230089 - IPAV - Introduction to Audiovisual Processing

Coordinating unit: 230 - ETSETB - Barcelona School of Telecommunications Engineering
Teaching unit: 739 - TSC - Department of Signal Theory and Communications
Academic year: 2018
Degree: BACHELOR'S DEGREE IN TELECOMMUNICATIONS TECHNOLOGIES AND SERVICES ENGINEERING (Syllabus 2015). (Teaching unit Compulsory)
ECTS credits: 6  Teaching languages: Catalan, Spanish

Teaching staff

Coordinator: FRANCISCO JAVIER HERNANDO PERICAS
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Muñoz Medina, Olga
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Pascual Iserte, Antonio
Rodríguez Fonollosa, José Adrián
Ruiz Hidalgo, Javier
Villares Piera, Nemesio Javier

Prior skills

See "requisites" section

Requirements

Probability and Statistics (PIE) - prerequisite
Signals and Systems (SSIS) - prerequisite

Degree competences to which the subject contributes

Generical:
3. 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

lectures
laboratory classes
Individual (learning)
Partial exam
Final Exam
Lab

Learning objectives of the subject

The development of intuition of the behavior of audiovisual systems and the characteristics of signals, with special emphasis on audiovisual signals.
### Study load

<table>
<thead>
<tr>
<th>Study load</th>
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</thead>
<tbody>
<tr>
<td><strong>Total learning time:</strong> 150h</td>
<td>Hours large group:</td>
<td>52h</td>
<td>34.67%</td>
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<tr>
<td></td>
<td>Hours small group:</td>
<td>13h</td>
<td>8.67%</td>
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<tr>
<td></td>
<td>Self study:</td>
<td>85h</td>
<td>56.67%</td>
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# Content

<table>
<thead>
<tr>
<th>1. Human Perceptive System</th>
<th>Learning time: 7h</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 4h</td>
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<tr>
<td></td>
<td>Self study : 3h</td>
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</tbody>
</table>

**Description:**
- User's importance
- Human Auditory System
- Human Visual System

**Related activities:**
Practice I. Signal analysis with DFT. Application to speech signals

<table>
<thead>
<tr>
<th>2. The signal in the time and spatial domains</th>
<th>Learning time: 23h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 8h</td>
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<tr>
<td></td>
<td>Self study : 15h</td>
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</tbody>
</table>

**Description:**
- Sequences $x[n]$ and $x[m,n]$
- Quantization
- 1D: Non uniform quantization. Dynamic margin control
- 2D: Grey transformations. Histogram. Histogram equalization

**Related activities:**
Practice II. Quantization of audio-visual signals
Practice III. Image histogram and 2D-DFT

<table>
<thead>
<tr>
<th>3. The signal in the frequency domain</th>
<th>Learning time: 23h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 8h</td>
</tr>
<tr>
<td></td>
<td>Self study : 15h</td>
</tr>
</tbody>
</table>

**Description:**
- Short-term 1D Fourier Transform
- Spectrogram. Time-frequency analysis
- 2D Fourier Transform
- 2D-DFT
- Importance of the phase

**Related activities:**
Practice III. Image histogram and 2D-DFT
### 4. Sampling, decimation and interpolation

**Description:**
- 2D Sampling
- Decimation and interpolation
- Change of sampling rate

**Related activities:**
- Practice IV: Decimation and interpolation of 1D signals
- Practice V: Decimation, interpolation and filtering of 2D signals

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

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### 5. 2D convolution and correlation

**Description:**
- 2D convolution.
- Correlation (1D). Periodicity estimation.
- Correlation (2D). Pattern detection.

**Related activities:**
- Practice IV: Filtering and equalization

**Learning time:** 30h  
Theory classes: 10h  
Self study: 20h

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### 6. Linear time-invariant systems and filtering

**Description:**
- Z transform
- Systems defined by means of finite difference equations
- Filtering. Filter specification, linear phase, design of filter with Matlab, equalization.

**Learning time:** 23h  
Theory classes: 8h  
Self study: 15h
7. Audio-visual signal format

**Description:**
- Information compression
- Audio signal formats
- Image signal formats. Colour representation

**Related activities:**
Practice II. Quantization of audio-visual signals
Practice III. Image histogram and 2D-DFT

**Learning time:** 7h
- Theory classes: 4h
- Self study: 3h
# Planning of activities

<table>
<thead>
<tr>
<th>Activity</th>
<th>Hours</th>
<th>Laboratory classes</th>
<th>Theory classes</th>
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<tbody>
<tr>
<td><strong>Partial controls</strong></td>
<td>4h</td>
<td>2h</td>
<td>2h</td>
</tr>
<tr>
<td><strong>Practice I. Signal analysis with DFT.</strong></td>
<td>2h</td>
<td>2h</td>
<td></td>
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<tr>
<td><strong>Application to speech signals</strong></td>
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</tr>
<tr>
<td><strong>Practice II. Quantization of audio-visual signals</strong></td>
<td>2h</td>
<td>2h</td>
<td></td>
</tr>
<tr>
<td><strong>Practice III. Image histogram and 2D-DFT</strong></td>
<td>2h</td>
<td>2h</td>
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<tr>
<td><strong>Practice IV. Decimation and interpolation of 1D signals</strong></td>
<td>2h</td>
<td>2h</td>
<td></td>
</tr>
<tr>
<td><strong>Practice V. Decimation, interpolation and filtering of 2D signals</strong></td>
<td>2h</td>
<td>2h</td>
<td></td>
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<tr>
<td><strong>Final exam</strong></td>
<td>3h</td>
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**Qualification system**

Partial exam (CNT): 30%
Laboratory (LAB): 20%
Final exam (FNL): 50%

Formula: \[
\text{max} \left( 0.30 \times \text{CNT} + 0.20 \times \text{LAB} + 0.50 \times \text{FNL} , 0.20 \times \text{LAB} + 0.80 \times \text{FNL} \right)
\]
Bibliography

Basic:

Complementary: