ENG-466

Distributed intelligent systems

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Cursus	Sem.	Type
Biocomputing minor	H	Opt.
Computational science and Engineering	MA1, MA3	Opt.
Computer science	MA1, MA3	Opt.
Cybersecurity	MA1	Opt.
Data Science	MA1, MA3	Opt.
Electrical and Electronical Engineering	MA1, MA3	Opt.
Energy Management and Sustainability	MA1, MA3	Opt.
Environmental Sciences and Engineering	MA1, MA3	Opt.
Microtechnics	MA1, MA3	Opt.
Robotics	MA1	Opt.
SC master EPFL	MA1, MA3	Opt.

Language of teaching	English
Credits	5
Withdrawal	Unauthorized
Session	Winter
Semester	Fall
Exam	Written
Workload	150h
Weeks	14
Hours	**5 weekly**
Lecture	2 weekly
Exercises	3 weekly
Number of positions	**60**

It is not allowed to withdraw from this subject after the registration deadline.

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, specific programming language used in the course (C and Matlab), and signals and systems

Learning Outcomes

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

- Design a reactive control algorithm
- 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 with mid-term verification, 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 written exam (50%).

Supervision

Office hours	Yes
Assistants	Yes
Forum	No

Resources

Bibliography

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

Websites

- http://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