INSTITUTO POLITÉCNICO DE BRAGANÇA

Course Unit	Robotics			Field of study	Automation										
Master in	Electrical and Computers Engineering			School	School of Technology and Management										
Academic Year	2023/2024	Year of study	1	Level	2-1	ECTS credits	6.0								
Type	Semestral	Semester	2	Code	5070-792-1204-00-23										
Workload (hours)	162	Contact hours	T -	TP 30	PL 30	TC -	S -	E -	OT -	O -					

T - Lectures; TP - Lectures and problem-solving; PL - Problem-solving, project or laboratory; TC - Fieldwork; S - Seminar; E - Placement; OT - Tutorial; O - Other

Name(s) of lecturer(s): José Alexandre de Carvalho Gonçalves

Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:
1. Understand the concepts of robotics.
2. Understand the perception and actuation systems in the field of robotics.
3. Identify and apply existing robotic solutions for real-world problem solving.
4. Apply the methods that allow the navigation of mobile robots.
5. Known and understand the emerging tools and algorithms in robotics domain.
6. Design, simulate e implement applications based on prototyping and commercial robots.

Prerequisites

Before the course unit the learner is expected to be able to:
Apply the base concepts of electronics and embedded systems

Course contents

- Introduction to robotics.
- Sensory Perception.
- Actuators for robotic systems.
- Robótica móvel
- Manipulators.
-Tools and emergent algorithms in the robotics domain, such as Machine Learning applied to Robotics, simulation environments, ROS operating system , prototyping based on 3D printing and battery management systems,
- Safety, Legislation and Standards.

Course contents (extended version)

1. Introduction to robotics
   - Robotics concept
   - Robot configurations
   - Apllications
   - Intelligent robotics concept
2. Sensory Perception
   - Sensors for mobile robots and manipulators
   - Sensor stochastic modelling
   - Sensor fusion techniques
3. Actuators to be applied in robotic systems
   - Modeling and control of DC motors, servo-motores and stepper motors.
4. Mobile robotics
   - Locomotion
   - Localization
   - Navigation
5. Manipulators
   - Direct and inverse kinematics
   - Industrial manupulator robot programming
   - Collaborative manipulator robot programming
6. Emergent Tools and algoriithms in the robotics domain
   - Machine Learning applied to Robotics
   - Simulation environments
   - ROS operating system
   - Prototyping based on 3D printing
   - Battery management systems
7. Safety, Legislation and Standards

Recommended reading

1. Siciliano, B., Khatib, O. (2016). Robotics and the Handbook. In: Siciliano, B., Khatib, O. (eds) Springer Handbook of Robotics. Springer Handbooks. Springer ISBN: 978-3-319-32552-1.
2. Bräunl, T. (2006). Mobile Robot Design and Applications with Embedded Systems, Springer. ISBN 978-3-540-34319-6.
3. Niku, S. B. (2019). Introduction to Robotics: Analysis, Control, Applications, Wiley Publisher, ISBN: 978-1-119-52760-2.
4. Siegwart, R. , Nourbakhsh I. R., Scaramuzza D. (2011). Introduction to Autonomous Mobile Robots (Intelligent Robotics and Autonomous Agents series), MIT Press., ISBN: 978-0-262-01535-6.
5. Quigley, M., Gerkey, B., Smart, W. D., (2016). Programming Robots with ROS - A Practical Introduction to the Robot Operating System, O'Reilly, ISBN: 978-1449323899.

Teaching and learning methods

- Lectures devoted to theoretical concepts.
- Demonstration sessions of real problems using industrial, collaborative and mobile robots.
- Implementing of practical challenges, one in the form of a mobile robot competition and another devoted to manipulation, being this tasks done in class and in non-face-to-face hours.

Assessment methods

- Evaluation - (Regular, Student Worker) (Final, Supplementary, Special)
  - Final Written Exam - 50% (A theoretical test will be mandatory.)
  - Practical Work - 50% (The laboratorial works will have a classification, reflecting its level of achivement.)

Language of instruction

Portuguese, with additional English support for foreign students.

Electronic validation

José Alexandre de Carvalho Gonçalves	José Luís Sousa de Magalhaes Lima	João Paulo Ramos Teixeira	José Carlos Rufino Amaro
06-03-2024	06-03-2024	13-03-2024	16-03-2024