Master Physique fondamentale et applications
Imaging and systems in optics

Responsable

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Descriptions

Code : SPFAU22

Nature : Unité d'enseignement

Domaines : Sciences et Technologies

Informations

Composante : Faculté des Sciences

LANGUE(S) D'ENSEIGNEMENT

Anglais

CONTENU

The students from different backgrounds refresh and elaborate their knowledge of the principles of optical imaging. The course starts with a reminder of the Huygens-Fresnel principle and of the Fresnel and Fraunhofer theories of diffraction. Then, a more general and rigorous approach, based on the resolution of Maxwell's equations, is adopted. The principles of image formation are studied using this approach. In particular, the link between the object defined by its permittivity distribution and the data collected for a given illumination (coherent or non coherent) is studied. The role of optical lenses, mirrors and the limitations of the performances of optical imaging systems (telescopes, far-field microscopes, near-field microscopes) in terms of resolution, accuracy are discussed.

Applications in astronomy, biology, nanotechnology… and solutions implemented for increasing the performances are studied. Recent advances in optical imaging are presented throughout this course.

I – Introduction
I.1 – Image-vision
I.2 – Brief description of the main imaging systems : microscopes, telescopes

II – Interaction between electromagnetic waves and heterogeneous objects
II.1 – Maxwell's equations
II.2 – Calculation of the scattered field with volume integral method
II.3 – Total field inside the object
II.4 – Numerical calculation
II.5 – Fourier transform of the Green function
II.6 – Green function in far-field

III – Optical imaging
III.1 – Accessible data, Optical Transfer Function
III.2 – Optical microscopes: field propagation, role of lenses, measured signal, cases of spatially coherent and incoherent illumination

COMPÉTENCES À ACQUÉRIR

- determine the link between the object (described by its permittivity distribution) and the diffracted field using an electromagnetic approach
- determine the link between the object (described by its fluorophore density) and the fluorescence intensity using an electromagnetic approach
- know what are the main approximated theories of diffraction with their limitations and domains of validity
- understand the difference between near field imaging and far field imaging
- understand the difference between coherent and incoherent imaging
- know what are the characteristics of the main imaging systems in optics (telescopes, microscopes…)
- know what are the origins of the limitations of optical systems in terms of resolution and accuracy
- know the solutions implemented in order to overcome the main limitations of classical imaging systems in optics

MODALITÉS D'ORGANISATION

Two hours sessions of mixed courses and tutorials

BIBLIOGRAPHIE, LECTURES RECOMMANDÉES

For the prerequisites: E. Hecht: Optics

J. Mertz : Introduction to optical microscopy

PRÉ-REQUIS OBLIGATOIRES

geometrical optics; wave optics : interferences, diffraction, optical coherence; electromagnetism

VOLUME HORAIRE

- Volume total: 30 heures
- Cours magistraux: 20 heures
- Travaux dirigés: 10 heures

CODES APOGÉE

- SPFAU22J [ELP]

M3C

Aucune donnée M3C trouvée

POUR PLUS D'INFORMATIONS

Aller sur le site de l'offre de formation...

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