Computer Vision

Academic Year: (2023 / 2024) **Review date: 31-01-2024**

Department assigned to the subject: Signal and Communications Theory Department

Coordinating teacher: GONZALEZ DIAZ, IVAN

Type: Electives ECTS Credits : 6.0

Year : 1 Semester : 2

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Machine Learning
Statistical Signal Processing
Biomedical Image Processing
Deep learning

OBJECTIVES

Students are expected to achieve the following goals:
- Learn how images are formed both in the human visual system and in digital cameras, attending both to photometric and geometric dimensions.
- Know well-known algorithms that implement processes of human vision: extraction of visual features, motion estimation, stereopsis (2-view geometry), structure from motion (n-view geometry) image registration, object tracking, visual recognition.
- Apply the knowledge acquired in previous related subjects (e.g. machine learning, deep learning) to the field of computer vision.
- Solve practical problems related to computer vision
- Design and develop a scientific-technical project that involves the use of computer vision techniques.

DESCRIPTION OF CONTENTS: PROGRAMME

Block 1: image Formation
- Topic 1: Light, shading and color.
- Topic 2: Geometric Camera Models and Camera Calibration

Block 2: Early Vision
- Topic 3: Local Invariant Features
- Topic 4: Motion Estimation and Optical Flow
- Topic 5: Stereopsis and Structure from Motion

Block 3: Mid-level Vision
- Topic 6: Object Tracking
- Topic 7: Image Registration: rigid and deformable

Block 4: High-level Vision
- Topic 8: Object Recognition & Image Classification with Convolutional Neural Networks
- Topic 9: Other applications of Deep Learning in images: object detection, segmentation, image matching, etc.

LEARNING ACTIVITIES AND METHODOLOGY

LEARNING ACTIVITIES

We will consider the following learning activities:
AF3 Theoretical practical classes

AF4 Laboratory practices
AF5 Tutorials
AF6 Team work
AF7 Student individual work
AF8 Partial and final exams

METHODOLOGIES
MD1: Class lectures by the professor with the support of computer and audiovisual media, in which the main concepts of the course are developed and complemented
with bibliography.
MD2: Critical reading of texts recommended by the professor of the course.
MD3: Resolution of practical cases, problems, etc. .... posed by the teacher individually or in groups.
MD4: Presentation and discussion in class, under the moderation of the professor, of topics related to the content of the course, as well as case studies.
MD5: Elaboration of works and reports individually or in groups.

TUTORING REGIME
There will be 2 hours a week of tutorials for students where the teacher will be available in his office.

ASSESSMENT SYSTEM

% end-of-term-examination:	0
% of continuous assessment (assigments, laboratory, practicals…):	100

SE2: Individual or team work done during the course

Continuous assessment (SE2=100%) based on the following aspects :

- Evaluation of laboratory and presentation / study scientific articles on topics of interest (50%).
- Development of a final project related to the subject of the course (50%).

In the extraordinary call, the student can chose one of the following two options:
- To repeat some laboratories or the final project to improve the qualifications and be evaluated following the same rules as in the ordinary call.
- To make a single exam about the contents of the course with a 100% of the grade.

BASIC BIBLIOGRAPHY

- Forsyth, Ponce Computer Vision: A Modern Approach, Pearson, 2012

- Ian Goodfellow, Yoshua Bengio, Aaron Courville Deep Learning, The MIT Press, Cambrigde, Massachussetts, London, England, 2016

- Richard Hartley & Andrew Zisserman Multiple View Geometry in Computer Vision, Cambridge University Press, 2003

- Richard Szeliski Computer Vision: Algorithms and Applications, Springer-Verlag, 2011