2015/2016

Video Analysis

Code: 43082

Credits: 6

Type: OB/OT/TFM Course: 1 Semester: 1

Contact

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Lecturers

Montse Pardàs (Module co-coordinator)
Verónica Vilaplana (Module co-coordinator)
Javier Ruiz Hidalgo (Project co-coordinator)
Xavier Giró Nieto (Project co-coordinator)
Josep Ramon Casas Pla
Ramon Morros Rubio
Ferran Marques Acosta
David Varas González
Jordi González Sabaté

Use of languages

Principal working language: English

Prerequisites

Degree in Engineering, Maths, Physics or similar

Objectives and contextualisation

The objective of this module is to present the main concepts and technologies that are necessary for image sequence analysis. In the first place, we will present the applications of image sequence analysis and the different kind of data where these techniques will be applied: mono-camera video sequences, multi-camera and depth camera sequences. Both theoretical bases and algorithms will be studied. Main subjects will be motion segmentation, background subtraction, motion estimation both in 2D and 3D, tracking algorithms and model-based analysis. Higher level techniques such as gesture or action recognition and video retrieval will also be studied. Students will work on a project on traffic monitoring where they will apply the concepts learned in the course.

Skills and learning outcomes

E01 - Identify concepts and apply the most appropriate fundamental techniques for solving basic problems in computer vision.

01 - Identify the basic problems to be solved in image sequence analysis, along with the specific algorithms.

E02 - Conceptualise alternatives to complex solutions for vision problems and create prototypes to show the validity of the system proposed.

02 - Identify the best representations that can be defined for solving problems of image sequence analysis.

E03 - Choose the most suitable software tools and training sets for developing solutions to problems in computer vision.

03 - Choose the learnt techniques and train them to resolve a particular image sequence analysis project.

E04 - Plan, develop, evaluate and manage solutions for projects in the different areas of computer vision.

04 - Plan, develop, evaluate and manage a solution to a particular image sequence analysis problem.

B06 - Use acquired knowledge as a basis for originality in the application of ideas, often in a research context.

05 - Use acquired knowledge as a basis for originality in the application of ideas, often in a research context.

B07 - Solve problems in new or little-known situations within broader (or multidisciplinary) contexts related to the field of study.

06 - Solve problems in new or little-known situations within broader (or multidisciplinary) contexts related to the field of study.

B10 - Continue the learning process, to a large extent autonomously

07 - Continue the learning process, to a large extent autonomously.

T02 - Understand, analyse and synthesise advanced knowledge in the area, and put forward innovative ideas.

08 - Understand, analyse and synthesise advanced knowledge in the area, and put forward innovative ideas.

T03 - Accept responsibilities for information and knowledge management.

09 - Accept responsibilities for information and knowledge management.

T04 - Work in multidisciplinary teams.

10 - Work in multidisciplinary teams.

Content

1. Introduction to video analysis and tracking. Motion segmentation
2. Motion segmentation. Background subtraction
3. Motion estimation. Optical flow
4. Bayesian tracking (I)
5. Bayesian tracking (II)
6. Tracking with active shapes
7. Model-based tracking
8. Gesture and action recognition
9. Gesture and action recognition
10. Behaviour understanding in videos
11. Applications

Methodology

Supervised sessions:

- **Lecture Sessions**, where the lecturers will explain general contents about the topics. Some of them will be used to solve the problems.

Directed sessions:

- **Project Sessions**, where the problems and goals of the projects will be presented and discussed, students will interact with the project coordinator about problems and ideas on solving the project (approx. 1 hour/week)
- **Presentation Session**, where the students give an oral presentation about how they have solved the project and a demo of the results.
- **Exam Session**, where the students are evaluated individually. Knowledge achievements and problem-solving skills

Autonomous work:

- Student will autonomously study and work with the materials derived from the lectures.
- Student will work in **groups** to solve the problems of the projects with deliverables:
    - Code
    - Reports
    - Oral presentations

Activities

TYPE	ACTIVITY	HOURS	LEARNING OUTCOMES
Supervised			
	Project, Presentation and Exam Sessions	9	1, 2, 3, 4, 5, 6, 7, 8, 9, 10
Directed			
	Lecture Sessions	20	1, 2, 3
Autonomous			

Homework	112	1, 2, 3, 4, 5, 6, 7, 8, 9, 10

Evaluation

The **final marks** for this module will be computed with the **following formula**:

Final Mark = 0.4 x **Exam** + 0.55 x **Project**+ 0.05 x **Attendance**

where,

Exam: is the mark obtained in the Module Exam (must be >= 3)
Attendance: is the mark derived from the control of attendance at lectures (minimum 70%)
Projects: is the mark provided by the project coordinator based on the weekly follow-up of the project and deliverables. All accordingly with specific criteria such as:

- Participation in discussion sessions and in team work (inter-member evaluations)
- Delivery of mandatory and optional exercises.
- Code development (style, comments, etc.)
- Report (justification of the decisions in your project development)
- Presentation (Talk and demonstrations on your project)

Evaluation activities

TITLE	HOURS	WEIGHTING	LEARNING OUTCOMES
Exam	3	0,4	2, 4, 5, 7, 9
Project	7	0,55	1, 2, 3, 6, 7, 8, 9

Bibliography

Journal articles:

1. M. Piccardi. *"Background subtraction techniques: a review"*. Journal: IEEE Int. Conf. On Systems, Man and Cybernetics 2004 , v. 4, pp. 3099-3104, 2004.
2. A. Sobral, A. Vacavant, *"A comprehensive review of background subtraction algorithms evaluated with synthetic and real videos",* Journal: Computer Vision and Image Understanding Vol. 122, pp. 4-21 · May 2014.
3. S. Baker, D. Scharstein, JP. Lewis, S. Roth, M. Black, R. Szeliski. *"A database and evaluation methodology for optical flow".* Journal: International Journal of Computer Vision, Vol. 92:1, pp. 1-31, 2011.
4. T. Cootes, G. Edwards, C. Taylor. *"Active appearance models".* Journal: IEEE Transactions on Pattern Analysis and Machine Intelligence, Vol. 6, pp. 681--685, 2001.
5. R. Poppe*. "Vision-based Human motion analysis: an overview".* Journal: Computer Vision and Image Understanding 108 (1-2): 4-18, 2007

Book:

- *"Sequential Monte Carlo methods in practice",* A. Doucet, N. de Freitas and N.Gordon (Eds.), Springer, 2001.