Universidad Zaragoza

Academic Year/course: 2022/23

68960 - Biomedical signal processing

Syllabus Information

Academic Year: 2022/23
Subject: 68960 - Biomedical signal processing
Faculty / School: 326 - Escuela Universitaria Politécnica de Teruel
Degree: 614 - Master's in Innovation and Entrepreneurship in Health and Wellbeing Technologies
ECTS: 3.0
Year: 1
Semester: Second semester
Subject Type: Optional
Module:

1. General information

1.1. Aims of the course

This course aims to provide the student with the basic knowledge of the different phases of signal processing in the field of health and well-being technologies. To this end, the student must become familiar with the physiological origin of the signals, which determine the processing techniques to be applied in order to obtain the relevant clinical information.
The student will learn to manage the signals according to the specific application, the detection of events and parameters estimation from different ways of representing the signals, including time and frequency domains.

These approaches and objectives are aligned with some of the Sustainable Development Goals, SDG, of the 2030 Agenda (https://www.un.org/sustainabledevelopment/es/) and certain specific goals, in such a way that the acquisition of the Learning outcomes of the subject provides training and competence to the student to contribute to a certain extent to their achievement:

? Goal 3: Ensure healthy lives and promote well-being for all at all ages.

> Target 3.4 By 2030, reduce by one third premature mortality from non-communicable diseases through prevention and treatment and promote mental health and well-being.
>
> Target 3.d Strengthen the capacity of all countries, in particular developing countries, for early warning, risk reduction and management of national and global health risks.

? Goal 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

> Target 4.4 By 2030, substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship.

? Goal 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.

> Target 8.6 By 2020, substantially reduce the proportion of youth not in employment, education or training.

? Goal 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.

> Target 9.5 Enhance scientific research, upgrade the technological capabilities of industrial sectors in all countries, in particular developing countries, including, by 2030, encouraging innovation and substantially increasing the number of research and development workers per 1 million people and public and private research and development spending.

1.2. Context and importance of this course in the degree

The subject is optional within the Interactive Systems and Advanced Signal Processing.

The course covers signal processing methods in order to obtain relevant information from signals recorded by different sensors in the field of health and well-being

1.3. Recommendations to take this course

The Biomedical Signal Processing course has no prerequisites. However, to conveniently follow the subject without a higher than expected workload, it is advisable for students to have some basic training in signals and systems.
In addition, the study and continued work, from the first day of the course, are essential to overcome the subject with the maximum advantage. It is important to resolve any doubts that may arise as soon as possible, for which the student has the advice of the teacher.

2. Learning goals

2.1. Competences

By passing the course, the student will be more competent to...

Basic competences:

CB6- Students have and understand knowledge that provides a basis or opportunity to be original in the development and / or application of ideas, often in a research context.

CB7- Students are able to apply their acquired knowledge and problem-solving skills in new or unfamiliar environments within broader (or multi-disciplinary) contexts related to their area of study.
CB9- Students are able to communicate their findings and the ultimate knowledge and reasons behind them to specialist and non-specialist audiences in a clear and unambiguous manner.
CB10- Students have the learning skills to enable them to continue studying in a largely self-directed or autonomous manner.

General competences:

CG1- Students have the knowledge, skills and abilities necessary to carry out innovative work in the field of technologies for Health and Well-being.
CG2- Students know how to write technical documents or reports describing a novel application in the field of technology for Health and Well-being, as well as knowledge of mechanisms to protect or distribute it.
CG3- Students search, manage, understand and critically analyze scientific publications, bibliography and documentation in the field of Health and Well-being Technologies.

CG4- Students start a research career in the field of Health and Well-being Technologies with guarantees.

Specific competences: CE8- Students analyze biomedical data and extracting relevant information from it for the resolution of problems in the field of Health and Well-being Technologies.

CE10- Students carry out, present and defend before a university court an original and innovative project or work that solves a real problem in the field of Health and Well-being Technologies in which the skills acquired in the teaching are synthesized and integrated.

2.2. Learning goals

The student will have to show the following skills in order to pass the course:

He/she understands the origin and mechanisms of biomedical signals generation .
He/she is able to characterize biomedical signals in time and frequency domains, as well as transforming the signals between the different domains and choosing the most suitable domain for each problem.
He/she is able to assess the advantages and disadvantages of different signal filtering strategies and is familiar with the concepts of optimal filtering and adaptive filtering.
He/she understands and carries out basic signal processing tasks such as filtering, conditioning, event detection, parameter estimation.

2.3. Importance of learning goals

Obtaining the information of interest for the specific application a technological system is designed is essential in the field of Health and Well-being

This information is obtained by recording biomedical signals with different sensors, but it is usually affected by artifacts or noise, or is difficult to extract directly from the recorded signal. For this reason, this course aims to enable the student to process these signals in order to obtain the information of interest from the point of view of Health and Well-being.

3. Assessment (1st and 2nd call)

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

The students must demonstrate that they have achieved the expected learning outcomes through the following assessment activities.

The final qualification for the course in the first call is divided as follows:
Assignments . 70% of the final qualification. This note will be achieved through the development of a series of practical works to be carried out throughout the course. If such practical work is not delivered in its entirety, or if its average grade is less than 5 out of 10, the student will need to carry out a practical recovery test to pass the course. This test will take place on the date of the final exam.

Theoretical and practical tests. 30% of the final qualification. It is a theoretical and practical test on the dates set by the center. A grade greater than 4 out of 10 must be obtained to pass the final exam. If this minimum is not reached, the final grade for the course will be the lowest between the average grade of the two parts and the grade for the exam.
For the second call, the evaluation will consist of the same parts as in the first call.

4. Methodology, learning tasks, syllabus and resources

4.1. Methodological overview

The learning process that has been designed for this subject is based on the following:

The continued study and work from the first day of class.
The course is presented in a practical basis, starting from the resolution of classic problems in biomedical signal processing. Although there will be some lectures, the subject will be focused on solving problems, practice sessions, and assignments so that the student learns by doing, always with the guidance of the teacher.

4.2. Learning tasks

The program includes the following activities:
? Recorded classes available on the virtual platform and / or synchronous meetings for content presentation.
? Practices whose aim is to familiarize students with basic signal processing tools and which are developed using telematic tools.
? Work sessions / problem solving sessions carried out using telematic tools.
? Personal study. Continuous student work will be promoted through the homogeneous distribution of the various learning activities. Tutorials are included here, such as direct attention to the student, identification of learning problems, orientation in the subject, attention to exercises and assignments.
? Assessment tests that, in addition to the qualifying function, are also a learning tool with which the student checks the degree of understanding and assimilation achieved.

4.3. Syllabus

Origin of biomedical signals. Electroencephalogram, electromyogram, electrocardiogram, photoplethysmography
Noise sources in biomedical signals. Electrical noise, baseline, physiological noise, motion artifacts.
Analysis of biomedical signals in time and frequency domain.
Digital signal filtering. FIR Filters and IIR Filters. Filter design.
Examples of representative applications with biomedical signals: noise reduction, event detection, feature extraction.

4.4. Course planning and calendar

The subject's schedule will be determined by the academic calendar that the center establishes for the corresponding course, including the exam dates of the official calls that can be consulted on the website of the Center (Escuela Universitaria Politécnica de Teruel, https: // eupt.unizar.es/).
The deadlines and follow-up of the works will be announced sufficiently in advance in class, as well as through the digital platform for the subject available at https://moodle.unizar.es/.
Each teacher will report their office hours.

4.5. Bibliography and recommended resources

http://psfunizar10.unizar.es/br13/egAsignaturas.php?codigo=68960