



## Course guides

# 230620 - DIVP - Digital Image and Video Processing

**Last modified:** 29/04/2020

**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:** 2020    **ECTS Credits:** 5.0    **Languages:** English

### LECTURER

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**Coordinating lecturer:** PHILIPPE SALEMBIER

**Others:** Philippe Salembier

### PRIOR SKILLS

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Basic knowledge in signal and systems and signal processing.

### DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

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**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

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- 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. Practical study: Noise reduction

**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

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### 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

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Final examination: from 50%

Partial examinations and controls: 25%

Individual assessments: 25%

## BIBLIOGRAPHY

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**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

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### Other resources:

Lectures notes and Problems collection.