295106 - 29511022 - Computer Vision

Coordinating unit: 295 - EEBE - Barcelona East School of Engineering
Teaching unit: 749 - MAT - Department of Mathematics
Academic year: 2018
Degree:
ECTS credits: 6
Teaching languages: English

Teaching staff

Coordinator: José Rodellar
Others: Raul Benitez, Jordi Torner, Francesc Alpiste, Santiago Alférez, Antoni Grau

Prior skills

Programming. Basic statistics.

Learning objectives of the subject

- Recognize different image modalities and their applications.
- Perform advanced manipulations of digital images stored in different file formats.
- Perform automatic segmentation and extraction of descriptors.
- Develop and implement algorithms for the automatic recognition of special patterns in images based on machine and deep learning methods.
- Getting an overview to VR development with Unity and introducing VR elements and user input.
- Introducing to different VR technologies and building an application.
- Publishing apps in Unity and exporting to mobile devices.
- Design and implement appropriate pipelines for specific real problems, including input datasets, decision on the most appropriate techniques and interpretation of the results.
- Generate high level reports including developments, evaluations and conclusions.

Study load

<table>
<thead>
<tr>
<th>Total learning time: 150h</th>
<th>Hours large group: 34h</th>
<th>22.67%</th>
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<tbody>
<tr>
<td></td>
<td>Hours medium group: 0h</td>
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<td>Hours small group: 20h</td>
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<td>Guided activities: 0h</td>
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<td>Self study: 96h</td>
<td>64.00%</td>
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# Content

| **Image processing** | **Learning time:** 12h  
| | Theory classes: 8h  
| | Laboratory classes: 4h |

**Description:**
- Image preprocessing: intensity transformations, spatial and statistical filters, filtering in the frequency domain
- Image segmentation: Otsu, watershed, morphological operations
- Feature extraction: geometrical descriptors, color spaces, texture analysis

**Related activities:**
- Laboratory session 1: Image preprocessing
- Laboratory session 2: Segmentation and features

**Specific objectives:**
Understand the essential steps from an original image to its final representation by means of quantitative descriptors.

| **Pattern recognition in images** | **Learning time:** 16h  
| | Theory classes: 10h  
| | Laboratory classes: 6h |

**Description:**
- Machine learning based on features: Linear discriminant analysis, Bayes classifier, principal component analysis, decision trees and support vector machines.
- Specialized architectures and codes for structured implementations.

**Related activities:**
- Laboratory session 3: Machine learning
- Laboratory session 4: Convolutional neural networks 1
- Laboratory session 5: Convolutional neural networks 2

**Specific objectives:**
Understand the theoretical background, formulate problems in biomedical and other application areas, develop and implement computer codes and be able to decide which algorithms perform better for each problem.
### Virtual reality

**Learning time:** 12h  
Theory classes: 4h  
Laboratory classes: 8h

**Description:**  
- Overview of virtual reality (VR) hardware and software to learn different ways to get started with this technology.  
- Practical cases of current applications ongoing in the biomedical sector.

**Related activities:**  
Laboratory session 6:  
Laboratory session 7:  
Laboratory session 8:  
Laboratory session 9:

**Specific objectives:**  
Develop and publish VR apps using Unity 3D platform. Presenting biomedical applications practical cases: Rehabilitation, surgical planning, 3D reconstruction, cognitive training, and others.

### Applications

**Learning time:** 14h  
Theory classes: 12h  
Laboratory classes: 2h

**Description:**  
Applications of the methodologies to practical problems in areas like:  
Robotics  
Medical images  
Satellite images  
Virtual reality

**Related activities:**  
Laboratory session 10: Application.

**Specific objectives:**  
Understand and solve specific problems using real data.

### Qualification system

- Partial exam 30%  
- Final exam 30%  
- Projects 40%
Bibliography

Basic:


Others resources:

Contents and software uploaded to Atenea