

Academic Year/course: 2024/25

69720 - Advanced biomedical signal processing

Syllabus Information

Academic year: 2024/25

Subject: 69720 - Advanced biomedical signal processing

Faculty / School: 110 - Escuela de Ingeniería y Arquitectura

Degree: 633 - Master's Degree in Biomedical Engineering

ECTS: 3.0

Year: 1

Semester: Second semester

Subject type: Optional

Module:

1. General information

The purpose of this subject is that the student acquires knowledge and methodologies of statistical signal processing for its application in biomedical signal processing, taking into account the clinical objectives of each application. It introduces the characterization of stochastic processes, optimal estimators, spectral estimation methods and adaptive filtering.

2. Learning results

To be able to design a biomedical signal conditioning system, taking into account the characteristics of these signals and the post-processing requirements, with the restrictions imposed by not distorting the useful information of the signals.

To be able to solve problems of detection or estimation of clinical parameters of interest, posing them optimally within the framework of detection/estimation theory.

To be able to analyse biomedical signals using spectral estimation techniques, selecting the technique according to the information available on the problem, and the requirements of the application, correctly interpreting the results.

3. Syllabus

1. Basic concepts of statistical signal processing.
2. Parameter estimation and event detection. Applications: averaging, EMG analysis, delays, heart rate variability, event detection, T wave alternations detection... Methods: Parameter estimation. Bias and variance. Optimal estimation (maximum likelihood, least squares, Bayesian methods).
3. Optimal detection. Applications: event detection, QRS detection, postural change detection. Methods: likelihood ratio test (LRT), Neyman-Pearson criterion, evaluation of a detector.
4. Optimal and adaptive filtering. Applications: noise and interference filtering and cancellation, component separation, adaptive estimation. Methods: Wiener filtering, adaptive filtering, LMS algorithm.

4. Academic activities

A01 Participative master class (24 hours). In addition to theory, there will be practical examples, demonstrations and problems.

A03 Laboratory practices (6 hours). Three practical sessions of 2 hours each will be carried out in a computer classroom. A report of the practical sessions must be submitted and will be evaluated.

A05 Practical application or research work (20 hours). Practical exercises will be carried out and students will have to hand them in on the dates set by the teacher (short questions, problems or small programming tasks, analysis and interpretation of processing methods in signals provided).

A06 Tutoring.

A08: Assessment (2 hours).

This course is **English Language Friendly**, which means that: the course syllabus is also available in English; the study and class materials are in English; the faculty is willing to conduct office hours in English; and students are allowed to take their assessments in English.

5. Assessment system

E1. Final two-part written exam (50% of the final grade; time available: 2 hours).

- Multiple-choice questions (multiple choice, four answers with penalty for failure).
- Short questions.

It is essential to obtain at least 5 points out of 10 in order to pass the subject.

E2. Tutored practical work (deliverable practical exercises, 30% of the final grade). Throughout the term, practical exercises will be proposed (short questions, problems or small programming tasks, analysis and interpretation of signal processing methods provided by the teacher). Students must deliver them on the established deadlines. Students will show the degree of acquisition of the competences corresponding to the subject and will provide interpretations of the results.

E3. Practical sessions reports: The grade of the practical session report will represent 20% of the final grade.

Students are entitled to be evaluated in a **single global test** that will take place on the date assigned by the centre for the final exam and in which the aspects evaluated in E2 and E3 will also be assessed.

Likewise, the second call will consist of a single overall written test that will take place during the period established for this purpose.

6. Sustainable Development Goals

- 3 - Good Health & Well-Being
- 8 - Decent Work and Economic Growth
- 9 - Industry, Innovation and Infrastructure