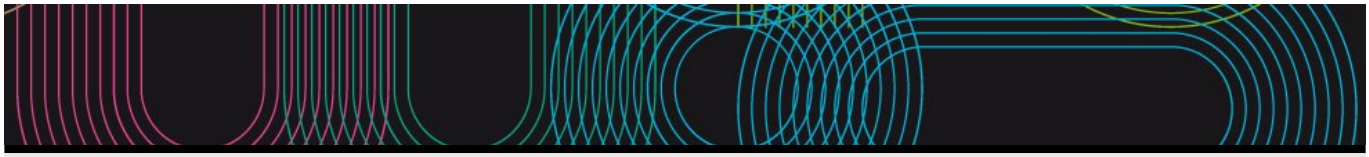

IDENTIFYING DATA				
Photogrametrics and robot vision				
Subject	Photogrametrics and robot vision			
Code	V05M185V01206			
Study programme	Máster Universitario en Visión por Computador			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	1st	2nd
Teaching language	English			
Department				
Coordinator	Martínez Sánchez, Joaquín			
Lecturers	Martínez Sánchez, Joaquín			
E-mail	joaquin.martinez@uvigo.es			
Web	http://https://www.imcv.eu/			
General description	In this subject students will learn to: 1.- Accurately model an image acquisition system from a geometric point of view; 2.- Model the relative orientation between images and the acquisition and processing methodologies to obtain a local system 3D model 3.- Describe and obtain a three-dimensional model in a global reference system based on orientation tools 4.-Integrate heterogeneus sensors and multimodal vision-laser information aimed at mapping and navigating the environment.			

Training and Learning Results	
Code	
A1	CB6 Possess and understand knowledge that provides a basis or opportunity to be original in the development and/or application of ideas, often in a research context
A4	CB9 Students should be able to communicate their findings - and the ultimate knowledge and reasons behind them - to specialist and non-specialist audiences in a clear and unambiguous manner
A5	CB10 Students should possess the learning skills to enable them to continue studying in a largely self-directed or autonomous manner.
C1	To know and apply the concepts, methodologies and technologies of image processing
C3	To know and apply the concepts, methodologies and technologies of image and video analysis
C5	To analyze and apply state-of-the-art methods in computer vision
C6	To know and apply the fundamentals of image acquisition and machine vision systems
C9	To know and apply the concepts, methodologies and technologies for the recognition of visual patterns in real scenes
D2	Capacity for teamwork, organization and planning

Expected results from this subject	Training and Learning Results
Know howto precisely modelling image acquisition systems from a geometrical point of view	A1 A4 A5 C6 C9 D2

Understand and apply the methodologies for image acquisition and processing oriented to obtain their relative orientation	A1 A4 A5 C1 C3 C5 C9 D2
Understand and apply orientation techniques aimed at obtaining georeferenced 3D models	A1 A4 A5 C1 C6 C9 D2
Understand and apply mapping and navigation techniques based on sensor fusion in a multimodal vision-laser system	A1 A4 A5 C1 C3 C6 C9 D2

Contents	
Topic	
Calibration of cameras. Geometrical transformations.	Geometrical properties of optical systems: Collinearity Condition. Geometrical resolution of a camera. Transformations in the plane: Similarity. Affinity. Projectivity. Polynomial transformations Calibration of a camera. Parameters. Errors. Iterative correction. Precision. Correction of perspective, rectification and metrology: Spatial image resection. Planar image rectification. Single view Measurement. Precision.
Relative and absolute orientation.	Coplanarity condition. Epipolar geometry and triangulation. Model Coordinate system . Quality Parameters and precision. Stereoscopic pairs. Absolute orientation. Global Reference Systems. Datum. Spatial Transformations. 7-Parameter Transformation.
Bundle Adjustment	Adjustment Models and self-calibration. Generation of orthoimages.
3D Point Clouds	Calculation and Collection 3D Processing
Robot Vision Applications	Motion estimation. Spatial image resection and Visual Odometry. Mapping.

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	10	20	30
Practices through ICT	25	40	65
Mentored work	0.5	20	20.5
Seminars	4	6	10
Objective questions exam	0.5	5	5.5
Problem and/or exercise solving	1	7.5	8.5
Report of practices, practicum and external practices	0.5	10	10.5
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
Lecturing	It will consisst of the collaborative discussion of contents of the course of way. This includes discussion and solving problems and practical case studies in the classroom.

Practices through ICT	Methodology oriented to solving cases of study related with the thematic of the course using software of reference. Practices and exercises focused on the implementation of the algorithms explained in the participatory classes. Specific hardware will be used in the laboratory in sessions of mandatory face-toface attendance
Mentored work	Taking into account proposed practical case studies, this method is oriented to solving and documenting a complete photogrammetric project, including the definition of: image acquisition methodologies in the field, supporting data collection for model georeferencing and the main photogrammetric products obtained through the photogrammetric process .
Seminars	The description of a concrete practical case related with the professional practice of photogrammetry.

Personalized assistance

Methodologies	Description
Lecturing	For all the modalities of teaching, tutorial session meetings could be held by telematic means (email, videoconference, forums in FAITIC, ...) Under the modality of previous agreement.
Practices through ICT	In the mandatory lab sessions there will be a continuous assesment of the student performance. For all the modalities of teaching, tutorial session meetings could be held by telematic means (email, videoconference, forums in FAITIC, ...) Under the modality of previous agreement.
Mentored work	For all the modalities of teaching, tutorial session meetings could be held by telematic means (email, videoconference, forums in FAITIC, ...) Under the modality of previous agreement.

Assessment

	Description	Qualification	Training and Learning Results		
Mentored work	The students will have to complete a case of study by means of the design of a methodology that include the steps seen in the course: 1.- Objectives, Requirements and Products analysis 2.- Definition of the image acquisition networks in the case study 3.- Image processing and analysis 4.- Obtaining key photogrammetric products	30	A1 A4 A5	C1 C3 C5 C6 C9	D2
Objective questions exam	The students will have to answer individually a test with questions about the contents of the course.	30	A1 A4 A5	C1 C3 C5 C6 C9	
Problem and/or exercise solving	The students will have to resolve of individual form and in small groups a group of cases and concrete practical exercises.	40	A1 A4 A5	C1 C3 C5 C6 C9	D2

Other comments on the Evaluation

For more information about the tests dates and schedule please visit the webpage of the programm: https://www.imcv.eu/

Sources of information

Basic Bibliography

Thomas Luhmann, **Close Range Photogrammetry**, Whittles Publishing, 2006

Richard Hartley, **Multiple view geometry in Computer Vision**, 2, Cambridge : Cambridge University Press, 2003

Karl Kraus, **Photogrammetry : geometry from images and laser scans**, 2, Berlin ; New York : Walter De Gruyter, cop., 2007

Complementary Bibliography

Wolfgang FörstnerBernhard P. Wrobel, **Photogrammetric Computer Vision**, Springer, 2016

Recommendations

Subjects that are recommended to be taken simultaneously

Instrumentation and processing for machine vision/V05M185V01104
Real time machine vision/V05M185V01207

Subjects that it is recommended to have taken before

Image description and modeling/V05M185V01102
Fundamentals of image analysis and processing/V05M185V01101