Syllabus

Subject

Subject / Group	22437 - Industrial Vision / 5
Degree	Degree in Automation and Industrial Electronic Engineering - Fourth year Degree in Computer Engineering (2014 syllabus) - Third year
Credits	6
Period	2nd semester
Language of instruction	English

Professors

Lecturers	Office hours for students					
	Starting time	Finishing time	Day	Start date	End date	Office / Building
Yolanda González Cid *Responsible* yolanda.gonzalez@uib.es	12:30	13:30	Tuesday	01/09/2019	31/07/2020	219/Anselm Turmeda. Es imprescindible solicitar cita previa por correo electrónico.

Context

This subject is included within the module called “Automation and Robotics”. Every subject of this module is optional. However, those students who take at least three of them will acquire deep knowledge about topics related to automation and robotics. In particular, this subject purports to initiate the student in the basics of image processing algorithms and their applications.

Requirements

Image Processing refers to processing of a 2D picture by a computer. The so called Computer Vision can be defined as the process by which information about the world around us is automatically obtained from one or more two-dimensional images. Computer vision is a continuing growing discipline due to the wide range of possible applications.

The learning goals of this subject are:

1. Understand the theoretical and practical fundamentals of the image processing algorithms.

2. Be able to apply and combine the basic algorithms in order to resolve more complex problems.

3. Know some of the main areas of applications of Image Processing and Computer Vision.

Recommended

Matlab programming.

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The students should also have taken the following subjects:

- Programación

- Matemáticas para la Ingeniería

Skills

Specific

* The Industrial Automation and Robotics specific skills are broaden

Generic

* T3. Capacity for presenting and defending opinions, ideas and technical reports in public
* T4. Capacity for using English
* T10. Capacity for dealing with problems applying the acquired knowledge to general applications
* T13. Capacity for working on your own

Basic

* You may consult the basic competencies students will have to achieve by the end of the degree at the following address: http://www.uib.eu/study/grau/Basic-Competences-In-Bachelors-Degree-Studies/

Content

Range of topics

---. Topics of this subject .---

1. Digital Image Processing. Introduction.

2. Digital Image Fundamentals.

The human visual system

Light and the electromagnetic spectrum

Image representation

Image sensing and acquisition

Sampling, quantisation and resolution

3. Image Enhancement.

Histogram processing

Point processing

4. Image Spatial Filtering.

Neighbourhood operations

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Correlation and convolution

Smoothing and sharpening operations

5. Image Restoration: Noise Removal.

Noise models

Noise removal using spatial domain filtering

Periodic noise

Noise removal using frequency domain filtering

6. Segmentation. Edge Detection and Thresholding.

Finding points, lines and edges

Edges: First and second derivative operators. Canny edge detector

Lines: Hough transformation

7. Morphological Image Processing.

Simple morphological operations. Erosion and dilate

Compound operations. Opening and closing

Hit and Miss

Morphological algorithms and applications

8. Image Representation and Description.

9. Image Processing Aplications.

Teaching methodology

In-class work activities (2.4 credits, 60 hours)

Modality	Name	Typ. Grp.	Description	Hours
Theory classes	Master classes	Large group (G)	The lecturer will describe the theoretical and practical fundamentals of the different topics covered in the course. In addition, for each topic the lecturer will provide information on the recommended working method and materials that students should use to autonomously study the subject. These master classes will be distributed throughout the semester. Each session will last from 1 to 2 hours, during which the theoretical descriptions and the resolution of exercises and problems will alternate.	12
Laboratory classes	Laboratory	Medium group (M)	Practical sessions related to the design of image processing algorithms will be organized. These will allow verifying the correct understanding of the techniques described in the theoretical and practical sessions. The student should hand in several reportswith their explained solution on how they deal with the proposed problems during	28

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Modality	Name	Typ. Grp.	Description	Hours
			the semester. This evaluation will assess whether the student knows how to correctly use the procedures and techniques related to some practical aspects of the subject. The students should also defense their answers orally, if required.	
ECTS tutorials	Tutorials for small groups or individuals	Small group (P)	Tutorial sessions will be organized, in which the student will demonstrate to the lecturer their understanding of the theoretical and practical concepts that have been presented in the master classes.	6
Assessment	Oral defence of some topics	Large group (G)	The student will do an oral presentation of different topics related to the content of the subject during the semester. This evaluation will assess whether the student understand those topics and is able to present the main concepts to the rest of the group.	10
Assessment	Written and practical exam	Large group (G)	The student will do a written examination at the end of the semester. This evaluation will assess whether the student has understood the theory and if they know how to correctly use the procedures and techniques that have been presented during the course. The numerical scoring criteria will be provided together with the exam questions.	4

At the beginning of the semester a schedule of the subject will be made available to students through the UIBdigital platform. The schedule shall at least include the dates when the continuing assessment tests will be conducted and the hand-in dates for the assignments. In addition, the lecturer shall inform students as to whether the subject work plan will be carried out through the schedule or through another way included in the Aula Digital platform.

Distance education tasks (3.6 credits, 90 hours)

Modality	Name	Description	Hours
Individual self-study	Study to assimilate the theory described in the sessions.	Each student will have to devote some time to individually assimilate the theoretical contents that were presented by the lecturer in the sessions.	30
Group or individual self-study	Completion of the practical exercises	Each student will have to devote some extra time (besides the time established in the course schedule) to complete the resolution of the problems proposed in the laboratory sessions. The solutions to these problems will have to be delivered for the lecturer to score them. Additionally, the students will be asked to freely participate at Ciència per a Tothom, developing and presenting a practical application to primary and secondary students.	45
Group or individual self-study	Completion of the theoretical report and oral presentation	Each student will have to devote some time (besides the time established in thecourse schedule) to prepare their report and oral presentation.	15

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Specific risks and protective measures

The learning activities of this course do not entail specific health or safety risks for the students and therefore no special protective measures are needed.

Student learning assessment

The skills that have to be acquired in this course will be evaluated by means of a series of assessment procedures associated to each evaluative activity. The table in this section describes, for each evaluative activity, the evaluation technique that will be used, the type of evaluation (recoverable or non-recoverable), the scoring criteria and the weight of the mark in the final mark of the subject (depending on the specific evaluative itinerary). This subject considers a single evaluative itinerary (labelled “A”) which is suitable both for students who can attend to all the sessions and for those who cannot. The students commit themselves to perform all the activities included in the “A” itinerary.

The student will get a numeric mark comprised between 0 and 10 for each evaluative activity. This mark will be used (with the corresponding weight) to compute the final mark of the subject. In order to pass, the student must get a minimum of 5 points in each retrievable activity and a minimum of 3 in each non retrievable activity.

Any student that only takes 1/3 or less of the evaluated activities will get a NP mark.

Frau en elements d'avaluació

In accordance with article 33 of Regulation of academic studies, "regardless of the disciplinary procedure that may be followed against the offending student, the demonstrably fraudulent performance of any of the evaluation elements included in the teaching guides of the subjects will lead, at the discretion of the teacher, a undervaluation in the qualification that may involve the qualification of "suspense 0" in the annual evaluation of the subject".

Laboratory

Modality	Laboratory classes
Technique	Student internship dissertation **(retrievable)**
Description	Practical sessions related to the design of image processing algorithms will be organized. These will allow verifying the correct understanding of the techniques described in the theoretical and practical sessions. The student should hand in several reportswith their explained solution on how they deal with the proposed problems during the semester. This evaluation will assess whether the student knows how to correctly use the procedures and techniques related to some practical aspects of the subject. The students should also defense their answers orally, if required.
Assessment criteria	Correctness of the proposed solutions, the quality of the delivered documentation and the students lab work. Every lab activity have to be delivered to obtain a Laboratory qualification. Both the digital solution and the hard copy should be delivered before the deadline. Not delivering both of them, implies that the lab activity will be considered not delivered. The delay handing lab solutions will mean a penalty of one point per day of delay, with a maximum delay of 10 days. Oral defense of the proposed solutions could also be required.

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Assessed skills: T4, T10 and T13.

Final grade percentage: 50%with a minimum grade of 5

Oral defence of some topics

Modality	Assessment
Technique	Oral tests **(non-retrievable)**
Description	The student will do an oral presentation of different topics related to the content of the subject during the semester. This evaluation will assess whether the student understand those topics and is able to present the main concepts to the rest of the group.
Assessment criteria	The student will do an oral presentation of different topics related to the content of the subject. Correctness of the explanations given during the presentation and the ability to express and defend an idea in English. The quality of the delivered report is also evaluated. The student have to make the oral presentations to obtain a Oral test qualification. Assessed skills: T3 andT4.

Final grade percentage: 30%with a minimum grade of 3

Written and practical exam

Modality	Assessment
Technique	Other methods **(retrievable)**
Description	The student will do a written examination at the end of the semester. This evaluation will assess whether the student has understood the theory and if they know how to correctly use the procedures and techniques that have been presented during the course. The numerical scoring criteria will be provided together with the exam questions.
Assessment criteria	Correctness of the answers which have to be properly explained and justified. The exam has two parts. The theoretical part which represents 80% of the written exam mark and the practical one, related to lab activities, which represents the 20% of the written exam mark. Assessed skills: T4, T10 and T13.

Final grade percentage: 20%with a minimum grade of 5

Resources, bibliography and additional documentation

Basic bibliography

- *Digital Image Processing (3rd Edition),*Rafael C. Gonzalez, Richard E. Woods Publisher: Prentice Hall; 3 edition (August 31, 2007)
ISBN-10: 013168728X,ISBN-13: 978-0131687288
- *Digital Image Processing Using MATLAB, 2nd ed.,*Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins Publisher: Gatesmark Publishing; 2nd edition (2009)
ISBN-10: 0982085400,ISBN-13: 978-0982085400
- AulaDigitlal: the subject webpage.

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Complementary bibliography

-*Robotics, Vision and Control: Fundamental Algorithms in MATLAB*, Peter Corke Publisher: Springer; 1st ed. 2011 edition (March 1, 2013)
ISBN-10: 3642201431,ISBN-13: 978-3642201431
- *Matlab, Second Edition: A Practical Introduction to Programming and Problem,*Stormy Attaway Publisher: Butterworth-Heinemann; 2 edition (August 11, 2011)
ISBN-10: 0123850819,ISBN-13: 978-0123850812
- *Essential matlab for engineers and scientists* Brian H. Hahn and Daniel T. Valentine Publisher: Academic Press, 2010
ISBN:9780123748836

Other resources

- http://homepages.inf.ed.ac.uk/rbf/CVonline/

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