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: 2018
Degree: 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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<tr>
<td></td>
<td>Self study:</td>
<td>86h</td>
<td>68.80%</td>
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## Content

<table>
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<tr>
<th><strong>Introduction</strong></th>
<th><strong>Learning time:</strong> 2h</th>
<th><strong>Description:</strong> Modern optimization vs classical one: Efficient solvable programmes</th>
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<tbody>
<tr>
<td><strong>Convex Sets and functions</strong></td>
<td><strong>Learning time:</strong> 4h 20m</td>
<td><strong>Description:</strong> Definitions and properties</td>
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<tr>
<td><strong>Convex programming and class of convex problems</strong></td>
<td><strong>Learning time:</strong> 8h 40m</td>
<td><strong>Description:</strong> 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</td>
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<td><strong>Duality</strong></td>
<td><strong>Learning time:</strong> 6h</td>
<td><strong>Description:</strong> 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</td>
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#### Algoritms

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<tr>
<td>Basic algorithms: interior point method</td>
</tr>
<tr>
<td>Simple methods for extremely large problems</td>
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<td>Applications: compressed sensing, ML decoding and SDP relaxation, 5G beamforming</td>
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#### 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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#### Qualification system

- Individual assessment 60%
- Group assessment 40%

#### Bibliography

**Basic:**


**Others resources:**

- Class notes and problems