270714 - MRS - Multi-Robot Systems

Coordinating unit: 270 - FIB - Barcelona School of Informatics
Teaching unit: 1042 - URV - Universitat Rovira i Virgili
Academic year: 2019
Degree: MASTER'S DEGREE IN ARTIFICIAL INTELLIGENCE (Syllabus 2017). (Teaching unit Optional)
ECTS credits: 4,5

Degree competences to which the subject contributes

Specific:
- CEA14. Capability to understand the advanced techniques of Vision, Perception and Robotics, and to know how to design, implement and apply these techniques in the development of intelligent applications, services or systems.
- CEP3. Capacity for applying Artificial Intelligence techniques in technological and industrial environments to improve quality and productivity.
- CEP4. Capability to design, write and report about computer science projects in the specific area of Artificial Intelligence.

General:
- CG3. Capacity for modeling, calculation, simulation, development and implementation in technology and company engineering centers, particularly in research, development and innovation in all areas related to Artificial Intelligence.

Transversal:
- CT3. TEAMWORK: Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.
- CT4. EFFECTIVE USE OF INFORMATION RESOURCES: Managing the acquisition, structuring, analysis and display of data and information in the chosen area of specialisation and critically assessing the results obtained.
- CT5. APPROPRIATE ATTITUDE TOWARDS WORK: Capability to be motivated for professional development, to meet new challenges and for continuous improvement. Capability to work in situations with lack of information.

Teaching methodology

In hours in the classroom exposed to the theoretical computer support.

In the laboratory classroom hours are put into practice the theoretical knowledge from simulation exercises.

At the end of the first month exposed the subject to develop the student (in groups of 3-4)

Learning objectives of the subject

1. Understand some cooperative techniques for locating, exploring and perceiving with multiple robots
2. Understand the limitations of the cooperative techniques in real environments
### Content

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<tr>
<th>Section</th>
<th>Description</th>
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<tr>
<td><strong>Multi-robot auto-localization</strong></td>
<td>Degree competences to which the content contributes: SLAM, probabilistic methods, particle filters, perceptions-based methods</td>
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<tr>
<td><strong>Techniques related to exploration and perception</strong></td>
<td>Degree competences to which the content contributes: Exploration in unknown environments, sensory data management and map generation</td>
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<td><strong>Multi-robot tasks coordination</strong></td>
<td>Degree competences to which the content contributes: Task assignment: explicit (Finite-state machines), emergent (behaviour-based), swarms, auctions (market-based, voting)</td>
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<td><strong>Dynamical physical systems</strong></td>
<td>Degree competences to which the content contributes: Multi-agent systems: software and logical versus physical ones. Dynamics and capacities.</td>
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<td><strong>Multi-robot related Architectures</strong></td>
<td>Degree competences to which the content contributes: Subsumption, Swarms, InteRRap, ALLIANCE, DPA2, others...</td>
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</table>
### Planning of activities

| Development of the theory and simulations | Hours: 69h  
Theory classes: 27h  
Practical classes: 0h  
Laboratory classes: 6h  
Guided activities: 0h  
Self study: 36h |
|------------------------------------------|-------------------------------------------------|

**Specific objectives:**
1, 2

| Homework by teams, with real robots | Hours: 43h 30m  
Theory classes: 0h  
Practical classes: 0h  
Laboratory classes: 7h 30m  
Guided activities: 0h  
Self study: 36h |
|------------------------------------|-------------------------------------------------|

### Qualification system

Homework by teams: 80%
Laboratory simulations: 20%

### Bibliography

**Basic:**

Oller, Albert. Slides "on-line".