



Course guides

230375 - GSP - Graph Signal Processing

Last modified: 07/07/2020

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:** 3.0 **Languages:** English

LECTURER

Coordinating lecturer: Alba Pagès zamora

Others: Alba Pagès Zamora

PRIOR SKILLS

Basic knowledge of matrix analysis, Fourier transform, and signal filtering.
Basic knowledge of programming in Matlab.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

CE1. 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.

Transversal:

CT4. 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.

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

- Theoretical lectures.
- Practical individual sessions in Matlab, and presentation of proposed problems.
- Practical sessions in groups and presentation of a report.

LEARNING OBJECTIVES OF THE SUBJECT

Graphs are useful for representing data obtained in numerous applications such as, for example, traffic evolution in a transport network, temperature values in different geographic locations, information dissemination in social networks or functional activities in the brain. The representation, analysis and compression of such data is a challenging task and requires the development of new tools that can identify and adequately exploit the structure of the data.

In this course, students will become familiar with the framework of "Graph Signal Processing", a discipline useful for processing data lying on a graph and that extends basic concepts of signal processing to graphs, such as frequency domain and filtering. Hand-out sessions will provide students with practical skills in the analysis of data in graphs.



STUDY LOAD

Type	Hours	Percentage
Self study	51,0	68.00
Hours large group	16,0	21.33
Hours small group	8,0	10.67

Total learning time: 75 h

CONTENTS

Introduction

Description:

Course organization. Motivation and main applications of graph signals.

Full-or-part-time: 1h 30m

Theory classes: 0h 30m

Self study : 1h

Algebraic Graph Theory

Description:

Graph theory fundamentals. Laplacian matrix and spectral properties.

Related activities:

Application: Graph Learning

Practical Session: Spectral Clustering

Full-or-part-time: 15h 30m

Theory classes: 7h 30m

Practical classes: 2h

Self study : 6h

Graph Signals

Description:

Definition of graph signals. Graph Fourier Transform. Convolution of graph signals.

Related activities:

Application: "Average Consensus"

Practical session: Frequency domain in graphs.

Full-or-part-time: 7h

Theory classes: 2h 30m

Practical classes: 1h 30m

Self study : 3h



Graph Systems and Filtering of Graph Signals

Description:

Graph linear systems filters. Graph filters in the frequency domain. Examples of graph filters.

Related activities:

Practical session: filtering of graph signals.

Full-or-part-time: 9h

Theory classes: 4h

Practical classes: 2h

Self study : 3h

Graph Convolutional Neural Networks

Description:

Multilayer Graph Convolutional Neural Networks with multiple features.

Full-or-part-time: 7h

Theory classes: 4h

Self study : 3h

GRADING SYSTEM

- Attendance is mandatory.
- Participation in class.
- Problems and/or group or individual presentation.

EXAMINATION RULES.

There is no final exam.

RESOURCES

Other resources:

Lecture slides.

Matlab graph toolbox and practical session guides.