



Teaching Guide

Identifying Data					2022/23
Subject (*)	Mobile Robotics	Code	770538020		
Study programme	Máster Universitario en Informática Industrial e Robótica				
Descriptors					
Cycle	Period	Year	Type	Credits	
Official Master's Degree	2nd four-month period	First	Optional	3	
Language	SpanishGalician				
Teaching method	Face-to-face				
Prerequisites					
Department	Ciencias da Computación e Tecnoloxías da InformaciónEnxeñaría IndustrialEnxeñaría Naval e Industrial				
Coordinador	Bellas Bouza, Francisco Javier	E-mail	francisco.bellas@udc.es		
Lecturers	Bellas Bouza, Francisco Javier Prieto Garcia, Abraham Quintían Pardo, Héctor	E-mail	francisco.bellas@udc.es abraham.prieto@udc.es hector.quintian@udc.es		
Web					
General description	The aim of the course is to provide a global vision of the problems to be dealt with and the existing solutions in the operation of mobile robots in industry, focusing on their autonomous operation. The course has a clearly practical focus, and the theoretical concepts will be worked on in a practical way through the programming of rolling robots, both real and simulated.				

Study programme competences

Code	Study programme competences
A1	CE01 - Capacidad para aplicar técnicas de análisis de datos y técnicas inteligentes en robótica y/o informática industrial
A4	CE04 - Capacidad para uso y desarrollo de código y librerías que permitan captar el entorno y actuar sobre él en sistemas robóticos y/o industriales
B2	CB7 - Que los estudiantes sepan aplicar los conocimientos adquiridos y su capacidad de resolución de problemas en entornos nuevos o poco conocidos dentro de contextos más amplios (o multidisciplinares) relacionados con su área de estudio
B5	CB10 - Que los estudiantes posean las habilidades de aprendizaje que les permitan continuar estudiando de un modo que habrá de ser en gran medida autodirigido o autónomo.
B9	CG4 - Extraer, interpretar y procesar información, procedente de diferentes fuentes, para su empleo en el estudio y análisis
B10	CG5 - Capacidad para proponer nuevas soluciones en proyectos, productos o servicios
B14	CG9 - Aplicar conocimientos de ciencias y tecnologías avanzadas a la práctica profesional o investigadora
C1	CT01 - Adquirir la terminología y nomenclatura científico-técnica para exponer argumentos y fundamentar conclusiones
C3	CT03 - Aplicar una metodología que fomente el aprendizaje y el trabajo autónomo

Learning outcomes

Learning outcomes	Study programme competences		
Ability to design, simulate and/or implement technological solutions involving the use of autonomous mobile robots in an industrial environment.	AC1 AC4	BC2 BC5 BC9 BC10 BC14	CC1 CC3
Understanding the scope and limitations of current autonomous mobile robots in terms of their sensing and actuation capabilities.	AC1 AC4	BC9 BC14	CC1 CC3
Understanding the fundamentals and main control techniques in autonomous robotics, and implement them practically on a mobile robot.	AC1 AC4	BC9 BC14	CC1 CC3
Understanding the particularities of using computer vision techniques in mobile robotics.	AC1 AC4	BC9 BC14	CC1 CC3



Understanding the fundamentals of the main problems of mobile autonomous robotics: localization, mapping and path planning, as well as a practical implementation of some of the main existing techniques.	AC1	BC9	CC1
	AC4	BC14	CC3

Contents	
Topic	Sub-topic
Introduction to mobile robotics	Locomotion: <ul style="list-style-type: none"> - Motors - Degrees of freedom - Legs - Wheels - Other effectors
Perception in mobile robotics	<ul style="list-style-type: none"> - Types of sensors - Sensors in mobile robotics <ul style="list-style-type: none"> -- Contact -- Distance -- Computer vision -- IMU -- GPS - Control architectures <ul style="list-style-type: none"> -- Deliberative -- Reactive -- Hybrid -- Communications
Movement control	- Position control system
Localization and mapping	<ul style="list-style-type: none"> - Navigation: <ul style="list-style-type: none"> -- Topological -- Metric - Simultaneous localisation and mapping <ul style="list-style-type: none"> -- Localisation (odometry, beacons) -- Visual SLAM
Trajectory planning	<ul style="list-style-type: none"> - Graph search - Wavefront-based planning

Planning				
Methodologies / tests	Competencies	Ordinary class hours	Student?s personal work hours	Total hours
Guest lecture / keynote speech	B5 B9 C1 C3	10.5	4.5	15
ICT practicals	B2 B5 B9 B10 B14 C1 C3	10	10	20
Oral presentation	A1 A4 B9 B10 B14	0.5	6.5	7
Supervised projects	A1 A4 B2 B10 B14 C1 C3	0	30	30
Personalized attention		3	0	3

(*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

Methodologies	
Methodologies	Description
Guest lecture / keynote speech	Oral presentation of the theoretical syllabus by the teachers of the course.



ICT practicals	Face-to-face sessions with the computer in which teachers will explain the use and programming of the mobile robotics techniques seen in theory, so that students acquire sufficient skills to use them autonomously. Real and/or simulated robots will be used.
Oral presentation	Theory paper(s) on a topic proposed by the teachers of the course, which must be presented in front of classmates and also handed in in writing.
Supervised projects	Carrying out work/projects outside the classroom in which different programmes related to the topics seen in practical classes will be implemented through ICT, using real or simulated robots selected by the subject teachers. These projects will be carried out autonomously by the students and their progress will be supervised by the lecturers.

Personalized attention

Methodologies	Description
Supervised projects ICT practicals	<p>During the practical work through ICT, the student will be able to consult the teacher about all the doubts that may arise regarding the programming of the robots.</p> <p>Tutored work: we recommend the use of personalised attention in these activities to resolve conceptual or procedural doubts that may arise during the resolution of practical problems. In addition, personalised attention will also focus on the student's explanation of the proposed solution.</p> <p>Oral presentation: students will have to go to the teachers to resolve any doubts they may have about the preparation of the work to be presented, both in terms of the content and the presentation itself.</p> <p>Students enrolled part-time will have an online personalised communication channel in all the methodologies.</p>

Assessment

Methodologies	Competencies	Description	Qualification
Supervised projects	A1 A4 B2 B10 B14 C1 C3	Several practical tasks will be proposed throughout the course focused on solving mobile robotics problems using real or simulated robots. These tasks will be developed autonomously by the student outside the classroom and must be defended in front of the lecturers.	70
Oral presentation	A1 A4 B9 B10 B14	The oral presentation of the theoretical work/works, the written version of the same and the active participation in the presentations of the classmates have an important weight in the final grade of the course.	30

Assessment comments

In order to obtain a pass in this subject, a minimum score of 50 must be passed by adding all the above methodologies, there being no minimum in any of them. If the student does not pass the subject in the ordinary exam, he/she will have to repeat the necessary activities of the methodology/s that were not passed in the extraordinary exam. As an example, if a student passed the Oral Presentation part but failed the Supervised Assignments, he/she will have to repeat the practical assignments necessary to achieve a pass, normally those that were not passed individually.

Assessment of the early sitting (December): students who opt for this sitting will have to repeat the tutored work and oral presentation methodologies. It is necessary to contact the lecturers at the beginning of the term in order to establish appropriate deadlines.

Students enrolled part-time, in the event of not being able to make the oral presentation with the rest of the students nor in person neither online, an alternative date must be arranged with the teachers. This modification must be requested to the teachers of the subject at the beginning of the course.

The fraudulent realisation of tests or activities, once verified, will directly imply the qualification of failing "0" in the subject in the corresponding call, thus invalidating any qualification obtained in all the assessment activities for the extraordinary call.

Sources of information



Basic	<ul style="list-style-type: none">- Kelly, Alonzo (2013). Mobile robotics: mathematics, models and methods. Cambridge University Press- Nehmzow, Ulrich (2003). Mobile robotics a practical introduction. Springer- ? Siegwart, Roland (2004). Introduction to autonomous mobile robots. MIT Press
Complementary	<ul style="list-style-type: none">- Joseph, Lentin (2015). Learning robotics using Python : design, simulate, program, and prototype an interactive autonomous mobile robot from scratch with the help of Python, ROS, and Open-CV. Packt Publishing- Robin R. Murphy (2000). Introduction to AI Robotics. A Bradford Book- Lynch, Kevin (2017). Modern robotics : mechanics, planning, and control. Cambridge University Press

Recommendations

Subjects that it is recommended to have taken before

Autonomous Robotics Applications/770538015
Machine Vision I/770538018
Introduction to Python for Engineers/770538011
Smart Robotics and Autonomous Systems/770538005

Subjects that are recommended to be taken simultaneously

Introduction to Python for Engineers/770538011
Machine Learning I/770538016

Subjects that continue the syllabus

Other comments

The documents to be deliver in this subject:- Virtual format or digital support will be requested.- They'll be done on the Virtual Campus without printing them.In case they?re done in paper:- Don't use plastics.- Use double-sided printing.- Use recycled paper.- Avoid printing drafts.

(*)The teaching guide is the document in which the URV publishes the information about all its courses. It is a public document and cannot be modified. Only in exceptional cases can it be revised by the competent agent or duly revised so that it is in line with current legislation.