**Audio and acoustic signal processing**

COM-415

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**Cursus**

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<th>Cybersecurity</th>
<th>Sem.</th>
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<tr>
<td>Data Science</td>
<td>MA1</td>
<td>Opt.</td>
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<tr>
<td>Humanités digitales</td>
<td>MA1, MA3</td>
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<td>Informatique</td>
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<td>Mineur en Data science</td>
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<td>SC master EPFL</td>
<td>MA1, MA3</td>
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**Language** English  
**Credits** 5  
**Session** Winter  
**Semester** Fall  
**Exam** Written  
**Workload** 150h  
**Weeks** 14  
**Hours** 5 weekly

**Number of positions**

**Summary**

The objective of the course is to introduce theory, methods, and basic psychoacoustics that is needed to understand state-of-the-art techniques used in pro audio and consumer audio, including microphones, surround sound, mixing and audio coding.

**Content**

- Acoustics and audio is covered and the manipulation and processing of audio signals. It is shown how Fourier analysis of a sound field yields the representation of the sound field with plane waves. These and other acoustic insights are used to explain microphone techniques and reproduction of sound fields.
- Psychoacoustics, loudness perception and spatial hearing are covered in detail. The latter is used to motivate stereo and surround mixing and audio playback. Audio playback is put into context with a detailed coverage of room acoustics.
- The short-time Fourier transform is introduced as a tool for flexible manipulation of audio signals, such as filtering, delaying and other spectral modification. Matrix surround, audio coding, and beamforming are also treated.

**Learning Prerequisites**

**Recommended courses**

Signal processing for communication, any course on Signals and Systems

**Learning Outcomes**

By the end of the course, the student must be able to:

- Apply basics of acoustics, signal processing, reproduction and capture
- Understand and implement linear and adaptative filtering, beamforming, noise suppression, audio coding, stereo and multichannel sound capture and reproduction

**Teaching methods**

In class ex-cathedra + exercices + mini-project supervision

**Expected student activities**

- Theoretical and practical exercises
• MINI-PROJECTS: individual or in small groups

**Assessment methods**

• Final exam
• Midterm exam
• Mini-project

**Supervision**

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<tr>
<th>Office hours</th>
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<td>Assistants</td>
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