69320 - Advanced treatment of biomedical signals

Información del Plan Docente

Academic Year	2017/18
Faculty / School	110 - Escuela de Ingeniería y Arquitectura
Degree	547 - Master's in Biomedical Engineering
ECTS	3.0
Year	1
Semester	Second semester
Subject Type	Optional
Module	---

1.General information

1.1.Introduction

1.2.Recommendations to take this course

1.3.Context and importance of this course in the degree

1.4.Activities and key dates

2.Learning goals

2.1.Learning goals

2.2.Importance of learning goals

3.Aims of the course and competences

3.1.Aims of the course

3.2.Competences

4.Assessment (1st and 2nd call)

4.1.Assessment tasks (description of tasks, marking system and assessment criteria)

5.Methodology, learning tasks, syllabus and resources

5.1.Methodological overview

The methodology followed in this course is oriented towards achievement of the learning objectives. A wide range of teaching and learning tasks are implemented, such as lectures where the main contents are presented and discussed; practice sessions with practical examples, demonstrations and problems; autonomous work; and an assignment consisting on the programming, analysis and study of methods for biomedical signal processing on a set of biomedical signals.

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5.2.Learning tasks

The course includes the following learning tasks:

- **A01 Lectures** (22 hours). The teacher explains the main contents of the course. This activity will take place in the classroom and will include practical examples, demonstrations and problem solving. Student participation is encouraged.
- **A03 Computer lab sessions** (6 hours). 3 two-hour sessions are held in a computer room. The students must submit a report of the practical work, which will be evaluated (E3).
- **A05 Assignments** (20 hours). A task will be assigned consisting on programming, studying and analyzing biomedical signal processing methods on a set of signals given to the student. The student will show the degree of acquisition of skills relevant to the assignment and provide interpretations of the results. The evaluation (E2) will take into account the submitted report as well as the the suitability and originality of the proposed solution.
- **A06 Tutorials**. Teacher's office hours are available for students who want to review and discuss the materials and topics presented in both theoretical and practical classes.
  A08 Assessment (2 hours). A set of a final written test and the submission of assignments and tasks. The details can be found in the Assessment Section.

5.3.Syllabus

The course will address the following topics:

- Topic 1. Basics of statistical signal processing.
- Topic 2. Parameter estimation and detection of events. Applications: Averaging, EMG analysis, delays, heart rate variability, event detection, detection of T-wave alternans ... Methods: Parameter estimation. Bias and variance. Optimal estimation (maximum likelihood, least squares, Bayesian methods). optimal detection. MAP criterion. GLRT.
- Topic 3. Optimal and adaptive filtering. Applications: filtering and noise cancellation, source separation, adaptive estimation. Methods: Wiener Filtering, Adaptive Filtering Algorithms (LMS).
- Topic 4. Signal processing methods (PCA, ICA). Applications: single-trial EP Analysis, Separation of fetal ECG. Methods: Principal component analysis (PCA and transformed KL), Independent component analysis (ICA).
- Topic 5. Time-frequency representation. Applications: Removing noise, signal segmentation, cardiorespiratory coupling. Methods: Short-time Fourier Transform, Spectrogram, wavelet transform.

5.4.Course planning and calendar

Further information concerning the timetable, classroom, office hours, assessment dates and other details regarding this course, will be provided on the first day of class or please refer to the EINA website.

5.5.Bibliography and recommended resources

BB	Rangayyan, R.M . Biomedical signal analysis: A case-study approach / Rangayyan, R.M Wiley-Interscience, 2002
BB	Sörnmo, Leif. Bioelectrical signal processing in cardiac and neurological applications / Leif Sörnmo, Pablo Laguna Burlington [Massachusetts] : Elsevier, Academic Press, cop. 2005
BC	Hayes, Monson H.. Statistical digital signal processing and modeling / Monson H. Hayes New York [etc.] : John Wiley and Sons, cop. 1996
BC	Kay, Steven M.. Fundamentals of statistical signal processing : Estimation

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	theory / Steven M. Kay Englewood Cliffs, New Jersey : Prentice Hall International, cop. 1993
BC	Manolakis, Dimitris G.. Statistical and adaptive signal processing : spectral estimation, signal modeling, adaptive filtering and array processing / Dimitris G. Manolakis, Vinay K. Ingle, Stephen M. Kogon Boston [etc.] : McGraw Hill, 2000
BC	Zelniker, Glenn. Advanced digital signal processing : Theory and applications / Glenn Zelniker, Fred J. Taylor New York [etc.] : Marcel Dekker, cop. 1994