230620 - DIVP - Digital Image and Video Processing

Coordinating unit: 230 - ETSETB - Barcelona School of Telecommunications Engineering
Teaching unit: 739 - TSC - Department of Signal Theory and Communications
Academic year: 2019
Degree: MASTER'S DEGREE IN ADVANCED TELECOMMUNICATION TECHNOLOGIES (Syllabus 2019). (Teaching unit Optional)
MASTER'S DEGREE IN TELECOMMUNICATIONS ENGINEERING (Syllabus 2013). (Teaching unit Optional)
ECTS credits: 5
Teaching languages: English

Teaching staff
Coordinator: PHILIPPE SALEMBIER
Others: Philippe Salembier

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.

<table>
<thead>
<tr>
<th>Study load</th>
<th>Hours large group:</th>
<th>39h</th>
<th>31.20%</th>
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<tr>
<td></td>
<td>Hours medium group:</td>
<td>0h</td>
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<td>Hours small group:</td>
<td>0h</td>
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<td></td>
<td>Guided activities:</td>
<td>0h</td>
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<td>Self study:</td>
<td>86h</td>
<td>68.80%</td>
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## 1. Introduction

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

**Learning 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

**Learning 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

**Learning 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.

**Learning time:** 26h
- Theory classes: 11h
- Self study: 15h
## 5. Region-based processing

**Learning time:** 22h 20m  
Theory classes: 13h 20m  
Self study: 9h

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

## 6. Video processing

**Learning time:** 23h  
Theory classes: 8h  
Self study: 15h

**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 detection, object tracking.
Planning of activities

<table>
<thead>
<tr>
<th><strong>Homework</strong></th>
<th><strong>Hours:</strong> 10h</th>
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<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>Theory classes: 10h</td>
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<tr>
<td>- Pixel-based processing</td>
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<td>- Transformed domain and linear filters</td>
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<tr>
<td>- Multi-frequency analysis &amp; coding</td>
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<td>- Mathematical morphology</td>
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<td>- Segmentation</td>
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<table>
<thead>
<tr>
<th><strong>Exercise done in class</strong></th>
<th><strong>Hours:</strong> 4h</th>
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<tr>
<td><strong>Description:</strong></td>
<td>Theory classes: 4h</td>
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<tr>
<td>Exercises to strengthen the theoretical knowledge on each course section.</td>
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<th><strong>Short answer test (Control)</strong></th>
<th><strong>Hours:</strong> 1h</th>
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<tr>
<td><strong>Description:</strong></td>
<td>Theory classes: 1h</td>
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<td>Mid term control.</td>
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<th><strong>Final exam</strong></th>
<th><strong>Hours:</strong> 2h</th>
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<tr>
<td><strong>Description:</strong></td>
<td>Theory classes: 2h</td>
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<td>Final examination.</td>
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Qualification system

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

Basic:


Complementary:


Others resources:

Lectures notes and Problems collection.