Humanoid Robots

Academic Year: (2019 / 2020) **Review date: 29/09/2016 13:52:42**

Department assigned to the subject: Systems Engineering and Automation Department

Coordinating teacher: BALAGUER BERNALDO DE QUIROS, CARLOS

Type: Electives ECTS Credits : 3.0

Year : 1 Semester : 2

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Basic subjects on mechanics, control and programming

OBJECTIVES

The aim is to introduce humanoid robotics. A historical review of this area of robotics will be done by analyzing human evolution and focusing on bio (human) robot inspired design. The kinematics human models and our walk are analyzed, both from the energy point of view as well temporary efficiency and ergonomics services applications in open environments. All this leads to demonstrate the need for full-size humanoid robots.

The subject focuses on the study of kinematics and dynamics models. Kinematics in the classical methods of robotics with Denavit-Hartemberg are described, but the student is also introduced in the new modeling methods such as Lie Logic and the Product of Exponentials (POE). Also, the concept of global ZMP stability is introduced. In the dynamics of the subject distributed masses and concentrated concentrated models have been studed. Among these models Single and Double inverted pendulum and also the so called "car-table" models will be analyzed.

Another part of the course is dedicated to the generation of walking steps of the robot (gait), control architectures, both hardware and software, and the man-machine interfaces. In addition, OS and programming languages for humanoids as well as software and hardware architectures will be studied. Finally, numerous examples of applications are presented and introduced to the topics of skills, learning and task generation.

DESCRIPTION OF CONTENTS: PROGRAMME

1. Introduction
2. State of the art of humanoids
3. Definitions and classification of stability criteria.
4. Kinematics
4.1 Kinematics of bipedism
4.2 Models D-H
4.3 Model based on Lie Logic and POE
5. Dynamics
5.1 Classical models
5.2 Models of inverted pendulums
5.3 Model of "car-table"
6. Generation of gaits of humanoids
7. Grasping abilities
8. Control Architecture: hadware and software
9. Tasks generation: skills, learning, etc.
9. HMI and collaboration

1. Introduction
2. State of the art of humanoids
3. Definitions and classification of stability criteria.
4. Kinematics
4.1 Kinematics of bipedism
4.2 Models D-H
4.3 Model based on Lie Logic and POE
5. Dynamics
5.1 Classical models
5.2 Models of inverted pendulums
5.3 Model of "car-table"
6. Generation of gaits of humanoids
7. Grasping abilities
8. Control Architecture: hadware and software
9. Tasks generation: skills, learning, etc.
9. HMI and collaboration

LEARNING ACTIVITIES AND METHODOLOGY

Tutorials will be after the classes

ASSESSMENT SYSTEM

% end-of-term-examination/test:	20
% of continuous assessment (assigments, laboratory, practicals…):	80

1) Minimum class attendance 70% in order to pass
2) Class attendance - 20% of the mark
3) Quality of work presentation in class - 60% of the mark
4) Final exame (test) - 20% of the mark