UNIVERSITAT POLITÈCNICA
DE CATALUNYA
BARCELONATECH

Course guide
230620 - DIVP - Digital Image and Video Processing

Last modified: 25/05/2023

Unit in charge:	Barcelona School of Telecommunications Engineering
Teaching unit:	739 - TSC - Department of Signal Theory and Communications.

Degree:	MASTER'S DEGREE IN TELECOMMUNICATIONS ENGINEERING (Syllabus 2013). (Optional subject). MASTER'S DEGREE IN ADVANCED TELECOMMUNICATION TECHNOLOGIES (Syllabus 2019). (Optional subject).

Academic year: 2023   **ECTS Credits:** 5.0   **Languages:** English

LECTURER

Coordinating lecturer:	Consultar aquí / See here: https://telecos.upc.edu/ca/estudis/curs-actual/professorat-responsables-coordinadors/responsables-assignatura
Others:	Consultar aquí / See here: https://telecos.upc.edu/ca/estudis/curs-actual/professorat-responsables-coordinadors/professorat-assignat-idioma

PRIOR SKILLS

Basic knowledge in signal and systems and signal processing.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. Ability to apply information theory methods, adaptive modulation and channel coding, as well as advanced techniques of digital signal processing to communication and audiovisual systems.
2. Ability to design and dimension transport, broadcast and distribution networks for multimedia signals
3. Ability to integrate Telecommunication Engineering technologies and systems, as a generalist, and in broader and multidisciplinary contexts, such as bioengineering, photovoltaic conversion, nanotechnology and telemedicine.
4. Ability to model, design, implement, manage, operate, administrate and maintain networks, services and contents

Transversal:
5. TEAMWORK: Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.

6. EFFECTIVE USE OF INFORMATION RESOURCES: Managing the acquisition, structuring, analysis and display of data and information in the chosen area of specialisation and critically assessing the results obtained.

7. FOREIGN LANGUAGE: Achieving a level of spoken and written proficiency in a foreign language, preferably English, that meets the needs of the profession and the labour market.

TEACHING METHODOLOGY

- Lectures
- Individual work (distance)
- Exercises
- Short answer test (Control)
- Extended answer test (Final Exam)

LEARNING OBJECTIVES OF THE SUBJECT

Learning objectives of the subject:

This course provides a general view of basic techniques for digital image and video processing. The study of these techniques is based on different models of the image and the type of applications targeted by each model. Topics covered in the course are linear and non-linear filtering, enhancement and restoration, coding as well as vision systems and industrial and biomedical applications. The analysis of still images is considered first and, then, it is extended to the case of image sequences (video).

Learning results of the subject:

- Ability to understand, use, design or specify basic image or video processing algorithm in the context of a complete application.
- Knowledge about the most popular image processing tools.

STUDY LOAD

Type	Hours	Percentage
Hours large group	39,0	31.20
Self study	86,0	68.80

Total learning time: 125 h

CONTENTS

1. Introduction

Description:
- Digital images definition & formation,
- Human visual system

Full-or-part-time: 8h
Theory classes: 4h
Self study : 4h

2. Low-level image representation - the Pixel

Description:
Pixel-based model: Luminance and color,
Practical study 1: Visualisation Equalisation
Practical study 2: Image search

Full-or-part-time: 7h
Theory classes: 3h
Self study : 4h

3. Space-frequency representation of images

Description:
Image filtering, 2D convolution and correlation. Practical study: Restoration
Fourier analysis DCT, DFT. Practical study 2: Resolution
Multiresolution: Pyramid , Wavelet, Convolutional Neural Network. Practical study: Noise reduction, Classification

Full-or-part-time: 26h 40m
Theory classes: 10h
Self study : 16h 40m

4. Shape and image - geometric structures

Description:
Geometrical transforms, Practical study 1: Image registration
Hough transform, Practical study 2: Road detection in remote sensing, Soccer field analysis
Mathematical morphology, Practical study 3: Biomedical and industrial applications.

Full-or-part-time: 26h
Theory classes: 11h
Self study : 15h

5. Region-based processing

Description:
Contour-texture image model, Segmentation. Deep learning.
Practical study: Biomedical applications, Photography, Unsupervised segmentation, object interaction

Full-or-part-time: 22h 20m
Theory classes: 13h 20m
Self study : 9h

6. Video processing

Description:
Pixel-based model. Practical study 1: Surveillance system.
Space-frequency model. Practical study 2: Mosaic creation.
Geometrical model. Practical study 3: Video restoration
Region-based model. Practical study 4: Shot detección, object tracking.

Full-or-part-time: 23h
Theory classes: 8h
Self study : 15h

ACTIVITIES

Homework

Description:
- Pixel-based processing
- Transformed domain and linear filters
- Multi-frequency analysis & coding
- Mathematical morphology
- Segmentation

Full-or-part-time: 10h
Theory classes: 10h

Exercise done in class

Description:
Exercises to strengthen the theoretical knowledge on each course section.

Full-or-part-time: 4h
Theory classes: 4h

Short answer test (Control)

Description:
Mid term control.

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

Final exam

Description:
Final examination.

Full-or-part-time: 2h
Theory classes: 2h

GRADING SYSTEM

Final examination: from 50%
Partial examinations and controls:25%
Individual assessments: 25%

BIBLIOGRAPHY

Basic:
- González, R.C.; Woods, R.E. Digital image processing [on line]. 4th ed.; global ed. New York: Pearson, 2018 [Consultation: 03/07/2020]. Available on: https://ebookcentral.proquest.com/lib/upcatalunya-ebooks/detail.action?docID=5573669. ISBN 1292223049.

Complementary:

- Pratt, W.K. Digital image processing: PIKS scientific inside. 4th ed. New York: John Wiley, 2007. ISBN 9780471767770.

RESOURCES

Other resources:
Lectures notes and Problems collection.