230691 - SPEE - Signal Processing for Electronic Engineering

Coordinating unit: 230 - ETSETB - Barcelona School of Telecommunications Engineering
Teaching unit: 739 - TSC - Department of Signal Theory and Communications
Academic year: 2020
Degree: MASTER'S DEGREE IN ELECTRONIC ENGINEERING (Syllabus 2013). (Teaching unit Compulsory)
MASTER'S DEGREE IN ADVANCED TELECOMMUNICATION TECHNOLOGIES (Syllabus 2019).
(Teaching unit Optional)
ECTS credits: 5
Teaching languages: English

Teaching staff
Coordinator: Lamarca Orozco, M. Meritxell

Prior skills
Characterization of discrete-time signals and systems, both in the time domain and in the transformed domain (Fourier transform, Z transform, DFT)
Analog signal sampling and reconstruction (sampling theorem)
Random variables

Degree competences to which the subject contributes

Specific:
CEE22. Ability to characterize deterministic and random signals in time or space, and in the frequency domain.
CEE21. Ability to process continuous variable signals using digital techniques.
CEE23. Ability to analyze, model, identify and simulate linear systems, especially digital filters and adaptive systems.

Transversal:
CT3. 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.
CT5. 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
Activities:
- Lectures
- Application examples
- Lab work with Matlab
- Exercises
- Team work (at home)
- Individual work (at home)
- Final exam

Activities planning:
- Exercises to strengthen theoretical knowledge.
- Lab work to implement processing techniques in Matlab.
- Final exam with theoretical questions and exercises.
### Learning objectives of the subject

Understanding the concepts and techniques of the field of statistical signal processing, and their use in real applications.

### Study load

<table>
<thead>
<tr>
<th>Total learning time: 125h</th>
<th>Hours large group:</th>
<th>39h</th>
<th>31.20%</th>
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<tbody>
<tr>
<td></td>
<td>Self study:</td>
<td>86h</td>
<td>68.80%</td>
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## Content

<table>
<thead>
<tr>
<th>Topic</th>
<th>Learning time</th>
<th>Description</th>
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| **1. Fundamentals of digital signal processing**                       | 15h           | Theory classes: 4h  
Laboratory classes: 1h  
Self study: 10h |
| **Description:**                                                      |               | Introduction and applications  
Random variables and stochastic processes |
| **2. Estimation theory fundamentals**                                  | 23h           | Theory classes: 4h  
Laboratory classes: 3h  
Self study: 16h |
| **Description:**                                                      |               | Bias, variance, mean square error  
Maximum likelihood estimation |
| **3. Scalar quantization**                                            | 9h            | Theory classes: 2h  
Laboratory classes: 1h  
Self study: 6h |
| **Description:**                                                      |               | Uniform quantization  
Dithering |
| **4. Sigma-Delta modulation**                                         | 9h            | Theory classes: 2h  
Laboratory classes: 1h  
Self study: 6h |
| **Description:**                                                      |               | Oversampling quantization  
Sigma-Delta modulation |
### 5. Impulsive noise

**Learning time:** 8h  
Theory classes: 2h  
Self study: 6h

**Description:**  
- Impulsive noise modeling  
- Outlier detection  
- Impulsive noise filtering

### 6. Spectral estimation

**Learning time:** 34h  
Theory classes: 7h  
Laboratory classes: 3h  
Self study: 24h

**Description:**  
- Periodogram and autocorrelation estimates  
- Smoothing the periodogram  
- Parametric spectral estimation: AR processes  
- Spectrogram

### 7. Wiener filtering

**Learning time:** 27h  
Theory classes: 5h  
Laboratory classes: 4h  
Self study: 18h

**Description:**  
- Problem formulation and applications  
- Optimum filter coefficients  
- Adaptive filtering, LMS algorithm

### Qualification system

- Final exam (including Lab work): 50%  
- Individual/team assignments: 50%
Bibliography

Basic:


Others resources:

Audiovisual material

Teacher's material: notes, problem sets, laboratory guides

Resource