University of the Balearic Islands

Teaching guide

Academic year	2014-15
Subject	11302 - Image Processing and Applications
Group	Group 1, 1S
Teaching guide	A
Language	English

Subject identification

Subject 11302 - Image Processing and Applications
Credits 1.2 de presencials (30 hours) 1.8 de no presencials (45 hours) 3 de totals (75 hours).
Group Group 1, 1S (Campus Extens)
Teaching period 1st semester
Teaching language English

Professors

Lecturers	Horari d'atenció alumnes					
	Starting time	Finishing time	Day	Start date	Finish date	Office
Bartomeu Coll Vicens tomeu.coll@uib.es	11:00h	12:00h	Tuesday	01/09/2014	30/06/2015	174, edifici Anselm Turmeda. En qualsevol cas, es pot concertar la tutoria amb els professor
	15:00h	16:00h	Monday	01/09/2014	30/06/2015	174, edifici Anselm Turmeda. En qualsevol cas, es pot concertar la tutoria amb els professor
	11:00h	12:00h	Wednesday	01/09/2014	30/06/2015	174, edifici Anselm Turmeda. En qualsevol cas, es pot concertar la tutoria amb els professor
Ana Belén Petro Balaguer anabelen.petro@uib.es	12:00h	13:00h	Monday	15/09/2014	14/09/2015	Despatx 111, Edifici Anselm Turmeda

Contextualisation

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In the world of new technologies, digital images occupy a central place. Think of digital photography from camera commercial, medical images (X-rays, CT scan, magnetic resonance imaging, etc.), the images obtained from the video surveillance, satellite images that allow us to study on earth, etc.. On a formal level, an image is an application defined on the plane, such that each point (x, y) correspond to a value that makes what is known as gray level or intensity. In the color case, this value is in vector form (R,G,B) which means the Red, Green and Blue information of the image. A discrete or digital imaging comes from the continuous setting and it is defined as a finite sample of a set of small squares centered at the points (i, j). These squares (i, j) 's are called pixels and its associated value is the value of gray level or intensity.
This course will focus on mathematical models to study, between others, the following problems or topics:

to improve the contrast, to clean the image from the noise and disturbances suffered in the process of capture (denoising process), segmentation of the objects contained within the image and compression of the image in order to avoid problems in the transmission of the information.

The teachers:

B. Coll: Bartomeu Coll is full professor and head of the reserach group TAMI (Mathematical Processing and Analysis of Images). His interests focus on the restoration and digital image processing as well as the applications in the field of satellite images and digital photography.

A.B. Petro: Ana Belén Petro belongs to TAMI group. She is a doctor in mathematics from 2006 and her interests focus on the image restoration and appications mainly in the field of color image.

Requirements

Essential requirements

The specific requirements of the master

Recommendable

The specific requirements of the master

Skills

Specific

* CE3: Acquire advanced knowledge in the frontiers of knowledge and demonstrate in the context of internationally recognized scientific research, a full understanding of theoretical and practical aspects in the scientific methodology..
* EMA5: Capacity to perform the various steps in the process of mathematical modeling in image processing courses: problem statement, experimentation / testing, mathematical modeling, simulation / program, discussion of results and refinement / model rethinking.
* EMA6: Learn to determine in the field of digital images if the model of a given problem is well formulated and it is mathematically well-posed in a suitable functional framework..

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Generic

* CG1: Systematic understanding of a field of study and mastery of skills and methods of research associated with that field..

Basic

* You may consult the basic competencies students will have to achieve by the end of the Master's degree at the following address: http://estudis.uib.cat/master/comp_basiques/

Content

Theme content

0. Introduction
   Image formation, image representation
1. Fourier transform and Sampling.
   The 2-D Discrete Fourier Transform

   Sampling. The Shanon theorem

   Filtering in the Frequency domain.
2. Local operators and PDE's
   Edge contourn detection: multiscale theory, classical approach (Canny), LSD model

   Denoising: heat equation, mean curvature motion, total variation

   From local operators to non-local: NL-means, NL-Bayer,
3. Segmentation
   K-means

   Mumford-Shah, Region growing, Region merging, etc.

   Graph-cuts
4. Compression
   Losless compression: png

   PG, DCT, JPEG, JPEG2000

Teaching methodology

In-class work activities

Modality	Name	Typ. Grp.	Description	Hours
Theory classes	Lectures	Large group (G)	In this activity, we will give the theoretical background of the subjects.	14

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Modality	Name	Typ. Grp.	Description	Hours
Practical classes	Practical classes	Medium group (M)	In this activity, the students will do the problems/activities proposed in each subject. In this activity, skills EMA5 and EMA6 will be evaluated.	10
Laboratory classes	Computer laboratory	Medium group (M)	In this activity, from IPOL and MatLab software, the students will do a set of practices. In this activity, skills EMA5 and EMA6 will be evaluated.	6

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.

Distance education work activities

Modality	Name	Description	Hours
Group or individual self-study	Individual self-study or group	In this activity, students will perform a work proposed at the beginning of the course. In this activity, skills CE3, EMA5, EMA6 and CG1 will be evaluated.	45

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

Practical classes

Modality	Practical classes
Technique	Short-answer tests **(non-retrievable)**
Description	In this activity, the students will do the problems/activities proposed in each subject. In this activity, skills EMA5 and EMA6 will be evaluated.

Assessment criteria

Final grade percentage: 25%

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Computer laboratory

Modality	Laboratory classes
Technique	Papers and projects **(non-retrievable)**
Description	In this activity, from IPOL and MatLab software, the students will do a set of practices. In this activity, skills EMA5 and EMA6 will be evaluated.

Assessment criteria

Final grade percentage: 25%

Individual self-study or group

Modality	Group or individual self-study
Technique	Papers and projects **(retrievable)**
Description	In this activity, students will perform a work proposed at the beginning of the course. In this activity, skills CE3, EMA5, EMA6 and CG1 will be evaluated.

Assessment criteria

Final grade percentage: 50%

Resources, bibliography and additional documentation

The bibliography will follow during the course is based on some books on the subject in addition to scientific papers that will serve to the development of the course.

Basic bibliography

R.C. Gonzalez, R.E. Woods, S.L. Eddinds, Digital image processing using MatLab, 2on edition, ISBN 0982085400, 2009.

G. Aubert, P. Kornprobst, Mathematical Problems in Image Processing: Partial Differential Equations and the Calculus of Variations (Applied Mathematical Sciences), ISBN 0387322000, 2006.

Complementary bibliography

Research articles published in scientific journals and other resources.

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