



DIGITAL IMAGE PROCESSING

2024 - DIGITAL IMAGE PROCESSING (2024-25)

General

Code: 20024

Lecturer responsible:

MARTINEZ MARIN, TOMAS

Credits ECTS:

6,00

Theoretical credits:

0,90

Practical credits:

1,50

Distance-base hours:

3,60

Departments involved

- **Dept:** PHYSICS, ENGINEERING SYSTEMS AND SIGNAL THEORY

Area: SIGNAL THEORY AND COMMUNICATIONS

Theoretical credits: 0,9

Practical credits: 1,5

This Dept. is responsible for the course.

This Dept. is responsible for the final mark record.

Study programmes where this course is taught

- [DEGREE IN SOUND AND IMAGE IN TELECOMMUNICATION ENGINEERING](#)

Course type: COMPULSORY (Year: 3)

Competencies and objectives

Course context for academic year 2024-25

Digital Image Processing is a constant evolving subject in its technological aspect, both in processing power and transmission, but also for the breakthrough digital processing techniques have experienced in areas such as filtering, compression and image analysis.

Current and future applications of Digital Image Processing are virtually endless. Digital television, video games, mobile phones, animated films are just some examples of the impact it currently has in the consumer society. In industrial and service applications, machine vision inspection and robotics are of great importance, as well as the great development in remote sensing and medical imaging.

From a historical perspective, digital image processing is a multidimensional generalization of the techniques of one-dimensional digital signal processing (DSP). The origins of DSP back to the nineteenth century, although its practical development does not appear until the sixties, when Cooley and Tukey proposed an efficient algorithm for the calculation of the Fourier transform: The FFT (Fast Fourier Transform). Then, with the advent of microprocessors, specific processors adapted for the calculation of FFT's were designed. These two factors have been very important in the spectacular advance of DSP, which has today penetrated all sectors of society and especially in the digital image processing.

Previous courses required:

20014 - SEÑALES Y SISTEMAS

20015 - TEORÍA DE LA COMUNICACIÓN

20019 - TRATAMIENTO DIGITAL DE SEÑAL

Related courses:

20021 - TELEVISIÓN.

UA Basic Transversal Competences

- **CT10** : Capacitat d'afrontar, projectar i resoldre problemes reals demanats per la societat en l'àmbit de l'enginyeria.
- **CT11** : Capacitat d'aprendre i aplicar, de manera autònoma i interdisciplinària, nous conceptes i mètodes.
- **CT12** : Capacitat d'assimilar l'evolució contínua de la tecnologia en l'àmbit de desenvolupament professional i adaptar-s'hi.
- **CT13** : Capacitat d'adoptar el mètode científic en el plantejament i realització de treballs diversos tant en l'àmbit acadèmic com en el professional.
- **CT14** : Disposar de la capacitat d'autocrítica necessària per a l'anàlisi i millora de la qualitat d'un projecte.
- **CT6** : Capacitat d'utilitzar la llengua anglesa amb fluïdesa per a accedir a la informació tècnica, respondre a les necessitats de la societat, i poder ser autosuficient en la preparació de la seua vida professional.
- **CT7** : Capacitat d'exposició oral i escrita.
- **CT8** : Capacitat de planificar tasques i comprometre's en el compliment d'objectius i terminis.
- **CT9** : Capacitat de treball en grup.

Specific Competences:>>Basic

- **B1** : Capacitat per a resoldre els problemes matemàtics que es pugen plantejar en l'enginyeria. Aptitud per a aplicar els coneixements sobre àlgebra lineal, geometria, geometria diferencial, càlcul diferencial i integral, equacions diferencials i en derivades parcials, mètodes numèrics, algorísmia numèrica, estadística i optimització.
- **B2** : Coneixements bàsics sobre l'ús i programació dels ordinadors, sistemes operatius, bases de dades i programes informàtics amb aplicació en enginyeria.
- **B4** : Comprensió i domini dels conceptes bàsics de sistemes lineals i les funcions i transformades relacionades, teoria de circuits elèctrics, circuits electrònics, principi físic dels semiconductors i famílies lògiques, dispositius electrònics i fotònics, tecnologia de materials i la seua aplicació per a la resolució de problemes propis de l'enginyeria.

Basic Transversal Competences

- **CT2** : Que els estudiants sàpien aplicar els seus coneixements al seu treball o vocació d'una forma professional i posseïsquen les competències que solen demostrar-se per mitjà de l'elaboració i defensa d'arguments i la resolució de problemes dins de la seua àrea d'estudi.
- **CT3** : Que els estudiants tinguen la capacitat de reunir i interpretar dades rellevants (normalment dins de la seua àrea d'estudi) per a emetre judicis que incloguen una reflexió sobre temes rellevants d'índole social, científica o ètica.
- **CT4** : Que els estudiants puguin transmetre informació, idees, problemes i solucions a un públic tant especialitzat com no especialitzat.
- **CT5** : Que els estudiants hagen desenvolupat aquelles habilitats d'aprenentatge necessàries per a emprendre estudis posteriors amb un alt grau d'autonomia.

Specific Competences: >> Competences Specific to Sound and Image

- **E1** : Capacitat de construir, explotar i gestionar serveis i aplicacions de telecomunicacions, enteses aquestes com a sistemes de captació, tractament analògic i digital, codificació, transport, representació, processament, emmagatzematge, reproducció, gestió i presentació de serveis audiovisuals i informació multimèdia.

- **E5** : Capacitat per a crear, codificar, gestionar, difondre i distribuir continguts multimèdia, atenent criteris d'usabilitat i accessibilitat dels serveis audiovisuals, de difusió i interactius.

Exclusive skill taught in this course

No data

Learning outcomes (Training objectives)

No data

Specific objectives stated by the academic staff for academic year 2024-25

SO1: To explore and evaluate the role of different components of a digital image processing.

SO2: Understanding the wide range of present and future applications of digital image processing, both for the visible spectrum images such as those from other sensors (Radar, Ultrasonic, etc.).

SO3: To introduce students to the multidimensional digital signal processing in the field of images (2D) and video (3D).

SO4: To identify the problems of image processing as signal problems of linear systems, whose basic concepts have been acquired in previous courses.

SO5: Extending the theory of sampling and spectral representation to multidimensional signals.

SO6: Differentiate and justify the two major approaches to image processing: processing in the spatial and frequency domains.

SO7: To analyze and implement different techniques of coding and image compression.

SO8: Understanding the image analysis using methods of image segmentation and mathematical morphology.

Content and bibliography

Content for academic year 2024-25

UNIT 1: Fundamentals of image processing. (SO1, SO2, SO4)

Basics. Visual perception. Geometric transformations. Histogram. Point transformations. Histogram equalization.

UNIT 2: Spatial image filtering. (SO3, SO6)

Linear and nonlinear spatial filtering. Adaptive filtering. Mathematical morphology.

UNIT 3: Image Filtering in frequency. (SO3, SO5, SO6)

Introduction to multidimensional processing. The two-dimensional Fourier Transform. Enhancement in the frequency domain. Image restoration. Models of image degradation. Types of noise. Wiener Filter. Adaptive filtering.

UNIT 4: Color image processing. (SO3, SO5)

Introduction. Color models. Format conversion. Techniques for color image processing. Color image segmentation.

UNIT 5: Image Compression. (SO7)

Basics. Models image compression. Information Theory. Encoding methods. Techniques in space and frequency. Standards still image and video compression.

UNIT 6: Image Analysis. (SO8)

Introduction. Segmentation. The Hough transform. Imaging methods. Image recognition.

UNIT 7: Advanced Topics. (SO8)

Artificial neural networks. Principal component analysis. Application to face recognition and tracking people.

Related links

No data

Digital image processing : using MATLAB

Author(s): González, Rafael C.

Issue: Upper Saddle River : Prentice Hall, 2004;

ISBN: 0-13-008519-7

Category: Básico

Digital image processing, fourth edition

Author(s): González, Rafael C.

Issue: Upper Saddle River : Pearson-Prentice Hall, 2018;

ISBN: 978-1-292-22304-9

Category: Básico

Digital image processing, fourth edition

Author(s): González, Rafael C.

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Author(s): González, Rafael C.

Issue: Upper Saddle River : Pearson-Prentice Hall, 2018;

ISBN: 978-1-292-22304-9

Category: Básico

The image processing handbook

Author(s): Russ, John C. ; Neal, F. Brent

Issue: Boca Raton : CRC Press, 2016;

ISBN: 1-4987-4028-6

Category: Complementario

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Author(s): Russ, John C. ; Neal, F. Brent

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Category: Complementario

Assessment

Assessment procedures and criteria 2024-25

General observations

Ordinary exam

mark = Control (12%) + Work (8%) + Theory (50%) + Laboratory (30%)

Observation: The minimum mark in the final exam in order to consider the continuous evaluation is 4 points. In this convocatory, the recovery of the continuous evaluation is not considered. The final work is delivered after Christmas.

Extraordinary exam

mark = Control (12%) + Work (8%) + Theory (50%) + Laboratory (30%)

Observation: Final mark is computed as in the previous evaluation: final exam (50%) plus continuous evaluation (50%) carried out during the course. The mark of the continuous evaluation cannot be upgraded.

Recovery: Theory (50%), Control (12%).

The detection of copy or plagiarism will be marked "0" in the corresponding test. The Department and the Polytechnic School or Faculty will be informed about this incident. The reiteration in the conduct in this or other subject will entail the notification to the corresponding vice-rector of the faults committed so that they study the case and sanction according to the legislation.

Description	Criteria	Type	Weighting system
Classroom	<p>Delivery of reports and midterm test.</p> <p>The theoretical contents are assessed by a test dated on the 7th week for both DIP groups. The test consists of multiple choice questions or short answers about the concepts explained (recoverable in extraordinary exams). Furthermore, a free-format final assignment on a practical application of DIP in image analysis will be carried out (not recoverable in extraordinary exams).</p>	ACTIVITIES OF EVALUATION DURING THE SEMESTER	20
Reports	<p>Delivery of reports</p> <p>In the laboratory, the method of continuous assessment is used, which especially will take into account the strategies employed in solving practicals. In addition, each student or group (2 members) must submit a report after each practical, where the results, discussion and coherence as well as the algorithms and programs implemented will be explained. Seven practicals will be carried out whose results will be submitted in weeks 3, 5, 7, 9, 10, 12 and 14 (30% of the mark, not recoverable in extraordinary exams).</p>	ACTIVITIES OF EVALUATION DURING THE SEMESTER	30
Final exam	<p>Final exam about theoretical concepts</p> <p>At the end of the semester a final exam of the course is performed which will consist of solving several practical exercises of image processing, usually programmed in Matlab. In order to pass the course, the mark in this final exam will be equal or greater than 4 over 10.</p>	FINAL TEST	50

Official exam dates for academic year 2024-25

Exam session	Date	Time	Group - Classroom(s) allocated	Comments
(C1) Pruebas extraordinarias de finalización de estudios	25/09/2024			
(C2) Periodo ordinario para asignaturas de primer semestre	23/01/2025			Teoría

Academic staff



MARTINEZ MARIN, TOMAS

Lecturer responsible

THEORY CLASS: Groups: 1 , 2

COMPUTER PRACTICALS: Groups: 1 , 2



MARTINEZ GUARDIOLA, FRANCISCO JAVIER

THEORY CLASS: Groups: 1 , 2

COMPUTER PRACTICALS: Groups: 1 , 2 , 3

Groups

THEORY CLASS



Group	Semester	Morning or afternoon session	Language	No. of enrolled students	
Gr. 1 (THEORY CLASS) : 1 (ARA)	1S	Morning	English	15	▪ Allowed DEGREE IN SOUND AND IMAGE IN TELECOMMUNICATION ENGINEERING
Gr. 2 (THEORY CLASS) : 2	1S	Morning	Spanish	30	▪ Allowed DEGREE IN SOUND AND IMAGE IN TELECOMMUNICATION ENGINEERING ▪ Allowed MOBILITY PROGRAMME - MASTER LEVEL

COMPUTER PRACTICALS






Group	Semester	Morning or afternoon session	Language	No. of enrolled students	
Gr. 1 (COMPUTER PRACTICALS) : 1 (ARA)	1S	Morning	English	15	▪ Allowed DEGREE IN SOUND AND IMAGE IN TELECOMMUNICATION ENGINEERING
Gr. 2 (COMPUTER PRACTICALS) : 2	1S	All day	Spanish	16	▪ Allowed DEGREE IN SOUND AND IMAGE IN TELECOMMUNICATION ENGINEERING
Gr. 3 (COMPUTER PRACTICALS) : 2	1S	All day	Spanish	14	

Timetables

THEORY CLASS

Group	Start date	End date	Day	Start time	End time	Lecture room
1	09/09/2024	20/12/2024	LUN	12:30	14:00	0016P2008 
2	09/09/2024	20/12/2024	MAR	14:30	16:00	0016P1001 

COMPUTER PRACTICALS

Group	Start date	End date	Day	Start time	End time	Lecture room
1	09/09/2024	20/12/2024	LUN	14:00	14:30	0016P2008 
1	09/09/2024	20/12/2024	MIE	08:30	10:30	0016PB064 
2	09/09/2024	20/12/2024	MAR	16:00	16:30	0016P1001 
2	09/09/2024	20/12/2024	JUE	17:00	19:00	0016P1002 
3	09/09/2024	20/12/2024	MAR	16:00	16:30	
3	09/09/2024	20/12/2024	JUE	19:00	21:00	0016P1002 