Course guide
310625 - 310625 - Digital Image Processing

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Unit in charge:	Barcelona School of Building Construction
Teaching unit:	751 - DECA - Department of Civil and Environmental Engineering.

Degree:	BACHELOR'S DEGREE IN GEOINFORMATION AND GEOMATICS ENGINEERING (Syllabus 2016). (Compulsory subject).

Academic year: 2023   **ECTS Credits:** 6.0   **Languages:** Catalan

LECTURER

Coordinating lecturer: ALBERT PRADES VALLS

Others:

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. Capacity of spatial vision and knowlege of the graphic representation techniques, for traditional methods of metric and geometric geometry but also for applications of assisted design by a computer.

2. Capacity for the resolution of mathematic problems that can be set out in engineering. Aptitude to apply the knowledge about: linear algebra, geometry, differential geometry, differential and integral calculus, differential equations and in partial derivates, numeric methods, numeric algorithm, stadistics and optimization.
3. Knowledge, application and analysis of the processes of treatment of digital images and special information, proceding from airborne and satelite sensors.
4. Knowledge, use and application of the treatment techinques. Analysis of special data. Study of models applied to the engineering and architecture.
5. Knowledge, use and application of instruments and appopriate photogrametric methods for the fullfilment of cartographic.
6. Basic knowledge about use and computer programmation, operative systems, databases and software programmes with application in the enginnering.
7. (ENG) Planificació, projecte, direcció, execució i gestió de processos de mesura, sistemes d'informació, explotació d'imatges, posicionament i navegació; modelització, representació i visualització de la informació territorial en, sota i sobre la superfície terrestre.

Generical:
10. Use of teams and instrumental: Capacity to select the necessary ressources to the achievement of the planned goals according to the quality requirements. Use of the teams, in adequated conditions, with professional efficiency and taking into account the limitations of the instruments and its context of use, in relation with the required precissions.

Transversal:
8. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 1. Planning oral communication, answering questions properly and writing straightforward texts that are spelt correctly and are grammatically coherent.
9. TEAMWORK - Level 1. Working in a team and making positive contributions once the aims and group and individual responsibilities have been defined. Reaching joint decisions on the strategy to be followed.
11. EFFECTIVE USE OF INFORMATI0N RESOURCES - Level 1. Identifying information needs. Using collections, premises and services that are available for designing and executing simple searches that are suited to the topic.

TEACHING METHODOLOGY

The directed learning hours consist of theoretical classes (large group) where the teacher makes a brief presentation to introduce the general learning objectives related to the basic concepts of the subject. Subsequently, and through the practices, we try to motivate and involve students to actively participate in their learning.

Support material is used through ATENEA: learning objectives by contents, concepts, examples, programming of evaluation and directed learning activities and bibliography.

The practical sessions are intended to incorporate some generic competencies.

After each session, tasks outside the classroom are proposed, to be worked on individually.

Other hours of autonomous learning must also be considered, such as those dedicated to guided readings and the resolution of the problems proposed on the different contents, through the virtual campus ATENEA.

LEARNING OBJECTIVES OF THE SUBJECT

The intention is that the student acquires the enough knowledge to operate with digital images in order to be able to, the subjects of superior courses related with the photogrametry and remote surveying.

STUDY LOAD

Type	Hours	Percentage
Hours large group	24,0	16.00
Hours medium group	36,0	24.00
Self study	90,0	60.00

Total learning time: 150 h

CONTENTS

Digital image

Description:
The subject starts with the basic topic of digital image:
· Introduction with the digital image.
· Sensors, formative image system, codification.
· Noise in the image: of lecture, termic, from different efficiency, etc.
· Vision systems: monoscopic and estereoscopic.

Related activities:
Activity 1
Activity 2

Full-or-part-time: 30h
Theory classes: 6h
Practical classes: 6h
Self study : 18h

Treatment of digital image

Description:
In this chapter is introduced the bases of image basic treatment.
1) Definition of histogram: Changes of histogram: linear, logarithmic, square root, equalization.
2) Screen in the image space: the product of convolution, filters based in the average.
3) The transformed of Fourier, theorem of sample, screen in the frequence space.
4) Image quality, compression of images
5) Image formats used in geomatics: tiff, geotiff, jpeg2000.

Related activities:
Activity 3

Full-or-part-time: 45h
Theory classes: 6h
Practical classes: 12h
Self study : 27h

Image matching

Description:
For some photogrametric applications some methods are necessary to automate processes. Some methods to identify correspondences between two or more frames are seen in this chapter.
1) Methods based in areas: correlation and minimum quadratic adjustment.
2) Methods based in correspondences of characteristics: detection of points and characteristics of interest, correspondence between characteristics.
3) Operators SIFT and SURF, definition of characteristics, correspondences in relation to these characteristics.

Related activities:
Activity 4

Full-or-part-time: 45h
Theory classes: 6h
Practical classes: 12h
Self study : 27h

Multispectral images

Description:
In this chapter will be seen some treatment methods of multispectral image:
Transformation of principle components, tasseled-head, index of vegetation, quotient of bands.

Related activities:
Activity 5

Full-or-part-time: 30h
Theory classes: 6h
Practical classes: 6h
Self study : 18h

ACTIVITIES

ACTIVITY 1

Description:
Basic use of the program that will be used in the practices of the subject

Specific objectives:
At the end of the practice the student must be capable of using minimally the tools that will be used during the whole course.

Material:
The documentation will be in Atenea. The exercise will be done in the calculus center.

Delivery:
The activity will take place during the first week and is not evaluated.

Full-or-part-time: 1h
Practical classes: 1h

ACTIVITY 2

Description:
A collection of basic introductory exercises to digital imaging will be solved and the topics will be discussed:
· Spatial and spectral discretization: measurements of an image, digital levels, etc.
· Basic statistics on an image: histogram, medium values, average, covariance matrix.
· Changes of histogram: linears, square root, logarythmic, equation and estereocopic vision.

Specific objectives:
At the end of the practice the student must be capable of doing improvements in the digital images using the changes of histogram and build with a stereoscopic even, a tridimensional image.

Material:
The documentation will be in Atenea. The exercise will be done in the calculus center.

Delivery:
The activity will take place between the second and the fouth week and is evaluated with a 10% of the final mark.

Full-or-part-time: 3h 30m
Practical classes: 2h
Laboratory classes: 1h 30m

ACTIVITY 3

Description:
Application of different filters to the images and check their deffects.

Specific objectives:
About an image with some type of deffect, the student must know which type of screen is the most adequated to correct it.

Material:
The documentation will be in Atenea. The exercise will be done in the calculus center.

Delivery:
The activity will take place during the fifht and seventh week and is evaluated with a 10% of the final mark.

Full-or-part-time: 6h
Practical classes: 3h
Laboratory classes: 3h

MIDTERM EXAM

Description:
Written midterm exam evaluated

Delivery:
The activity will take place during the seventh or eighth week and its evaluated with a 20% of the final mark.

Full-or-part-time: 1h
Theory classes: 1h

ACTIVITY 4

Description:
Application of even methods to find correspondence between images.

Material:
The documentation will be in Atenea. The exercise will be done in the calculus center.

Delivery:
The activity will take place during the ninth and the eleventh week and is evaluated with a 10% of the final mark.

Full-or-part-time: 5h
Practical classes: 3h
Laboratory classes: 2h

ACTIVITY 5

Description:
Application of global transformations in a multispectral image

Material:
The documentation will be in Atenea. The exercise will be done in the calculus center.

Delivery:
The activity will take place during the twelveth and the fourteenth week and is evaluated with a 10% of the final mark.

Full-or-part-time: 5h
Practical classes: 3h
Laboratory classes: 2h

FINAL EXAM

Description:
Written final exam evaluated

Material:
The activity will take place at the end of the course and is evaluated with a 40 % of the final mark.

Full-or-part-time: 1h
Theory classes: 1h

GRADING SYSTEM

The final qualification is the addition of the following partial qualifications:

Final mark= 0,1 * activity 2 + 0,1 * activity 3 + 0,1 * activity 4 + 0,1 activity 5 + 0,2 * midterm exam + 0,4 * final exam

BIBLIOGRAPHY

Basic:
- Pinilla Ruiz, Carlos. Elementos de teledetección. Madrid: RA-MA, 1995. ISBN 8478972021.
- González, Rafael C. ; Woods, Richard E. Tratamiento digital de imágenes. 1996. Wilmington: Addison-Wesley, 1996. ISBN 0201625768.
- Schenk, Toni. Fotogrametría digital. Barcelona: Marcombo, 2002. ISBN 843935746X.