### 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 such as self-organization 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
- 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.
• 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 homework in team

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

Assessment methods
Oral exam (60%) with continuous assessment during the semester (40%).

Supervision
Office hours  Yes
Assistant  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
Prerequisite for
R&D activities in engineering