69319 - Analysis of medical images

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. It is based on a practical orientation where all methodologies employed during the course will be illustrated with real examples. In some cases, the same examples will be used to present and compare the performance of several methodologies. Therefore, the learning process will be driven by projects and examples, which will cover the following topics:

1. Representation and visualization of medical images. MRI, CT, ultrasound images.

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2. Segmentation of medical images. Voxel-wise methods. Regions of interest methods. Model-based methods. Brain tumor segmentation.
3. Registration of medical images. Rigid and non-rigid registration. Computational anatomy. Brain morphometry.
4. Statistical shape analysis. Group-level inference for clinical trials and disease undertanding. Individual-level inference for image-based diagnosis.

5.2.Learning tasks

The course includes the following learning tasks:

- **A01 Lectures** (18 hours). The set of lectures will be devoted to introduce the concepts, to show illustrating examples. During these lectures both teacher and students will make use of the computer during the class.
- **A04 Laboratory sessions** (4 hours). A minimum of two sessions (two hours each) will take place in a computer room. The students will have to prepare a short project which will be previously announced and available through the Moodle platform https://moodle.unizar.es/.
- **A03 Projects.** Each individual student will make a project under the guidance of the teacher. This project will be evaluated with a short document and with an oral presentation.
- **A06 Tutorials.** The teacher will be available to the students for helping them in their learning process, either in small groups or individually. A minimum of six hours will be offered per week.
- **A08 Assessment.** A set of tests will be taken during the course, with either a theoretical or practical orientation. These activities are described in more detail in the Assessment Section. These activities will help to monitor and to assess the quality of the individual learning process for each student.

5.3.Syllabus

The course will address the following topics:

1. Basic concepts of medical imaging. Imaging modalities. Representation and visualization of medical images. Image formats: DICOM, Analyze, Nifty. Pipelines of medical image analysis.
2. Segmentation of medical images.
    - Thresholding. Morphological filtering.
    - Probabilistic models for image segmentation
    - ITK-SNAP tool.
3. Registration of medical images.
    - Rigid and non-rigid registration.
    - Deformation models: parametric and non-parametric.
    - Toolbox FAIR
4. Statistical shape analysis.
    - Shape descriptors. Pose definition
    - Hypothesis testing. Multiple comparison correction.

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 and Moodle https://moodle.unizar.es/.

5.5.Bibliography and recommended resources

BC	Dhawan, A. Medical image analysis / A Dhawan. J. Wiley & Sons Inc, New Jersey, 2011.
BC	Hajnal, J. Medical image registration / J. Hajnal, D. Hill, D. Hawkes CRC Press, Florida, 2001.
BC	Handbook of medical image processing and analysis [Recurso electrónico] / edited

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by Issac N. Bankman. . 2nd ed. Academic Press, San Diego, 2000.

BC Moderstizki, J. FAIR, Flexible algorithms for image resgistration / J. Moderstizki . SIAM, Philadelphia, 2009.

BC Toennies, K . Guide to medical image analysis, methods and algorithms / K. Toennies . Springer, London, 2012.