Universidad Zaragoza

Academic Year/course: 2024/25

69160 - Multirobot Systems

Syllabus Information

Academic year: 2024/25
Subject: 69160 - Multirobot Systems
Faculty / School: 110 - Escuela de Ingeniería y Arquitectura
Degree: 615 - Máster Universitario en Robótica, Gráficos y Visión por Computador / Robotics, Graphics and Computer Vision
ECTS: 3.0
Year: 1
Semester: Second semester
Subject type: Optional
Module:

1. General information

The objective of the course is to train students in the key aspects related to multi-robot systems and their applications in different contexts. This requires approaching the discipline from different levels:

- The fundamentals related to the classification of the different types of multi-robot systems, the associated problems, and the conceptual framework and tools to work with these systems are studied.
- Techniques and algorithms that allow working with multi-robot systems are presented.
- The development and implementation of these algorithms requires studying and practicing techniques and programming languages.
- Different case studies and application examples of multi-robot systems are analyzed.
- Finally, the development of applications in the context of multi-robot systems is addressed.

After completing their formation, students are intended to achieve competences related to the analysis, design and programming of multi-robot systems.

Multirobot Systems is framed within the subject of Advanced Topics in Robotics. In this subject, general concepts of multi-robot systems are presented, addressing theoretical aspects, implementation and their practical application. Compulsory subjects of "Autonomous Robots" and "Computer Vision" have been taken in the previous semester, which introduce some of the basic principles used in this subject. In this course, students learn to analyze and design multi-robot systems, understanding the significance and advantages of systems made up of multiple robots in various applications, as well as their potential in different fields.

2. Learning results

The student must be able to:

- Know the specific challenges and problems in the context of multi-robot systems.
- Know and apply advanced techniques in the context of multi-robot systems.
- Understand and evaluate the impact of applications in advanced robotics.
- Identify the problems under investigation for which there are no known solutions in the field of robotics.
- Have a practical knowledge of the above aspects.
- Present the proposed technical and / or scientific results, synthesizing the main ideas.
- Evaluate relevant bibliographic sources.

Multi-robot systems have a growing application in a wide range of contexts, including industrial automation, cooperative logistics and transport, cooperative monitoring of environments or facilities, or exploration and rescue, among others. The presence of several robots working in a coordinated way introduces a series of important improvements. Parallel execution allows better use of resources, reducing execution times in tasks that are inherently distributed. The presence of several robots introduces greater robustness to failures due to redundancy. The use of multi-robot systems allows tasks that would not be possible with a single team member to be carried out. On the other hand, having multi-robot systems requires addressing the specific problems related to the assignment of tasks, coordination between robots, communications between them, and cooperative decision-making. The knowledge acquired in this subject is of great importance, since it allows students to have an approach to these type of systems, and to the fundamental tools to work with them and to design applications in these contexts. This subject also allows student to consolidate and get a deeper knowledge of concepts related to perception, robotics and control.

3. Syllabus

Syllabus:

- Introduction
- Classification of multi-robot systems

- Conceptual framework and classic models
- Fundamentals and applications
- Case studies (related to topics that include: Connectivity maintenance and rendezvous, Search, Reconnaissance and Mapping in Search and Rescue Scenarios, Deployment, Formation Control, Boundary Estimation and Tracking, Robot Swarms, Mobile Sensor Networks, Cooperative Manipulation and Transport, Task Allocation)
- Examples of recent results

4. Academic activities

The program offered to the students to help them achieve the expected results includes the following activities:

- Lectures
- Solution of problems and cases
- Lab sessions
- Practical research or application work
- Autonomous work and evaluation

5. Assessment system

Students must demonstrate that they have achieved the expected learning outcomes through the following assessment activities:
In accordance with the regulations of the University of Zaragoza, the evaluation of this subject is established as Global Type. In each call, the evaluation will comprise a single test:
Assessment of Practical Work (100%): Graded between 0 and 10 points. The objective of this test is to evaluate the knowledge and skills acquired during the development of a case study that requires putting all the learning results into play.

6. Sustainable Development Goals

9 - Industry, Innovation and Infrastructure