**Imaging optics**

Psaltis Demetri

### Cursus

<table>
<thead>
<tr>
<th>Cursus</th>
<th>Sem.</th>
<th>Type</th>
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<tbody>
<tr>
<td>Electrical and Electronical Engineering</td>
<td>MA2, MA4</td>
<td>Opt.</td>
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<tr>
<td>Life Sciences Engineering</td>
<td>MA2, MA4</td>
<td>Opt.</td>
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<tr>
<td>Mechanical engineering</td>
<td>MA2, MA4</td>
<td>Opt.</td>
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<tr>
<td>Microtechnics</td>
<td>MA2, MA4</td>
<td>Opt.</td>
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<tr>
<td>Minor in Imaging</td>
<td>E</td>
<td>Opt.</td>
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<td>Photonics minor</td>
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### Summary

Introduction to optical imaging systems such as camera objectives and microscopes. Discussion of imaging formation. Principles of design of imaging optics with geometrical optics and analysis with raytracing. Presentation of different applications in photography and microscopy.

### Content

- Light: electro-magnetic waves, scalar theory
- Statistical optics: temporal and spatial coherence
- Fourier optics representation of imaging
- Image quality - Point-spread function and optical transfer functions
- Detection of light: noise and detectors
- Microscopy: dark field, phase and polarization contrast, fluorescence
- Optical design; beam propagation code
- Holography, tomography, 3D imaging, confocal

### Keywords

Optical imaging, optical instruments, optical design, performance analysis, aberrations, resolution and contrast, microscopy

### Learning Prerequisites

**Required courses**
- Micro 321 Ingénierie optique I
- Micro 322 Ingénierie optique II
- Analysis IV, Linear algebra, General physics III/IV

**Recommended courses**
- Signals and systems, Image processing

### Important concepts to start the course
Matrix calculations, Fourier transformation, Electromagnetic waves, refraction and reflection, polarization, signal filtering, basics of geometrical optics

Learning Outcomes

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

• Sketch optical systems
• Estimate performance of optical systems
• Analyze imaging systems and the image quality
• Characterize the elements of imaging systems

Transversal skills

• Set objectives and design an action plan to reach those objectives.
• Communicate effectively with professionals from other disciplines.
• Continue to work through difficulties or initial failure to find optimal solutions.

Teaching methods

Lecturing with exercises

Assessment methods

During semester evaluation. Final written exam in the last day of class.

Supervision

Office hours  No
Assistants Yes
Forum No
Others Possible to take dates

Resources

Virtual desktop infrastructure (VDI)
No

Bibliography

B.A. Saleh and M.C. Teich, Fundamental of photonics (2007)

Ressources en bibliothèque

• Fundamental of photonics / Saleh
• Introduction to Fourier optics / Goodman

Notes/Handbook
Course material and slides covering geometrical and matrix optics, Fourier optics, microscopy are published on Moodle

**Moodle Link**

- [https://go.epfl.ch/MICRO-421](https://go.epfl.ch/MICRO-421)