



## IDENTIFYING DATA

### (\*)Cargas útiles basadas en sensores activos

Subject	(*)Cargas útiles basadas en sensores activos			
Code	O07M174V01202			
Study programme	(*)Máster Universitario en Operacións e Enxeñaría de Sistemas Aéreos non Tripulados			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Optional	1st	2nd
Teaching language	Spanish English			
Department				
Coordinator	González Jorge, Higinio			
Lecturers	González Jorge, Higinio Martínez Sánchez, Joaquín			
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Web	<a href="http://aero.uvigo.es">http://aero.uvigo.es</a>			
General description	This subject shows the principles of operation of LiDAR and RADAR sensors, calibration procedures and data processing. 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.			

## Competencies

Code	
CB3	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
CB4	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
CB5	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
CG3	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
CG4	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
CG5	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
CT2	Ability to communicate orally and in writing in Galician
CT6	Ability to work as a team
CT7	Capacity for organization and planning
CT8	Ability of analysis and synthesis
CT9	Capacity for critical reasoning and creativity

## Learning outcomes

Learning outcomes	Competences
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Know the different active sensors existent, LiDAR and RADAR.	CB3 CB4 CB5 CG3 CG4 CG5 CT2 CT6 CT7 CT8 CT9
Understand the procedures of calibración of sensors.	CB3 CB4 CB5 CG3 CG4 CG5 CT2 CT6 CT7 CT8 CT9
Learn to integrate sensors mechanically, implementation of boresighting, utilization of gimbal and synchronization.	CB3 CB4 CB5 CG3 CG4 CG5 CT2 CT6 CT7 CT8 CT9
Know different techniques of LiDAR and RADAR data processing and the algorithms for operations of segmentation, classificaiton and generation of digital terrain models.	CB3 CB4 CB5 CG3 CG4 CG5 CT2 CT6 CT7 CT8 CT9
Know how to integrate LiDAR and RADAR data in geographic information systems.	CB3 CB4 CB5 CG3 CG4 CG5 CT2 CT6 CT7 CT8 CT9

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## Contents

Topic

LiDAR sensors.

RADAR sensors.

Sensor synchronization and range calibration

Orientation calibration. Boresighting.

UAS-LiDAR system for data acquisition.

Data processing I. Registration and geopositioning.

Data processing II. Filtering.

Data processing III. Rasterization and voxelization.

Data processing IV. Classification.

Results integration on geographic information systems.

<b>Planning</b>			
	Class hours	Hours outside the classroom	Total hours
Lecturing	10	0	10
Mentored work	7	63	70
ICT supported practices (Repeated, Dont Use)	22	22	44
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.

<b>Methodologies</b>	
	Description
Lecturing	Presentation of the contents using audiovisual media. The contents will be downloaded from the online platform.
Mentored work	Small projects that students should implement will be considered.
ICT supported practices (Repeated, Dont Use)	Practices will be carried out using computers in which the students will have to program a LiDAR data acquisition or perform the processing of LiDAR point clouds.

<b>Personalized assistance</b>	
Methodologies	Description
Lecturing	Face to face tutorials. Attention by email.
ICT supported practices (Repeated, Dont Use)	Face to face tutorials. Attention by email.
Mentored work	Face to face tutorials. Attention by email.

<b>Assessment</b>					
	Description	Qualification	Evaluated Competences		
Mentored work	The student will have to deliver problems solved by the professor	40	CB3 CB4 CB5	CG3 CG5	CT2 CT6 CT7 CT8 CT9
ICT supported practices (Repeated, Dont Use)	The student will have to deliver reports for each of the practices carried out	60	CB3 CB4 CB5	CG3 CG4 CG5	CT2 CT6 CT7 CT8 CT9

### **Other comments on the Evaluation**

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

In the July evaluation students must submit all reports of practices and problems that do not individually reach a minimum grade of 5.

### **Sources of information**

#### **Basic Bibliography**

**Light detection and ranging (LiDAR)**, Portland State University,

Jamie Carter et al., **An introduction to LiDAR technology, data and applications**, National Oceanic and Atmospheric Administration,

Francesc Rocadenbosch, **Introduction to LiDAR remote sensing systems**, Universitat Politècnica de Catalunya,

Frank A Ranking, **LiDAR applications in surveying and engineering**,

Demetrios Gatzolis, Hans-Erik Andersen, **A guide to LiDAR data acquisition and processing for the forests of the Pacific Northwest**, United States Department of Agriculture,

David Jenn, **RADAR fundamentals**, US Navy Postgraduate School,

**RADAR range equation**,

**RADAR tutorial**,

Andy Myrick et al, **Synthetic Aperture RADAR (SAR)**, Lincoln Laboratory - MIT,

## Complementary Bibliography

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### Recommendations

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#### Subjects that continue the syllabus

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(\*)Prácticas externas/O07M174V01205

(\*)Traballo Fin de Máster/O07M174V01206

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#### Subjects that it is recommended to have taken before

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(\*)Fundamentos de sistemas aéreos non tripulados/O07M174V01101

(\*)Operacións de sistemas aéreos non tripulados/O07M174V01102

(\*)Sensores embarcados/O07M174V01104

(\*)Sistemas de comunicacións e navegación por radio/O07M174V01103

(\*)Sistemas de control/O07M174V01105

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### Contingency plan

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#### Description

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In the event of a COVID19 health alert, all teaching, tutorization and assessment will become 100% virtual.

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