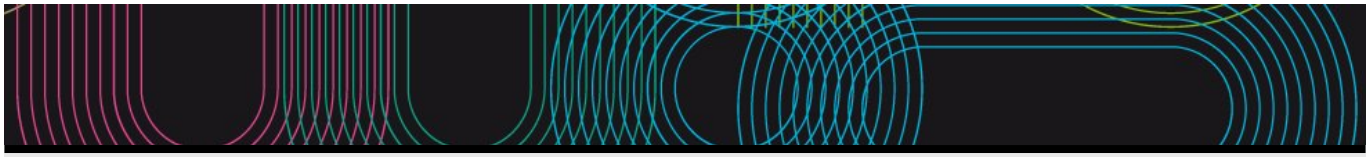

IDENTIFYING DATA				
On-board sensors				
Subject	On-board sensors			
Code	O07M174V01104			
Study programme	Máster Universitario en Operaciones e Ingeniería de Sistemas Aéreos no Tripulados			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	1st	1st
Teaching language	Spanish English			
Department				
Coordinator				
Lecturers				
E-mail				
Web	http://aero.uvigo.es			
General description	Course that shows the main sensors that integrate an unmanned aerial system, focusing especially on those of the navigation system. International students may request from the teachers: a) materials and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English.			

Training and Learning Results	
Code	
A3	That the students be able to integrate knowledge and face the complexity of formulating judgments from information, which being incomplete or limited, includes reflections on social and ethical responsibilities linked to the application of their knowledge and judgments
A4	That the students know how to communicate their conclusions - and the latest knowledge and reasons that support them - to specialized and non-specialized audiences in a clear and unambiguous manner
A5	That students have the learning abilities that allow them to continue studying in a way that will have to be largely self-directed and autonomous
B3	That students acquire the capabilities to analyze the needs of a company in the field of unmanned aerial systems and determine the best technological solution for the same
B4	That the students acquire the knowledge to develop unmanned aerial systems or to plan specific operations, depending on the existing needs and to apply the existing technological tools
B5	That students know and be able to apply the principles and methodologies of research, such as bibliographical searches, data collection and analysis and interpretation thereof, as well as the presentation of conclusions, in a clear, concise and rigorous way
D6	Ability to work as a team
D7	Capacity for organization and planning
D8	Ability of analysis and synthesis
D9	Capacity for critical reasoning and creativity

Expected results from this subject	
Expected results from this subject	Training and Learning Results

Know the existing inertial systems and the algorithms used to generate trajectories.	A3 A4 A5 B3 B4 B5 D6 D7 D8 D9
Learn to integrate the results of GNSS systems and inertial systems.	A3 A4 A5 B3 B4 B5 D6 D7 D8 D9
Know the barometric systems used in UAS.	A3 A4 A5 B3 B4 B5 D6 D7 D8 D9
Know the operation of systems based on pitot tube and ultrasound.	A3 A4 A5 B3 B4 B5 D6 D7 D8 D9
Understand of a LiDAR system, the data it provides (point clouds) and the possibilities it offers for indoor mapping with SLAM-type algorithms.	A3 A4 A5 B3 B4 B5 D6 D7 D8 D9
Understand the operation of image-based systems, as well as the generation of three-dimensional environments based on stereoscopic images and the basic algorithmics for image processing.	A3 A4 A5 B3 B4 B5 D6 D7 D8 D9

Contents
Topic
Inertial systems (accelerometers, gyroscopes and magnetometers.
Navigation. Complementary filter
Navigation. Kalman filter

Barometric systems, systems based on pitot tube and ultrasound systems.
LiDAR systems.
Basic processing of LiDAR data. Indoor navigation and SLAM.
Image based systems.
Image processing I
Image processing II
Photogrammetry and steoroscopic systems

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	10	0	10
ICT suppoted practices (Repeated, Dont Use)	22	22	44
Mentored work	7	63	70
Report of practices, practicum and external practices	0	10	10
Problem and/or exercise solving	3	13	16

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

Methodologies

	Description
Lecturing	Presentation of the contents using audiovisual media. The contents are uploaded on the online training platform
ICT suppoted practices (Repeated, Dont Use)	Practices will be carried out using computers in which students will have to program procedures to acquire sensor data or carry out signal conditioning operations
Mentored work	Small projects will be proposed that students must implement

Personalized assistance

Methodologies	Description
Lecturing	Face to face tutoring. Attention by email.
ICT suppoted practices (Repeated, Dont Use)	Face to face tutoring. Attention by email.
Mentored work	Face to face tutoring. Attention by email.

Assessment

	Description	Qualification	Training and Learning Results		
ICT suppoted practices (Repeated, Dont Use)	The student will have to submit reports for each of the practices carried out.	60	A3 A4 A5	B3 B4 B5	D6 D7 D8 D9
Mentored work	The student will have to deliver solved problems raised by the teacher.	40	A3 A4 A5	B3 B4 B5	D6 D7 D8 D9

Other comments on the Evaluation

Students to pass must submit all practice and problem reports. Everyone must individually achieve a minimum grade of 5.

In the July assessment, students must submit all those practice reports and problems that do not individually reach a minimum grade of 5.

Sources of information

Basic Bibliography

Eduardo Huerta, Aldo Mangiaterra, Gustavo Noguera, **GPS - Posicionamiento satelital**, UNR Editora, 2005

Oliver J. Woodman, **An introduction to inertial navigation**, Uniersity of Cambridge, 2007

José Bosch, Manuel Carmona, **Instrumentación electrónica avanzada**, Departament d'Electronica, Universitat de Barcelon, 2012

Omar Bustillos Ponte, **Instrumentación industrial**, Escuela de Ingeniería y Ciencias Aplicadas, Univer, 2001

Fabian Inostroza, **Filtros**, 2015

Greg Welch, Gary Bischop, **An introduction to the Kalman filter**, Department of Computer Science, University of Nort, 2006
Lindsay Kleeman, **Understanding and applying Kalman filtering**, Department of Electrical and Computer Systems Eng.,
James Hays, **Introduction to computer vision**,
Jan Erik Solem, **Programming Computer Vision with Python**,
Jamie Carter et al., **An introduction to LiDAR technology, data and applications**, National Oceanic and Atmospheric Administration,

Complementary Bibliography

Recommendations

Subjects that continue the syllabus

Sistemas de control/O07M174V01105

Subjects that it is recommended to have taken before

Fundamentals of unmanned aerial systems/O07M174V01101
Unmanned aerial systems operations/O07M174V01102
Radio communication and navigation systems/O07M174V01103