade) and T (remaining 40%). The **EF** part of the test coincides with the final exam described in the mixed system. The additional part of the global test **T** is focused on verifying that the student has worked on the subject on their own, acquiring competences similar to those assessed in items**T1** and**T2** of the mixed system. In the **simple system** context, it is necessary to pass each of the 2 parts of the global test **(EF** and **T** separately in order to pass the subject.

6. Sustainable Development Goals

3 - Good Health & Well-Being
9 - Industry, Innovation and Infrastructure