Course guides
230695 - ACO - Applied Convex Optimization

Unit in charge: Barcelona School of Telecommunications Engineering
Teaching unit: 739 - TSC - Department of Signal Theory and Communications.
Degree: MASTER'S DEGREE IN ELECTRONIC ENGINEERING (Syllabus 2013). (Optional subject).
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: 5.0 Languages: Spanish, English

LECTURER
Coordinating lecturer: Perez Neira, Ana Isabel
Others: Perez Neira, Ana Isabel

PRIOR SKILLS
Basic Algebra

TEACHING METHODOLOGY
Classroom sessions

LEARNING OBJECTIVES OF THE SUBJECT
The so-called optimization problems rise in very different fields and applications. In all of them the function to be optimize is the so-called cost or objective function and the variables that we control to carry out the optimization are many times confined, which it is called the constraints of the problem. Convex optimization arise frequently in engineering problems but often go unrecognized. This course shows that there is a substantial and useful theory for such problems. The course will give students the tools and training to recognize convex optimization problems that arise in wireless communications and networks. The basic theory of such problems is presented together with the required background to use the methods in their own research or engineering work.

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>31.20</td>
</tr>
<tr>
<td>Self study</td>
<td>86.0</td>
<td>68.80</td>
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</tbody>
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Total learning time: 125 h
## CONTENTS

### Introduction

**Description:**
Modern optimization vs classical one: Efficient solvable programmes

**Full-or-part-time:** 2h
Theory classes: 2h

### Convex Sets and functions

**Description:**
Definitions and properties

**Full-or-part-time:** 4h 20m
Theory classes: 4h 20m

### Convex programming and class of convex problems

**Description:**
Formulation of a convex optimization problem
Study of: LP, QP, SOCP, SDP, GP
Problem relaxation
Applications: norm minimization, filter design, low rank optimization problems (eg. Netflix, video security, image restoration)
Convex software tool programming

**Full-or-part-time:** 8h 40m
Theory classes: 4h 20m
Practical classes: 4h 20m

### Duality

**Description:**
Lagrange Duality and KKT conditions
Primal-Dual decomposition
Applications: Radio resource management for satellite and wireless comm (power control, waterfilling, MIMO transceiver design), cloud computing

**Full-or-part-time:** 6h
Theory classes: 4h
Practical classes: 2h

### Algorithms

**Description:**
Basic algorithms: interior point method
Simple methods for extremely large problems
Applications: compressed sensing, ML decoding and SDP relaxation, 5G beamforming

**Full-or-part-time:** 9h
Theory classes: 9h
Multi-Objective optimization

**Description:**
Theory
Applications: interference networks, portfolio optimization, SVM and classification

**Full-or-part-time:** 9h
Theory classes: 9h

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**GRADING SYSTEM**

Individual assessment 60%
Group assessment 40%

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**BIBLIOGRAPHY**

**Basic:**

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**RESOURCES**

**Other resources:**
Class notes and problems