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Image processing and reconstruction

Academic Year: (2018 / 2019)   **Review date: 09-05-2018**

Department assigned to the subject: Bioengineering and Aeroespace Engineering Department

Coordinating teacher: PASCAU GONZALEZ GARZON, JAVIER

Type: Compulsory ECTS Credits : 6.0

Year : 3 Semester : 2

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)
-        Introduction to bioengineering
-        Systems and signals

OBJECTIVES
The course provides basic knowledge on digital image processing focused on medical image data. After completion of the course the student will understand concepts as sampling, quantization, noise or interpolation in the field of 3D imaging, and specifically for every medical image modality. Students will acquire skills to process digital images in the spatial and frequency domain, and will be able to use some advanced techniques as morphological processing or segmentation.

DESCRIPTION OF CONTENTS: PROGRAMME
1.   Basic introduction to medical image processing. Visual Perception.
2.   Image Sampling and Quantization.
3.   Interpolation and geometrical transformations.
4.   Image enhancement in the spatial domain: Point processing
5.   Color. Image file formats.
6.   Image enhancement in the spatial domain: Filtering
7.   Morphological processing
8.   Image enhancement in the frequency domain
9.   Medical Image segmentation
10.   Image compression
11.   Medical Imaging Modalities: conventional radiology, CT, Nuclear imaging, MR, US.

LEARNING ACTIVITIES AND METHODOLOGY
Teaching methodology will be mainly based on lectures, seminars and practical sessions.

Students are required to read assigned documentation before lectures and seminars. Lectures will be used by the teachers to stress and clarify some difficult or interesting points from the corresponding lesson, previously prepared by the student. Seminars will be mainly dedicated to interactive discussion with the students, present and evaluate homework.

Grading will be based on continuous evaluation (including short-exams, homework, group essays, practical sessions, and student participation in class and Aula Global) and a final exam covering the whole subject. Help sessions and tutorial classes will be held prior to the final exam.

Attendance to lectures, short-exams or submission of possible homework is not compulsory. However, failure to attend any exam or submit the exercises before the deadline will result in a grade of 0 in the corresponding exercise and will influence the final continuous evaluation score.

The practical sessions may consist on laboratory work or visits to research or clinical centers. A laboratory report will be required for each of them. Homework exercises will also be a very important contribution, since they will imply solving a specific problem, proposing an algorithm and implement it using computer tools. The attendance to 80% of practical sessions is mandatory. Failure to hand in the laboratory reports on time or unjustified lack of attendance will result in 0 marking for that practice session.

ASSESSMENT SYSTEM
Continuous evaluation: It accounts for up to 40% of the final score of the subject, and includes three components:

1) Short-exams: These exams will take place mostly during seminars, and will be announced at least one week in advance.

2) Practical sessions and homework exercises: They will be assessed through quizzes or exercises to be

solved in groups or individually or a laboratory notebook or report in that will be handed in at the end of each practical session. Attendance to at least 80% of the practical sessions is mandatory; otherwise the score will be 0 in this item.

3) Student participation: It includes contribution to seminars, forum in Aula Global, attitude, or other activities.

Final exam: The final exam will cover the whole subject and will account 60 % of the final score. The minimum score in the final exam to pass the subject is 4.0 over 10, notwithstanding the mark obtained in continuous evaluation.

Extraordinary exams: The mark for students attending any extraordinary examination will be the maximum between:
a) 100% exam
b) 60% exam and 40% continuous evaluation if it is available in the same course

Academic conduct: All exams will be closed-book, closed-notes, no PC or mobile phone, or anything else other than a writing implement and the exam itself. Plagiarism, cheating or other acts of academic dishonesty will not be tolerated. Any infractions whatsoever will result in a failing grade.

% end-of-term-examination:	60
% of continuous assessment (assigments, laboratory, practicals…):	40

BASIC BIBLIOGRAPHY

- G. Dougherty Digital Image Processing for Medical Applications, Cambridge University Press, 2009

- R. C. Gonzalez, R. E. Woods Digital Image Processing, Pearson Education, 2008

ADDITIONAL BIBLIOGRAPHY

- H.C. Russ The Image Processing Handbook, CRC Press Inc, 2011

- P. Suetens Fundamentals of Medical Imaging, Cambridge University Press, 2009