Digital image processing

Academic Year: **(2022 / 2023)**   **Review date: 09/05/2022 12:13:14**

Department assigned to the subject: Signal and Communications Theory Department

Coordinating teacher: DIAZ DE MARIA, FERNANDO

Type: Compulsory ECTS Credits : 6.0

Year : 3 Semester : 2

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Linear Systems
Video System Engineering

OBJECTIVES

- Know the mathematical and statistical foundations of Digital Image Processing, emphasizing linear processing.
- Know the main sources of image degradation, and the possibilities of image restoration techniques.
- Know the basic components of image analysis and image understanding systems.
- Know elementary strategies for image segmentation, feature extraction, morphological processing and object recognition.
- Know the basic tools for processing image sequences.
- Use a specific software environment to implement image processing algorithms.
- Implement and use basic processing tools: linear and non-linear local processing, image transform, morphological operators, basic methods for feature extraction and segmentation.
- Solve complex image processing problems through the combination of basic processing blocks.
- Design strategies and image processing algorithms for solving specific problems.

DESCRIPTION OF CONTENTS: PROGRAMME

0. Introduction. Applications of Digital Image Processing
1. Digital image and Video
2. Pointwise transformations
3. Filtering
4. Edge detection
5. Geometric transformations
6. Image Processing in the Frequency Domain
7. Image restoration
8. Segmentation
9. Morphological image processing
10. Image Descriptors
11. Introduction to Neural Networks (NNs)
12. Convolutional Neural Networks (CNNs) for image classificacion
13. CNNs for object detection and segmentation

LEARNING ACTIVITIES AND METHODOLOGY

The course will be organized around two types of class sessions: theoretical and laboratory.

THEORY

The theoretical classes will consist of conventional oral sessions by the teacher, with the aim to present and discuss the fundamental concepts and tools for digital image processing, providing the students with the opportunity to ask and resolve whatever questions arise during learning. Slides, blackboard and software demonstrations will be used to support the session.

LAB SESSIONS

Between 25% and 40% of the course will be developed in the laboratory, with the following objectives (1) to get some skills in the use of an Image Processing Software, (2) use the image processing tools to visualize the eficacy of the methods discussed during the theoretical sessions, (3) solve simple image processing problems, and (4) complete a final lab project oriented to solve a complex problem.

ASSESSMENT SYSTEM

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

The final student grade will be computed as a weighted sum of the grades of the mid-term exam, the final lab project and the final exam. Additionally, a minimum score of 4/10 on the final exam is required to pass the course.

The final lab project will be evaluated according to: the justification of the engineering decisions taken to solve the stated problems, the efficient use of the available softwar, the quality of the experimental results, and the critical analysis carried out by the students. In addition, the quality of the technical report, the software, and the oral presentations is evaluated, as well as the fullfiment of the requirement to acknowledge external sources and to provide original contributions, that is taken into account to compute the final score.

The final exam will be used to evaluate the knowledge acquisition of the theoretical concepts, as well as the acquired skills to design strategies for solving complex image processing problems.

BASIC BIBLIOGRAPHY

 - Rafael C. González and Richard E. Woods Digital Image Processing. Fourth Edition, Pearson, 2018

 - Wilhelm Burger and Mark J. Burge Principles of Digital Image Processing: Fundamental Techniques, Springer-Verlag, 2009

 - Wilhelm Burger and Mark J. Burge Principles of Digital Image Processing: Core Techniques, Springer-Verlag, 2009