Summary
The goal of this course is to transmit knowledge in sensing, computing, communicating, and actuating for programmable field instruments and, more generally, embedded systems. The student will be able to put in practice the knowledge acquired using concrete software and hardware tools.

Content
- Fundamentals of signal processing
- An introduction to dynamical systems
- Basic linear control techniques
- Basic communication techniques
- Basic localization techniques
- Microcontrollers, sensors, actuators, and transceivers
- Hardware resource constraints and management
- Embedded system programming
- Examples of programmable, mobile field instruments

Keywords
Signal processing, programming, control, communication, embedded systems, mobile robotics, sensors, sensor systems, field instruments

Learning Prerequisites

**Required courses**
Analysis I to IV (complex analysis), good knowledge of Matlab, Python, and C programming

**Recommended courses**
Fundamental in probability and statistics

Learning Outcomes
By the end of the course, the student must be able to:
• Estimate environmental monitoring system requirements (communication, sensing, actuation, computation)
• Develop software for an embedded system/instrument
• Analyze signals in time and frequency domain
• Analyze C/Matlab/Python program outputs
• Implement C/Matlab/Python code
• Compute direct and inverse Fourier Transforms
• Analyze constraints and resources of an embedded system/instrument
• Conduct systematic experiments and system performance evaluation
• Design digital filters
• Design control algorithms
• Design localization algorithms

Transversal skills
• Plan and carry out activities in a way which makes optimal use of available time and other resources.
• Write a scientific or technical report.
• Demonstrate a capacity for creativity.
• Access and evaluate appropriate sources of information.
• Make an oral presentation.
• Collect data.
• Evaluate one’s own performance in the team, receive and respond appropriately to feedback.

Teaching methods
Ex-cathedra lectures, assisted exercises, and a course project involving teamwork

Expected student activities
Attending lectures, carrying out exercises and the course project, and reading handouts.

Assessment methods
Written exam (60%) with continuous control during the semester (40%).

Supervision
Office hours Yes
Assistants Yes
Forum Yes

Resources
Bibliography
Lecture notes, a few targeted papers/book chapters

Websites
• https://disal.epfl.ch/teaching/signals_instruments_systems

Moodle Link
• https://moodle.epfl.ch/course/view.php?id=7321

Prerequisite for

Signals, instruments and systems