ENG-466   **Distributed intelligent systems**

Martinoli Alcherio

Cursus	Sem.	Type
Biocomputing minor	E	Opt.
Civil Engineering	MA2, MA4	Opt.
Computational science and Engineering	MA2, MA4	Opt.
Computer science	MA2, MA4	Opt.
Cybersecurity	MA2, MA4	Opt.
Data Science	MA2, MA4	Opt.
Electrical and Electronical Engineering	MA2, MA4	Opt.
Energy Management and Sustainability	MA2, MA4	Opt.
Energy Science and Technology	MA2, MA4	Opt.
Environmental Sciences and Engineering	MA2, MA4	Opt.
Microtechnics	MA2, MA4	Opt.
Robotics, Control and Intelligent Systems		Opt.
Robotics	MA2, MA4	Opt.
SC master EPFL	MA2, MA4	Opt.

Language of teaching	English
Credits	5
Session	Summer
Semester	Spring
Exam	Oral
Workload	150h
Weeks	14
Hours	**5 weekly**
Courses	2 weekly
Exercises	3 weekly
Number of positions	

Summary

The goal of this course is to provide methods and tools for modeling distributed intelligent systems as well as designing and optimizing coordination strategies. The course is a well-balanced mixture of theory and practical activities using simulation and real hardware platforms.

Content

- Introduction to key concepts such as self-organization and software and hardware tools used in the course
- Examples of natural, artificial and hybrid distributed intelligent systems
- Modeling methods: sub-microscopic, microscopic, macroscopic, multi-level; spatial and non-spatial; mean field, approximated and exact approaches
- Machine-learning methods: single- and multi-agent techniques; expensive optimization problems and noise resistance
- Coordination strategies and distributed control: direct and indirect schemes; algorithms and methods; performance evaluation
- Application examples in distributed sensing and action

Keywords

Artificial intelligence, swarm intelligence, distributed robotics, sensor networks, modeling, machine-learning, control

Learning Prerequisites

Required courses

Fundamentals in analysis, probability, and programming for both compiled and interpreted languages

Recommended courses

Basic knowledge in statistics, programming language used in the course (C, Matlab, Python), and signals and systems

Learning Outcomes

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

- Design control algorithms
- Formulate a model at different level of abstraction for a distributed intelligent system
- Analyze a model of a distributed intelligent system
- Analyze a distributed coordination strategy/algorithm
- Design a distributed coordination strategy/algorithm
- Implement code for single robot and multi-robot systems
- Carry out systematic performance evaluation of a distributed intelligent system
- Apply modeling and design methods to specific problems requiring distributed sensing and action
- Optimize a controller or a set of possibly coordinated controllers using model-based or data-driven methods

Transversal skills

- Demonstrate a capacity for creativity.
- Access and evaluate appropriate sources of information.
- Collect data.
- Plan and carry out activities in a way which makes optimal use of available time and other resources.
- Make an oral presentation.
- Write a scientific or technical report.
- 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

Continuous control (50%) with final oral exam (50%).

Supervision

Office hours	Yes
Assistants	Yes
Forum	Yes

Resources

Bibliography

Lecture notes, selected papers and book chapters distributed at each lecture.

Websites

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

Moodle Link

- https://moodle.epfl.ch/course/view.php?id=15472

Prerequisite for

R&D activities in engineering