Course guide
230024 - PIV - Image and Video Processing

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

Degree: BACHELOR'S DEGREE IN TELECOMMUNICATIONS TECHNOLOGIES AND SERVICES ENGINEERING (Syllabus 2015). (Optional subject).

Academic year: 2022  ECTS Credits: 6.0  Languages: Catalan, Spanish

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

REQUIREMENTS

INTRODUCTION TO AUDIOVISUAL SIGNAL PROCESSING - Prerequisite

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Generical:
10 ECI N3. They will have acquired knowledge related to experiments and laboratory instruments and will be competent in a laboratory environment in the ICC field. They will know how to use the instruments and tools of telecommunications and electronic engineering and how to interpret manuals and specifications. They will be able to evaluate the errors and limitations associated with simulation measures and results.

TEACHING METHODOLOGY

Theoretical Lecture
Lab session
Group work
Individual work
Mid-term control
Final exam

LEARNING OBJECTIVES OF THE SUBJECT

The goal of this course is to introduce the most important image and video processing techniques. The Processing techniques are presented building from concepts that the students have encountered in previous courses (in particular "Signals and Systems" and "Introduction to AV signal processing") . The course presents a wide range of real applications. Moreover, the students will also have the opportunity to design and develop a complete image processing applications.
STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Hours large group</td>
<td>39.0</td>
<td>26.00</td>
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<tr>
<td>Hours small group</td>
<td>26.0</td>
<td>17.33</td>
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<tr>
<td>Self study</td>
<td>85.0</td>
<td>56.67</td>
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Total learning time: 150 h

CONTENTS

**Topic 1. Pixel-based image representation**

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

**Full-or-part-time:** 12h
- Theory classes: 6h
- Self study: 6h

**Topic 2. 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:** 22h 20m
- Theory classes: 5h
- Laboratory classes: 4h
- Self study: 13h 20m

**Topic 3. Geometric model for images**

**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 20m
- Theory classes: 9h
- Laboratory classes: 2h
- Self study: 15h 20m
### Topic 4. Region-based image representation

**Description:**
Practical study: Biomedical applications, Photography, Unsupervised segmentation, object interaction

**Full-or-part-time:** 17h 20m
Theory classes: 5h 20m
Laboratory classes: 2h
Self study: 10h

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### Topic 5. 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 detection, object tracking.

**Full-or-part-time:** 32h 40m
Theory classes: 12h 20m
Laboratory classes: 2h
Self study: 18h 20m

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### Topic 6. Design and implementation of an image processing system

**Description:**
Design and implementation of an image processing system

**Full-or-part-time:** 33h 30m
Laboratory classes: 14h
Self study: 19h 30m

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### ACTIVITIES

#### Short answer test (Control)

**Description:**
Continuous evaluation

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

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#### Lab session

**Description:**
Low-level image representation - the Pixel

**Full-or-part-time:** 2h
Theory classes: 2h
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<tr>
<th>Lab session</th>
<th>Description</th>
<th>Full-or-part-time: 2h</th>
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<td>Space-frequency representation of images</td>
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<td>Theory classes: 2h</td>
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<tr>
<td>Lab session</td>
<td>Description: Shape and image - geometric structures</td>
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<td>Full-or-part-time: 2h</td>
<td>Theory classes: 2h</td>
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<td>Region-based processing</td>
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<td>Full-or-part-time: 2h</td>
<td>Theory classes: 2h</td>
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<td>Video processing</td>
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<td>Full-or-part-time: 2h</td>
<td>Theory classes: 2h</td>
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<td>Lab session</td>
<td>Description: Design and implementation of an image processing system</td>
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<td>Laboratory classes: 6h</td>
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<td>Final Exam</td>
<td>Description: Final exam</td>
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<td>Final exam</td>
<td>Theory classes: 2h</td>
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GRADING SYSTEM

Final exam: 40%
Control: 20%
Lab session: 40%

BIBLIOGRAPHY

Complementary:

RESOURCES

Other resources:
Lectures notes and Problems collection.