# University of the Balearic Islands

Teaching guide

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|---|---|
| Academic year | 2013-14 |
| Subject | 22437 - Industrial Vision |
| Group | Group 5, 2S, GEEI |
| Teaching guide | A |
| Language | English |

## Subject identification

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|---|---|
| **Subject** | 22437 - Industrial Vision |
| **Credits** | 2.4 in-class (60 hours) 3.6 distance (90 hours) 6 totals (150 hours). |
| **Group** | Group 5, 2S, GEEI(Campus Extens) |
| **Teaching period** | 2nd semester |
| **Teaching language** | English |

### Lecturers

| Lecturers | Timetable for student attention | | | | | |
|---|---|---|---|---|---|---|
| | **Starting time** | **Finishing time** | **Day** | **Start date** | **Finish date** | **Office** |
| Emilio García Fidalgo<br>emilio.garcia@uib.es | There are no defined sessions | | | | | |
| Yolanda González Cid<br>yolanda.gonzalez@uib.es | 12:30h | 13:30h | Thursday | 05/09/2013 | 24/07/2014 | 155 (Planta 1 del Anselm Turmeda) |
| Joan Pons Mayol<br>joan.pons@uib.es | 14:30h | 15:30h | Tuesday | 23/09/2013 | 28/02/2014 | Laboratori de robòtica o Despatx associats |

### Degrees where the subject is taught

| Degree | Character | Course | Studies |
|---|---|---|---|
| Degree in Industrial Engineering | Optional | Fourth year | Degree |
| Degree in Computer Engineering | Optional | Third year | Degree |

## Contextualisation

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:



Date of publication: 05/09/2013

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.

### Recommendable

Basic knowledge of Matlab programming.

The students should also have taken the following subjects:

o Programación

o Matemáticas para la Ingeniería

o Estadística

o Regulación Automática

o Robótica

## Skills

### Specific

1. The Industrial Automation and Robotics specific skills are broaden.

### Generic

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

## Content

### Theme content

---. 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



Date of publication: 05/09/2013

**3. Image Enhancement.**

Histogram processing

Point processing

**4. Image Spacial Filtering.**

Neighbourhood operations

Smoothing and sharpening operations

Correlation and convolution

**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 proccesing.**

Simple morphological operations. Erosion and dilate

Compound operations. Opening and closing

Morphological algorithms

## Teaching methodology

### In-class work activities

| Modality | Name | Typ. Grp. | Description |
|---|---|---|---|
| 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.<br>Each session will last from 1 to 2 hours, during which the theoretical descriptions and the resolution of exercises and problems will alternate. |
| 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.<br><br>The student should hand in several reports with their explained solution on how they deal with the posed problems during the semester. This |



Date of publication: 05/09/2013

| Modality | Name | Typ. Grp. | Description |
|---|---|---|---|
| | | | evaluation will assess whether the student knows how to correctly use the procedures and techniques related to some practical aspects of the subject. |
| ECTS tutorials | Tutorials for small groups or individuals | Small group (P) | Tutorial sessions will be organized, in which the student will demonstrateto the lecturer their understanding of the theoretical and practical concepts that have been presented in the master classes. |
| 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 thesemester. 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 | 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. |

## Distance education work activities

| Modality | Name | Description |
|---|---|---|
| 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. |
| Group or individual self-study | Completion of the practical exercises started in the laboratory | 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. |
| Group or individual self-study | Completion of the theoretical report and oral presentation | Each student will have to devote sometime (besides the time established in thecourse schedule) to prepare their report and oral presentation. |

## 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.

# Workload estimate

| Modality | Name | Hours | ECTS | % |
|---|---|---|---|---|
| **In-class work activities** | | **60** | **2.4** | **40** |
| Theory classes | Master classes | 12 | 0.48 | 8 |
| Laboratory classes | Laboratory | 28 | 1.12 | 18.67 |
| | **Total** | **150** | **6** | **100** |



Date of publication: 05/09/2013

| Modality | Name | Hours | ECTS | % |
|---|---|---|---|---|
| ECTS tutorials | Tutorials for small groups or individuals | 6 | 0.24 | 4 |
| Assessment | Oral defence of some topics | 10 | 0.4 | 6.67 |
| Assessment | Written and practical exam | 4 | 0.16 | 2.67 |
| **Distance education work activities** | | **90** | **3.6** | **60** |
| Individual self-study | Study to assimilate the theory described in the sessions. | 30 | 1.2 | 20 |
| Group or individual self-study | Completion of the practical exercises started in the laboratory | 45 | 1.8 | 30 |
| Group or individual self-study | Completion of the theoretical report and oral presentation | 15 | 0.6 | 10 |
| | **Total** | **150** | **6** | **100** |

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 Campus Extens platform.

## 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 evaluative activity.
Any student that takes the written exam will be considered as evaluated and will get a final mark.

### Laboratory

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| 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 reports with their explained solution on how they deal with the posed 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. |
| Assessment criteria | Correctness of the proposed solutions and the quality of the delivered documentation.<br><br>Assessed skills: T4, T10 and T13. |

Percentage of final qualification: 35% following path A



Date of publication: 05/09/2013

### Oral defence of some topics

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| 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 thesemester. 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 | Correctness of the explanations given during the presentation and the ability to express and defend an idea in English.<br><br>The quality of the delivered report is also evaluated.<br><br>The student will do an oral presentation of different topics related to the content of the subject.<br><br>Assessed skills: T3 andT4. |

Percentage of final qualification: 30% following path A

### Written and practical exam

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|---|---|
| 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.<br><br>The exam has two parts. The theoretical part which represents 20% of the mark in the final mark of the subject and the practical one, which represents the 15%.<br><br>Assessed skills: T4, T10 and T13. |

Percentage of final qualification: 35% following path A

## Resources, bibliography and additional documentation

### Basic bibliography

- *Digital Image Processing (3rd Edition),*Rafael C. Gonzalez, Richard E. Woods
- *Digital Image Processing Using MATLAB, 2nd ed.,*Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins
- UIBdigitlal: the subject webpage.

### Complementary bibliography

-*Robotics, Vision and Control: Fundamental Algorithms in MATLAB*, Peter Corke
- *Matlab, Second Edition: A Practical Introduction to Programming and Problem,*Stormy Attaway
- *Essential matlab for engineers and scientists* Brian H. Hahn and Daniel T. Valentine

### Other resources

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



Date of publication: 05/09/2013