EE-550

# Image and video processing

Ebrahimi Touradj

| Cursus | Sem. | Type |
|---|---|---|
| Digital Humanities | MA1, MA3 | Opt. |
| Electrical and Electronical Engineering | MA1, MA3 | Opt. |

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| Language of teaching | English |
| Credits | 6 |
| Session | Winter |
| Semester | Fall |
| Exam | Oral |
| Workload | 180h |
| Weeks | 14 |
| **Hours** | **6 weekly** |
| Lecture | 4 weekly |
| Project | 2 weekly |
| **Number of positions** | |

## Summary

This course covers fundamental notions in image and video processing, as well as covers most popular tools used, such as edge detection, motion estimation, segmentation, and compression. It is composed of lectures, laboratory sessions, and mini-projects.

## Content

**Introduction, acquisition, restitution**
Two-dimensionnal signals and systems, Elementary signals, Properties of two-dimentional Fourier transform, Discretization (spatial and spatio-temporal artefacts), Two-dimensional digital filters, Two-dimensional z-transform, Transfer function. Captors, monitors, printers, half-toning, color spaces.
**Multi-dimensional filtres**
Design of Infinite Impulse Response and Finite Impulse Response filters, Implementation of multi-dimensional filters, Directional decomposition and directional filters, M-D Sub-band filters, M-D Wavelets.
**Visual perception**
Neural system, Eye, Retina, Visual cortex, Model of visual system, Special effects, Mach phenomena and lateral inhibition, Color, Temporal vision.
**Contour and feature extraction, segmentation**
Local methods, Region based methods, Global methods, Canny, Mathematical morphology. Segmentation, Motion estimation
**Visual information coding**
Overview of the information theory and basics of rate-distortion, Conventional techniques : predictive coding, transform coding, subband coding, vector quantization, Advanced methods : multiresolution coding, perception based coding, region based coding, directional coding, fractals, Video coding : motion compensation, digital TV, High definition TV. Standards: JPEG, MPEG, H.261, H.263

## Keywords

Contour detection, motion estimation, segmentation, human visual system, image compression, video compression

## Learning Prerequisites

### Required courses

Fundamental notions of signal processing

### Recommended courses

Signal processing for communication

### Important concepts to start the course

Sampling, quantization, transforms, programming, algorithms, systems

## Learning Outcomes

By the end of the course, the student must be able to:

- Create simple image processing systems
- Create simple video processing systems
- Compare image processing tools
- Compare video processing tools
- Select appropriately optimal image and video processing tools

## Transversal skills

- Make an oral presentation.
- Write a scientific or technical report.

## Teaching methods

Ex cathedra, laboratory sessions, mini-projects

## Expected student activities

Written report of laboratory sessions, oral presentation of mini-projects, comprehension of various notions presented during the course, resolve simple problems of image and video processing.

## Assessment methods

Laboratories, mini-project, oral exam

## Supervision

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| Others | Students are encouraged to ask for appoitment with the professor any time outside of teaching hours |

## Resources

### Bibliography

handouts of image and video processing course
Fundamentals of Digital Image Processing, A. K. Jain

### Ressources en bibliothèque

- Fundamentals of Digital Image Processing / Jain

### Moodle Link

- https://go.epfl.ch/EE-550

## Prerequisite for

Semester projects , master thesis projects, doctoral thesis