



Course guides

230621 - COMVIS - Computer Vision

Last modified: 06/05/2019

Unit in charge: Barcelona School of Telecommunications Engineering
Teaching unit: 739 - TSC - Department of Signal Theory and Communications.

Degree: Academic year: 2019 **ECTS Credits:** 5.0
Languages: English

LECTURER

Coordinating lecturer: JOSEP RAMON MORROS

Others: JAVIER RUIZ, VERÓNICA VILAPLANA

PRIOR SKILLS

Important: You should have the following previous knowledge to follow the course:- Image processing: pixels, color spaces, histograms, frequency domain representation - Digital signal processing: linear filters, convolution - Vector and matrix algebraNotions of Matlab are useful, but these are easily obtained during the course.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

1. Ability to apply information theory methods, adaptive modulation and channel coding, as well as advanced techniques of digital signal processing to communication and audiovisual systems.
2. Ability to integrate Telecommunication Engineering technologies and systems, as a generalist, and in broader and multidisciplinary contexts, such as bioengineering, photovoltaic conversion, nanotechnology and telemedicine.

Transversal:

3. TEAMWORK: Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.
4. EFFECTIVE USE OF INFORMATION RESOURCES: Managing the acquisition, structuring, analysis and display of data and information in the chosen area of specialisation and critically assessing the results obtained.
5. FOREIGN LANGUAGE: Achieving a level of spoken and written proficiency in a foreign language, preferably English, that meets the needs of the profession and the labour market.

TEACHING METHODOLOGY

- Lectures- Practical work- Group work (distance) - Individual work (distance) - Exercises- Extended answer test (Final Exam)

LEARNING OBJECTIVES OF THE SUBJECT

Learning objectives of the subject:The aim of this course is to provide an overview of concepts and applications of computer vision. We will introduce low level techniques such as feature extraction and matching, edge detection, cameras and projection models and optical flow; mid-level topics such as video segmentation and feature tracking; high level methods such as object tracking. Then, examples of application will be shown, such as face and object recognition. Learning results of the subject:- Ability to understand and use techniques for image and video analysis: feature extraction, video segmentation, stereo, object detection.- Ability to use computer vision algorithms to implement high-level applications.



STUDY LOAD

Type	Hours	Percentage
Hours large group	39	31.20
Self study	86	68.80

Total learning time: 125 h

CONTENTS

1. Introduction

Description:

- Motivation, types of problems in CV- Image formation, perception, 3D sensors

2. Image Structure

Description:

- Color, texture, filtering and contours- Detection and representation of interesting points and 'blobs'- Modelling: RANSAC, Hough transform - Saliency maps

3. Stereo and 3D applications

Description:

- Single camera geometry, camera calibration- Epipolar geometry, homography

4. Video tracking

Description:

- Optical flow: Lucas-Kanade, Shi-Tomasi- Bayesian tracking: Kalman, Particle filters

5. Detection and recognition

Description:

- Specific object recognition: face detection and recognition- Bag of Words models- Part-based models

ACTIVITIES

LABORATORY

Description:

- Detecting contours and modelling lines: Canny, Hough, Ransac- Finding correspondences between images: Harris, SIFT- Fundamental matrix estimation- Application of homography: panorama creation- Face detection & recognition



EXERCISES

Description:

Exercises to strengthen the theoretical knowledge.

EXTENDED ANSWER TEST

Description:

Mid-term examination.

Full-or-part-time: 2 h

Theory classes: 2h

EXTENDED ANSWER TEST

Description:

Second term examination

Full-or-part-time: 2 h

Theory classes: 2h

GRADING SYSTEM

First term examination: 40% Second term examination: 40% Laboratory/Exercises assessments: 20%

BIBLIOGRAPHY

Basic:

- Szeliski, R. Computer vision: algorithms and applications [on line]. London: Springer, 2011 [Consultation: 20/10/2014]. Available on: <http://site.ebrary.com/lib/upcatalunya/docDetail.action?docID=10421311>. ISBN 9781848829350.
- Forsyth, D.A.; Ponce, J. Computer vision: a modern approach. 2nd ed. Boston, Mass.: Pearson Education, 2012. ISBN 9780136085928.

Complementary:

- Hartley, R.; Zisserman, A. Multiple view geometry in computer vision. 2nd ed. Cambridge: Cambridge University Press, 2003. ISBN 978-0521540513.
- Wang, Y.; Ostermann, J.; Zhang, Y.-Q. Video processing and communications. Upper Saddle River: Prentice Hall, 2002. ISBN 9788131733646.
- Hanjalic, A. Content-based analysis of digital video [on line]. Boston: Kluwer Academic, 2004 [Consultation: 29/07/2013]. Available on: <http://link.springer.com/book/10.1007/b106003/page/1>. ISBN 978-1402081149.