Universidad Zaragoza

Academic Year/course: 2024/25

67250 - Biomedical signal processing

Syllabus Information

Academic year: 2024/25
Subject: 67250 - Biomedical signal processing
Faculty / School: 110 - Escuela de Ingeniería y Arquitectura
Degree: 622 - Master's in Electronic Engineering
ECTS: 6.0
Year: 1
Semester: First semester
Subject type: Optional
Module:

1. General information

In the subject, Treatment of Biomedical Signals, students will have understood the electrical origins of bioelectric signals, and the relationship of the different types of signals on the surface of the body (ECG, EEG, EP, EMG). Always with clinical objectives in mind, signal treatment techniques for both detection and estimation in each application domain are presented in this subject. The subject must lead the student to know a range of biomedical signal processing techniques, and be able to use them to obtain clinical information from the signals, taking into account the particularities of each case and type of signal, as well as the possibilities and limitations. of these techniques. Consequently, the overall objective of the subject is for the student to understand and know how to use a set of signal processing tools to extract clinically useful information from the different types of biomedical signals.

2. Learning results

The student, to pass this subject, must demonstrate the following results:

1. Be able to design a biomedical signal conditioning system, taking into account the characteristics of these signals and the requirements of subsequent processing, with the restrictions imposed not distort the useful information present in the signals.

2. Be able to solve problems of detection or estimation of clinical parameters of interest, posing them optimally within the framework of detection/estimation theory. Particularly in the area of Electrocardiology, Electroenflaography and Electromyography.

3. Be able to interpret the sources of temporal and spatial information for the design of information systems. compaction of information, either with the aim of compression and communication, or with the aim of classification/monitoring and decision making regarding the underlying system (diagnosis/therapy).

4. Be able to extrapolate signal treatment concepts to the biomedical context, interpreting spatial and temporal mixtures/separations of sources, non-uniform sampling, varying systems in the time, extraction and interpretation of static and dynamic information, etc.

3. Syllabus

The Degree in Telecommunications Engineering aims, in addition to giving the fundamentals, positioning the tools of information and communication treatment in the context of their applications. In the context of this subject the application is the biomedical field, with applications for both diagnosis, therapies, interventions, follow-ups, etc. For this, an important part of the Engineering tries to exploit to the maximum the different sources of information that emanate of the alive systems to take, based on her, to take subsequent actions and / or decisions. Biomedical signals, and more specifically bio-electric, are a rich source of information about the organs or systems that generate them (cardiac, neurological, etc.). This subject puts at the service of professionals both deterministic techniques and statistics of treatment and detection of events in discrete signals, for use on biomedical signals in biomedical contexts where these signals may have some interest.

The distribution in thematic units of the theory of the subject will be as follows:

TOPIC 1. Introduction to the origin of biological signals, their types and characteristics, as well as the objectives that ICTs allow us to consider in this context.

TOPIC 2. Electrocardiogram (ECG): Description, parameters of clinical interest, interpretation; Detection of events (beats); interference cancellation; analysis of heart rate variability; signal averaging recurrent; Information compression and time-variant analysis (time-frequency representations); signs invasive (Electrograms) their use and singularities.

TOPIC 3. Electroencephalogram (EEG): interpretation and clinical information, frequency bands; cancellation of artifacts; spectral estimation; Analysis of evoked potentials (visual, auditory, etc.).

TOPIC 4. Electromyogram (EMG): origin and interpretation; parameters of interest and optimal estimation; Applications.

TOPIC 5. Other biomedical signs: Photoplestimogram (PPG), blood pressure (BP); Their interactions and physiological implications; Estimates of multimodal relationships (causation, correlations, etc.) (different types of signals) of clinical parameters.

4. Academic activities

Master classes (40 hours), introducing the concepts, the physiological bases of each type of signal and the objectives of their study as well as the particularities or new developments of signal treatment in these contexts.

Problem solving (12 hours), which are given individually to the student, and are subsequently presented by the student in one of the regulated classes

Laboratory Practices (4 hours), where some of the applications presented in class will be seen in a practical way.

Tutored work (20 hours), in which a case study will be proposed, individually or preferably in a group, with real data, and the student will develop the corresponding application with a specific clinical objective.

Evaluation tests (4 hours)

Personal study (72 hours)

5. Assessment system

The student must demonstrate that he / she has achieved the expected learning outcomes through the following assessment activities

E1: Presentations and oral debates

- Students should prepare during the course the presentation of specific topics, or the resolution of specially selected exercises, which will be presented orally to the class as a whole. The evaluation of this activity supposes 10% of the final note of asignatura.

E2: Tutored works

- Tutored works represent 50% of the final grade. The qualification will assess the student's analytical and critical ability to study a problem or specific aspects in a biomedical signal treatment application, making use of the theoretical and practical tools learned in the subject. In addition, the originality of the solutions, the ability to work in a group, the ability to coordinate the work and to communicate relevant information in an oral and written form will be evaluated, as the work done will be presented through a common report to the group and Of an oral presentation.

E3: Final examination

- The final exam will consist of a written test that represents 40% of the final grade. The test is divided into two parts: -
    - E3.1: Theoretical-practical issues: -
    - E3.2: Practical problems:

The student must obtain a grade of at least 4 out of 10 in the final exam grade (E3) to pass the subject. The student will have an overall test in each of the calls established throughout the course. The dates and times of the tests will be determined by the School.

6. Sustainable Development Goals

3 - Good Health & Well-Being
4 - Quality Education
17 - Partnerships for the Goals