

Waves propagation



In brief

➤ **Course language:** English

Presentation

Prerequisites

Mathematics

- Single variable calculus (derivatives, integrals) [essential]
- Basic multivariable calculus (gradients, partial derivatives) [essential]
- Differential equations (how to solve basic first/second ODEs) [essential]

Physics

- Basic mechanics (Newton's laws) [essential]
- Basic electromagnetism [preferred]

Programing

- Basic programing skills of Python (or Matlab) [preferred]

Learning objectives

The student after the course will:

- learn the basics of waves/wave-like phenomena;
- know how to model them correctly, both mathematically and numerically;

- understand when it is important to use them or when they can be substituted by simpler models, such as the geometric ones;
- have an overview of some biomedical applications, such as imaging techniques.

In this course, physical intuition and practical modeling are highlighted.

Description of the programme

Waves / wave-like phenomena are present everywhere and are very important. They appear in natural phenomena and human-made devices; hence their study is essential for science and technology. Applications range from biomedical imaging (ultrasound imaging, magnetic resonance imaging, optical coherence tomography, etc.) all the way to telecommunication and detection (antennas, radar, optical fibers, etc.).

In this course a general introduction to all wave-like phenomena is given. It provides an overview of the laws and methods used for modelling the propagation of waves. Electromagnetic/optic waves are studied with more detail, however, analogies with mechanical scenarios, such as sound and shear waves, are also mentioned. Aspects covered include the theory of diffraction, refraction, reflection, as well as more advanced topics such as polarization and the statistical properties of light and other waves.

Bibliography

Wave physics (general)

- Frank S. Crawford, Waves, McGrawHill.
- Howard Georgi, The physics of waves, Prentice Hall.

Mechanical waves

- Heinrich Kuttruff, Room Acoustics, Spon Press.

Optics and electromagnetism

- Eugene Hecht, Optics, Pearson Education.
- Joseph Goodman, Introduction to Fourier Optics, McMillan.

Teaching team

Luis Arturo ALEMAN-CASTANEDA (aleman-castaneda@fresnel.fr)

Total des heures

CM	Master class	24h
TD	Directed work	16h
		8h

Useful info

Name responsible for EU

Lead Instructor

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