ENG-466

Distributed intelligent systems

Cursus	Sem.	Type
Computational science and Engineering	MA1, MA3	Opt.
Computational science and engineering minor	H	Opt.
Computer science	MA1, MA3	Opt.
Cybersecurity	MA1, MA3	Opt.
Data Science	MA1, MA3	Opt.
Electrical and Electronical Engineering	MA1, MA3	Opt.
Energy Science and Technology	MA1, MA3	Opt.
Environmental Sciences and Engineering	MA1, MA3	Opt.
Mechanical engineering	MA1, MA3	Opt.
Microtechnics	MA1, MA3	Opt.
Robotics, Control and Intelligent Systems		Opt.
Robotics	MA1, MA3	Opt.

Language of teaching	English
Credits	5
Session	Winter
Semester	Fall
Exam	Oral
Workload	150h
Weeks	14
Hours	**5 weekly**
Courses	2 weekly
Project	1 weekly
Lab	2 weekly
Number of positions	

Remark

Pas donné en 2026-27

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.

Content

- Introduction to key concepts (e.g., self-organization, stigmergy) and 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
- Data-driven methods: in-line learning and metaheuristic optimization; expensive optimization problems and noise resistance; performance evaluation
- Coordination strategies and distributed control algorithms
- Application examples in distributed sensing and action

Keywords

Swarm intelligence, artificial intelligence, machine-learning, distributed robotics, swarm robotics, multi-robot systems, sensor networks, modeling, control, metaheuristic optimization

Learning Prerequisites

Required courses

Fundamentals in analysis, probability and statistics, and programming for both compiled and interpreted languages (C, Matlab, Python are used in the course).

Recommended courses

Signals and systems, continuous-time and discrete-time linear control 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
- Design simple control algorithms for single robots
- 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
- Optimize controllers and/or coordination strategies 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.
- Write a scientific or technical report.
- Evaluate one's own performance in the team, receive and respond appropriately to feedback.
- Make an oral presentation.
- Manage priorities.

Teaching methods

Ex-cathedra lectures, assisted exercises, and course project in teams

Expected student activities

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

Assessment methods

Oral exam (50%) with continuous assessment during the semester based on course project (50%).

Supervision

Office hours	Yes
Assistant.e.s	Yes
Forum	Yes

Resources

Virtual desktop infrastructure (VDI)

Yes

Bibliography

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

Websites

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

Moodle Link

- https://go.epfl.ch/ENG-466

Videos

- https://mediaspace.epfl.ch/channel/ENG-466+Distributed+intelligent+systems+-+Spring+2022/29956

Prerequisite for

R&D activities in engineering