230621 - COMVIS - Computer Vision

Coordinating unit: 230 - ETSETB - Barcelona School of Telecommunications Engineering
Teaching unit: 739 - TSC - Department of Signal Theory and Communications
Academic year: 2018
Degree: MASTER’S DEGREE IN INFORMATION AND COMMUNICATION TECHNOLOGIES (Syllabus 2009). (Teaching unit Optional)
MASTER’S DEGREE IN TELECOMMUNICATIONS ENGINEERING (Syllabus 2013). (Teaching unit Optional)
ECTS credits: 5
Teaching languages: English

Teaching staff
Coordinator: 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 algebra

Notions 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:

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

<table>
<thead>
<tr>
<th>Total learning time: 125h</th>
<th>Hours large group:</th>
<th>39h</th>
<th>31.20%</th>
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<tbody>
<tr>
<td></td>
<td>Hours medium group:</td>
<td>0h</td>
<td>0.00%</td>
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<tr>
<td></td>
<td>Hours small group:</td>
<td>0h</td>
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<tr>
<td></td>
<td>Guided activities:</td>
<td>0h</td>
<td>0.00%</td>
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<tr>
<td></td>
<td>Self study:</td>
<td>86h</td>
<td>68.80%</td>
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## Content

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<thead>
<tr>
<th>1. Introduction</th>
<th>Learning time: 7h</th>
</tr>
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<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>Theory classes: 3h</td>
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<td>Self study: 4h</td>
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- Motivation, types of problems in CV
- Image formation, perception, 3D sensors

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<tr>
<th>2. Image Structure</th>
<th>Learning time: 29h</th>
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<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>Theory classes: 9h</td>
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<tr>
<td></td>
<td>Guided activities: 4h</td>
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<tr>
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<td>Self study: 16h</td>
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- Color, texture, filtering and contours
- Detection and representation of interesting points and 'blobs'
- Modelling: RANSAC, Hough transform
- Saliency maps

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<tr>
<th>3. Stereo and 3D applications</th>
<th>Learning time: 30h</th>
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<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>Theory classes: 9h</td>
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<tr>
<td></td>
<td>Guided activities: 4h</td>
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<td>Self study: 17h</td>
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- Single camera geometry, camera calibration
- Epipolar geometry, homography

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<tr>
<th>4. Video tracking</th>
<th>Learning time: 29h</th>
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<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>Theory classes: 9h</td>
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<tr>
<td></td>
<td>Guided activities: 4h</td>
</tr>
<tr>
<td></td>
<td>Self study: 16h</td>
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- Optical flow: Lucas-Kanade, Shi-Tomasi
- Bayesian tracking: Kalman, Particle filters
5. Detection and recognition

**Learning time:** 30h
- Theory classes: 9h
- Guided activities: 4h
- Self study: 17h

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

Planning of 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

**Hours:** 2h
- Theory classes: 2h

**Description:**
Mid-term examination.

EXTENDED ANSWER TEST

**Hours:** 2h
- Theory classes: 2h

**Description:**
Second term examination
Qualification system

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

Bibliography

Basic:


Complementary:

