Course guide
820221 - RIVC - Industrial Robotics and Computer Vision

Last modified: 14/06/2023

Unit in charge: Barcelona East School of Engineering
Teaching unit: 707 - ESAII - Department of Automatic Control.

Degree: BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Compulsory subject).

Academic year: 2023 **ECTS Credits:** 6.0 **Languages:** Catalan, Spanish

LECTURER

Coordinating lecturer: SEBASTIAN TORNIL SIN

Primer quadrimestre:
ANTONI GRAU SALDES - Grup: M11, Grup: M12, Grup: M13, Grup: M14, Grup: M15, Grup: M16, Grup: M17
SEBASTIAN TORNIL SIN - Grup: M11, Grup: M12, Grup: M13, Grup: M14, Grup: M15, Grup: M16, Grup: M17

Others:

Primer quadrimestre:
ANTONI GRAU SALDES - Grup: M11, Grup: M12, Grup: M13, Grup: M14, Grup: M15, Grup: M16, Grup: M17
EDMUNDO GUERRA PARADAS - Grup: M11, Grup: M13, Grup: M14
SEBASTIAN TORNIL SIN - Grup: M11, Grup: M12, Grup: M13, Grup: M14, Grup: M15, Grup: M16, Grup: M17
SUSANA ADRIANA VELAZQUEZ LERMA - Grup: M15, Grup: M16, Grup: M17

Segon quadrimestre:
ANTONI GRAU SALDES - Grup: T11, Grup: T12, Grup: T13, Grup: T14
SEBASTIAN TORNIL SIN - Grup: T11, Grup: T12, Grup: T13, Grup: T14
SUSANA ADRIANA VELAZQUEZ LERMA - Grup: T13, Grup: T14

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
2. Understand the principles and applications of automated systems.

Transversal:
3. EFFECTIVE USE OF INFORMATI0N RESOURCES - Level 2. Designing and executing a good strategy for advanced searches using specialized information resources, once the various parts of an academic document have been identified and bibliographical references provided. Choosing suitable information based on its relevance and quality.

TEACHING METHODOLOGY

The course is based on lectures (30%), supervised problem solving (10%), and individual autonomous work (60%).

LEARNING OBJECTIVES OF THE SUBJECT

The general objective of the course is the presentation of two key technologies used in automated productive environments: industrial robotics and computer vision.

From the students perspective, the specific objectives associated with the field of industrial robotics are the following:
- Know the structure and basic operation of industrial manipulator robots.
- Know the main applications of industrial robots.
- Know the technology of the different elements that make up a robot.
- Know and know how to apply the physical principles necessary for the design and control of robots.
- Know how to program basic tasks in a commercial industrial robot.

Regarding the area of ??computer vision, the objectives are:
- Know the physical elements that make up an artificial vision system.
- Know the basic steps involved in image processing.
- Know the standard techniques of image processing.
- Know how to program vision applications.

STUDY LOAD

Type	Hours	Percentage
Hours small group	15,0	10.00
Self study	90,0	60.00
Hours large group	45,0	30.00

Total learning time: 150 h

CONTENTS

1. Introduction to industrial robotics.

Description:
History of industrial robotics. Economical and social aspects. The industrial manipulator robot. Statistics. Associations and manufacturers.

Related competencies :
CEEIA-27. Understand the principles and applications of automated systems.

Full-or-part-time: 9h
Theory classes: 3h
Self study : 6h

2. The articulated arm: morphology and components.

Description:
Components of an industrial manipulator robot. Mechanical configurations. Types of robots. Actuators. Transmission systems. Sensors.

Related competencies :
CEEIA-27. Understand the principles and applications of automated systems.

Full-or-part-time: 9h
Theory classes: 3h
Self study : 6h

3. Modelling and control.

Description:
Models of a manipulator robot. Representation of position and orientation. Forward kinematics. Inverse kinematics. Differential kinematics. Control. Trajectory generation.

Related competencies :
CEEIA-27. Understand the principles and applications of automated systems.

Full-or-part-time: 18h
Theory classes: 6h
Self study : 12h

4. Robotized cells.

Description:
Robot selection. Robot location. Terminal elements. Adapting and sensing the environment.

Related competencies :
CEEIA-27. Understand the principles and applications of automated systems.

Full-or-part-time: 9h
Theory classes: 3h
Laboratory classes: 6h

5. Robot programming.

Description:
Robot programming types. On-line programming. Off-line programming. Programming in MELFA BASIC IV. Simulation.

Related competencies :
CEEIA-27. Understand the principles and applications of automated systems.

Full-or-part-time: 17h
Theory classes: 3h
Laboratory classes: 8h
Self study : 6h

6. Applications.

Description:
Classification. Packaging and palletizing. Machine tending. Welding. Painting. Cutting, polishing and deburring.

Related competencies :
CEEIA-27. Understand the principles and applications of automated systems.

Full-or-part-time: 9h
Theory classes: 3h
Self study : 6h

7. Introduction to computer vision.

Description:
Definitions. Application domains. Industrial applications of computer vision.

Full-or-part-time: 9h
Theory classes: 3h
Self study : 6h

8. Image acquisition and processing systems.

Description:
Components of a computer vision system. Optical devices. Illumination systems. Specialized hardware for image processing.

Full-or-part-time: 9h
Theory classes: 3h
Self study : 6h

9. Image processing techniques.

Description:
Basic stages in image processing. Binarization. Segmentation. Morphological processing. Labeling. Obtaining characteristics. Linear and nonlinear filtering of gray-scale images.

Full-or-part-time: 27h
Theory classes: 9h
Self study : 18h

10. Programming computer vision applications.

Description:
Programming computer vision applications using MATLAB.

Full-or-part-time: 16h
Theory classes: 3h
Laboratory classes: 7h
Self study : 6h

GRADING SYSTEM

The evaluation formula used in the course is the following:
- Robotics exam: 35%.
- Computer Vision exam: 35%.
- Laboratory: 15%.
- Exercises: 15%.

There is re-assessment exam in this subject.

BIBLIOGRAPHY

Basic:
- Antonio Barrientos [et al.]. Fundamentos de robótica [on line]. 2ª ed. Madrid [etc.]: McGraw-Hill, cop. 2007 [Consultation: 29/04/2020]. Available on: http://www.ingebook.com/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=4101. ISBN 9788448156367.
- González, Rafael C.; Woods, Richard E.; Eddins, Steven L. Digital Image processing using MATLAB. 2nd ed. [s.l.]: Gatesmark Publishing, 2009. ISBN 0982085400.

Complementary:
- Rentería, Arantxa; Rivas, María. Robótica industrial : fundamentos y aplicaciones. Madrid: McGraw Hill, cop. 2000. ISBN 8448128192.
- Fu, K. S.; González, Rafael C.; Lee, C. S. G. Robótica : control, detección, visión e inteligencia. Madrid: McGraw-Hill, 1988. ISBN 8476152140.
- J. Amat [et al.]. Robótica industrial. Barcelona: Marcombo Boixareu, cop. 1986. ISBN 8426706096.