230695 - ACO - Applied Convex Optimization

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 ADVANCED TELECOMMUNICATION TECHNOLOGIES (Syllabus 2019).
(Teaching unit Optional)
MASTER'S DEGREE IN TELECOMMUNICATIONS ENGINEERING (Syllabus 2013). (Teaching unit Optional)
MASTER'S DEGREE IN ELECTRONIC ENGINEERING (Syllabus 2013). (Teaching unit Optional)
ECTS credits: 5
Teaching languages: Spanish, English

Teaching staff
Coordinator: Perez Neira, Ana Isabel
Others: Perez Neira, Ana Isabel

Opening hours
Timetable: 9h to 18h (prior arrangement)

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>Total learning time: 125h</th>
<th>Hours large group:</th>
<th>39h</th>
<th>31.20%</th>
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<tbody>
<tr>
<td>Self study:</td>
<td>86h</td>
<td>68.80%</td>
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<tr>
<td>Content</td>
<td>Learning time:</td>
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<td>---------------------------------------------</td>
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<tr>
<td>Introduction</td>
<td>2h</td>
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<td><strong>Description:</strong> Modern optimization vs classical one: Efficient solvable programmes</td>
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<tr>
<td>Convex Sets and functions</td>
<td>4h 20m</td>
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<tr>
<td><strong>Description:</strong> Definitions and properties</td>
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<tr>
<td>Convex programming and class of convex problems</td>
<td>8h 40m</td>
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| **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 |
| Duality                                     | 6h             |
| **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 |
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**Algorithms**

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<td>Basic algorithms: interior point method</td>
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<td>Simple methods for extremely large problems</td>
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<tr>
<td>Applications: compressed sensing, ML decoding and SDP relaxation, 5G beamforming</td>
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**Learning time:** 9h

- Theory classes: 9h

**Multi-Objective optimization**

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<th>Description:</th>
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<tr>
<td>Theory</td>
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<td>Applications: interference networks, portfolio optimization, SVM and classification</td>
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**Learning time:** 9h

- Theory classes: 9h

**Qualification system**

- Individual assessment: 60%
- Group assessment: 40%

**Bibliography**

**Basic:**


**Others resources:**

- Class notes and problems