## Image processing II

Liebling Michael, Sage Daniel, Unser Michaël, Van De Ville Dimitri

<table>
<thead>
<tr>
<th>Cursus</th>
<th>Sem.</th>
<th>Type</th>
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<tbody>
<tr>
<td>Computational science and Engineering</td>
<td>MA2, MA4</td>
<td>Opt.</td>
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<tr>
<td>Computational science and engineering minor</td>
<td>E</td>
<td>Opt.</td>
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<tr>
<td>Computer science</td>
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<td>Opt.</td>
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<td>Cybersecurity</td>
<td>MA2, MA4</td>
<td>Opt.</td>
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<td>Digital Humanities</td>
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<td>Opt.</td>
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<td>Environmental Sciences and Engineering</td>
<td>MA2, MA4</td>
<td>Opt.</td>
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<td>Life Sciences Engineering</td>
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<td>Opt.</td>
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<td>Microtechnics</td>
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<td>Minor in Imaging</td>
<td>E</td>
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<td>Neuro-X</td>
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<td>Photonics minor</td>
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<td>Robotics, Control and Intelligent Systems</td>
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<td>Robotics</td>
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<tr>
<td>SC master EPFL</td>
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### Language of teaching
- English

### Credits
- 3

### Session
- Summer
- Spring

### Exam
- Written

### Workload
- 90h

### Weeks
- 14

### Hours
- 3 weekly

### Lectures
- 3 weekly

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**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.
- **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-transform, 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