

**Module Description, available in: EN**

## Digital Image Processing

**General Information****Number of ECTS Credits**

3

**Module code**

FTP\_DigImPro

**Valid for academic year**

2021-2022

**Last modification**

2021-01-12

**Coordinator of the module**

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**Explanations regarding the language definitions for each location:**

- Instruction is given in the language defined below for each location/each time the module is held.
- Documentation is available in the languages defined below. Where documents are in several languages, the percentage distribution is shown (100% = all the documentation).
- The examination is available 100% in the languages shown for each location/each time it is held.

	Berne	Lausanne	Lugano	Zurich
<b>Instruction</b>		X E 100%		X E 100%
<b>Documentation</b>		X E 100%		X E 100%
<b>Examination</b>		X E 100%		X E 100%

**Module Category**

FTP Fundamental theoretical principles

**Lessons**

2 lecture periods and 1 tutorial period per week

**Entry level competences****Prerequisites, previous knowledge****Math** : basic calculus, linear algebra, probability, derivatives, matrix & vector product, orthogonal bases, eigenvalues, eigenvectors**Programming** : good command of any structured programming language (e.g., Python, Matlab, R, Java, C, C++)**Statistics** : mean, standard deviation, variance, co-variance, histograms, normal (gaussian) distribution**Signal Processing** : Linear&invariant systems, Convolution, 1D-filtering, Sampling, Fourier Transform

## Brief course description of module objectives and content

The goal of this module is to teach the fundamentals of image processing, while putting emphasis on their mathematical and algorithmic principles. In addition, specific 2D and 3D industrial and biomedical applications will be treated.

## Aims, content, methods

### Learning objectives and acquired competencies

Upon completion of this lecture, the students should be able to formulate an image processing problem and to propose and pursue alternative ways to its solution. They can discuss and compare different algorithms and their implementations with regard to robustness, speed and complexity.

### Contents of module with emphasis on teaching content

#### 1. Digital Image Fundamentals

- Linear and nonlinear systems
- Coordinate systems
- Geometric transformations
- Statistics: mean, standard deviation, histograms

#### 2. From 2D to 3D

- Camera model
- Epipolar geometry

#### 3. Linear and nonlinear filtering

- Convolution
- Correlation
- Spatial and frequency domain filtering

#### 4. Morphological Image Processing

- Erosion & Dilatation, Opening and Closing
- Hit-or-Miss-Transformation (HMT)
- Connected Filtering

#### 5. Image Segmentation

- Edge based
- Region based
- Intensity based

#### 6. Image description

- Boundary descriptors
- Regional descriptors
- Texture descriptors
- Salient points

#### 7. Object Recognition

- Model based
- Bayesian classifier
- Modern methods

### Teaching and learning methods

Classroom teaching and exercises (paper & with computer)

### Literature

Digital Image Processing (Gonzalez & Woods) 4th edition

## Assessment

### Certification requirements

Module does not use certification requirements

### Basic principle for exams

As a rule, all the standard final exams for modules and also all resit exams are to be in written form

### Standard final exam for a module and written resit exam

**Kind of exam**

written

**Duration of exam**

120 minutes

**Permissible aids**

*Aids permitted as specified below:*

**Permissible electronic aids**

No electronic aids permitted

**Other permissible aids**

open book

**Special case: Resit exam as oral exam**

**Kind of exam**

oral

**Duration of exam**

30 minutes

**Permissible aids**

*Aids permitted as specified below:*

**Permissible electronic aids**

No electronic aids permitted

**Other permissible aids**

open book