ENG-366

Signals, instruments and systems

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Cursus	Sem.	Type
Civil Engineering	BA5	Opt.
Environmental Sciences and Engineering	BA5	Obl.
HES - SIE	H	Obl.

Language of teaching	English
Credits	5
Session	Winter
Semester	Fall
Exam	Written
Workload	150h
Weeks	14
Hours	**5 weekly**
Courses	2 weekly
Exercises	3 weekly
Number of positions	

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
- Embedded system programming
- Basic control and communication concepts and techniques
- Basic localization methods
- Microcontrollers, sensors, actuators, and transceivers
- Hardware resource constraints and management
- Examples of programmable, mobile field instruments

Keywords

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

Learning Prerequisites

Required courses

Analysis I to IV, ICC (Python programming), Computational Methods and Tools (Matlab, Python, and C programming)

Recommended courses

Fundamental in Probability and Statistics, Estimation Methods

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 simple 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.
- Access and evaluate appropriate sources of information.
- Collect data.
- Evaluate one's own performance in the team, receive and respond appropriately to feedback.
- Assess progress against the plan, and adapt the plan as appropriate.
- Identify the different roles that are involved in well-functioning teams and assume different roles, including leadership roles.
- Manage priorities.
- Make an oral presentation.
- Use both general and domain specific IT resources and tools

Teaching methods

Ex-cathedra lectures, hands-on exercises, and course project

Expected student activities

Attending lectures, carrying out computer-based exercises and course project, and reading handouts.

Assessment methods

Written exam (50%) with continuous assessment (individual computer-based test and team project) during the semester (50%).

Supervision

Office hours	Yes
Assistants	Yes
Forum	Yes

Resources

Virtual desktop infrastructure (VDI)

No

Bibliography

Lecture notes, a few targeted papers/book chapters

Websites

- https://disal.epfl.ch/teaching/signals_instruments_systems

Moodle Link

- https://go.epfl.ch/ENG-366

Prerequisite for

Distributed Intelligent Systems (M2 and M4)