240IAU33 - Industrial and Service Robotics

Coordinator: JOAN ROSELL GRATACOS

Degree competences to which the subject contributes

Specific:

CEEAUT5. Design, project and program robotic systems for industrial and service applications.

Teaching methodology

Lectures, practical classes in computer classroom.
Teaching materials will be written in English.

Learning objectives of the subject

Students attending this course must be able to:
a) Describe the types of robots and the current applications of industrial and service robotics.
b) Analyze the performance and the logical correctness of robotics manufacturing systems.
c) Use sampling-based methods to plan the motions of industrial manipulators.
d) Describe the control schemes for visual servoing, for force control applications and for teleoperator systems.
e) Describe the main issues related to motion control and navigation of mobile robots in human environments.
f) Explain the main challenges of humanoid robotics.
g) Describe different robotic system architectures and middleware.

Study load

<table>
<thead>
<tr>
<th>Total learning time: 112h 30m</th>
<th>Hours large group: 27h 24.00%</th>
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<tbody>
<tr>
<td>Hours small group: 13h 30m</td>
<td>12.00%</td>
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<tr>
<td>Guided activities: 0h</td>
<td>0.00%</td>
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<tr>
<td>Self study: 72h</td>
<td>64.00%</td>
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# 240IAU33 - Industrial and Service Robotics

## Content

### Introduction

**Description:**
1.1. Types of robots  
1.2. Applications

**Learning time:** 3h  
Theory classes: 3h

### Industrial Robotics

**Description:**
2.1. Robotic manufacturing systems: Analysis of the logical correctness  
2.1.1. The Petri Nets formalism  
2.1.2. Analysis of the qualitative properties of the system  
2.2. Robotic manufacturing systems: Performance analysis  
2.2.1. Introduction to Discrete Event System simulation  
2.2.2. Simulation models: input data and validation issues  
2.2.3. Output analysis and comparison of alternative system designs  
2.3. Motion planning for industrial manipulators  
2.3.1. Problem modelling  
2.3.2. Sampling-based approaches: PRM, RRT  
2.3.3. Material transfer applications  
2.4. Visual servoing  
2.4.1. Position-based visual servoing  
2.4.2. Image-based visual servoing  
2.4.3. Welding applications  
2.5. Force control  
2.5.1. Compliance Control - Impedance Control  
2.5.2. Direct Force Control  
2.5.3. Hybrid Control  
2.5.4. Machining applications  
2.6. Robot co-workers: the new paradigm in industrial robotics  
2.6.1. Robots with flexible joints  
2.6.2. Control issues  
2.6.3. Safety issues

**Learning time:** 27h  
Theory classes: 13h 30m  
Self study: 13h 30m
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Service Robotics

Description:
3.1. Mobile robots in human environments
   3.1.1. Motion Control: kinematics, dynamics and trajectory tracking
   3.1.2. Navigation: Obstacle avoidance, localization and mapping
   3.1.3. Urban applications
3.2. Humanoids
   3.2.1. Biped locomotion
   3.2.2. Whole-body motions: redundancy
   3.2.3. Manipulation: contact modelling and grasping
   3.2.4. High level planning: Knowledge representation and inference
   3.2.5. Programming by Demonstration
   3.2.6. Social issues
3.3. Field robotics
   3.3.1. Sensors and actuators
   3.3.2. World modelling
   3.3.3. Exploration applications
3.4. Teleoperation and haptics
   3.4.1. Haptics: haptic devices and haptic rendering
   3.4.2. Architectures and control of teleoperator systems
   3.4.3. Applications in surgery and rehabilitation

Learning time: 24h
   Theory classes: 12h
   Self study: 12h

Robotic systems Implementation

Description:
4.1. Robotic Systems architectures
   4.1.1. Architectures
   4.1.2. Middleware
4.2. Communications in the Robotic Operating System (ROS)
   4.2.1. Publisher-subscriber
   4.2.2. Client-server

Learning time: 3h
   Theory classes: 1h 30m
   Self study: 1h 30m

Qualification system

Final assessment = 0.5* Final Exam + 0.25*Practicals reports + 0.25*Final work
The reassessment exam substitutes the final exam.
It is not mandatory to apply for the ordinary call for the reassessment of the subject.
Bibliography

Basic:

