## Modern digital communications: a hands-on approach

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### Cursus

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<tr>
<th>Informatique</th>
<th>Sem.</th>
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<tr>
<td>Mineur en Systèmes de communication</td>
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<td>Opt.</td>
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<td>SC master EPFL</td>
<td>MA1, MA3</td>
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### Summary

This course complements the theoretical knowledge learned in PDC with more advanced topics such as OFDM, MIMO, fading channels, and GPS positioning. This knowledge is put into practice with hands-on exercises based on Matlab and on a software-defined radio platform.

### Content

1. Software radio : key concepts.
2. Matlab implementation of the signal processing chain to the level of detail in Principles of Digital Communications.
3. Channel modeling, estimation, equalization.
4. Implementation of a basic wireless communication system using a software-defined radio testbed.
5. Fading and diversity.
6. OFDM and MIMO : theory and implementation.
7. CDMA in the context of a GPS system.
8. Decoding of a GPS signal and positioning.

### Keywords

Wireless, OFDM, Diversity, Coding, GPS, CDMA, MMSE, Rayleigh fading, software-defined radio, channel estimation.

### Learning Prerequisites

**Required courses**

COM-302 Principles of digital communication or equivalent

**Important concepts to start the course**

Solid understanding of linear algebra and probability as well as real and complex analysis.

### Learning Outcomes

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

- Design and implement an advanced digital communication system (data rate, spectral bandwidth, energy requirements, error probability, implementation complexity)
- Model physical properties of wired and wireless communication channels
• Implement various parts of a "physical-layer" digital communication system
• Understand what software-defined radio is all about

Teaching methods
Ex cathedra lectures and small projects

Expected student activities
Follow lectures; guided as well as independent work on projects

Assessment methods
Written and practical midterm and final exam during the semester.
40% midterm exam, 60% final exam.

Supervision
Office hours  Yes
Assistants  Yes
Forum  Yes

Resources
Notes/Handbook
Lecture notes