MICRO-512 **Image processing II**

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Cursus	Sem.	Type
Computational science and Engineering	MA2, MA4	Opt.
Computational science and engineering minor	E	Opt.
Computer science	MA2, MA4	Opt.
Cybersecurity	MA2, MA4	Opt.
Data Science	MA2, MA4	Opt.
Digital Humanities	MA2, MA4	Opt.
Environmental Sciences and Engineering	MA2, MA4	Opt.
Life Sciences Engineering	MA2, MA4	Opt.
Microtechnics	MA2, MA4	Opt.
Minor in Imaging	E	Opt.
Neuro-X minor	E	Opt.
Neuro-X	MA2, MA4	Opt.
Photonics minor	E	Opt.
Robotics, Control and Intelligent Systems		Opt.
Robotics	MA2, MA4	Opt.
SC master EPFL	MA2, MA4	Opt.

Language of teaching	English
Credits	3
Session	Summer
Semester	Spring
Exam	Written
Workload	90h
Weeks	14
Hours	**3 weekly**
Courses	2 weekly
Exercises	1 weekly
Number of positions	

Summary

Study of advanced image processing; mathematical imaging. Development of image-processing software and prototyping in Jupyter Notebooks; application to real-world examples in industrial vision and biomedical imaging.

Content

- **Directional image analysis.** Mathematical foundations. Structure tensor. Steerable filters.
- **Continuous representation of discrete data.** Splines. Interpolation. Geometric transformations. Multi-scale decomposition (pyramids and wavelets).
- **Image transforms.** Karhunen-Loève transform (KLT). Discrete cosine transform (DCT). JPEG coding. Image pyramids. Wavelet decomposition.
- **Reconstruction in the continuum.** Wiener filter. Radon transform. Fourier slice theorem. Filtered backprojection.
- **Computational imaging.** Imaging as an inverse problem. Iterative reconstruction methods. Elements of convex analysis. Regularization & sparsity constraints.

Learning Prerequisites

Required courses

Image Processing I

Recommended courses

Signals and Systems I & II, linear algebra, analysis

Important concepts to start the course

Basic image processing and related analytical tools (Fourier transform, z-tranform, etc.)

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Learning Outcomes

- Construct interpolation models and continuous-discrete representations
- Analyze image transforms
- Design image-reconstruction algorithms
- Formalize multiresolution representations using wavelets
- Design deconvolution algorithms
- Perform image analysis and feature extraction
- Design image-processing software (plugins)
- Synthesize steerable filters
- Construct interpolation models and continuous-discrete representations
- Analyze image transforms
- Design image-reconstruction algorithms
- Formalize multiresolution representations using wavelets
- Perform image analysis and feature extraction
- Design image-processing software
- Design image reconstruction algorithms

Transversal skills

- Plan and carry out activities in a way which makes optimal use of available time and other resources.
- Manage priorities.
- Access and evaluate appropriate sources of information.
- Use both general and domain specific IT resources and tools

Assessment methods

The objectives of the course will be assessed as follows:

- 70% final exam
- 30% IP labs

Resources

Moodle Link

- https://go.epfl.ch/MICRO-512