UNIVERSITEIT GENT

Studiefiche

Vanaf academiejaar 2024-2025

Bio-imaging and Image Informatics (I002617)

Cursusomvang *(nominale waarden; effectieve waarden kunnen verschillen per opleiding)*

Studiepunten 4.0 **Studietijd 120 u**

Aanbodsessies in academiejaar 2024-2025

A (semester 1) Engels Gent

Lesgevers in academiejaar 2024-2025

Skirtach, Andre	LA25	Verantwoordelijk lesgever
Parakhonskiy, Bogdan	LA25	Medelesgever

Aangeboden in onderstaande opleidingen in 2024-2025	**stptn**	**aanbodsessie**
Master of Science in Bioinformatics(afstudeerrichting Bioscience Engineering)	4	A
Master of Science in Bioscience Engineering: Cell and Gene Biotechnology	4	A
Uitwisselingsprogramma bio-ingenieurswetenschappen: cel- en genbiotechnologie (niveau master-na-bachelor)	4	A
Uitwisselingsprogramma Bioinformatics (niveau master)	4	A

Onderwijstalen

Engels

Trefwoorden

Bio-imaging, Microscopy, Image Processing, Image Analysis

Situering

The goal of this course is to provide a broad overview of different modalities for acquiring images and analyzing image data sets from biological material at the *nano-, micro- and macroscopic level*, with an eye on extracting qualitative as well as quantitative information.

Inhoud

We start off with a module explaining the basic concepts in microscopy-based image formation to define the possibilities and limitations of the available imaging technologies. In this module, standard fluorescence- and transmission light- as well as more advanced electron- and label-free Raman/IR (infrared), AFM (Atomic Force Microscopy) technologies are discussed. Their application ranges, recent developments in research as well as industrial applications (e.g. holographic microscopy) are also considered. The increase in throughput and variability in human interpretation calls for objective, automated image analyses, which will be treated in a second module. Finally, a third module will focus on the state-of-the-art of multimode microscopy integration methods and applications, emphasizing their multidisciplinary character and integration with bio- and nano- technologies.

Breakdown

Chapter I. Imaging modalities
• Light Microscopy
- Basics of Optical Microscopy (bright-field, phase contrast, fluorescence)
- Advanced Light Microscopy Techniques (confocal, live-cell, non-linear)
- Fluorophores
- Single molecule imaging and Superresolution
• Label-free imaging
- Atomic Force Microscopy (AFM)
- Raman scattering and IR (infrared) Microscopy
• (cryo)-Electron Microscopy
- Scanning Electron Microscopy
- Transmission Electron Microscopy

Chapter II. Image Analysis
• Image Properties and Image Processing
- Raster versus Vector Images
- Pixel, Neighbourhood, Morphological Operations. Kernel
- Frequency Domain and Image Reconstruction
• Image Analysis
- Feature Extraction and Elements of Machine Learning Algorithm

Chapter III. Interaction and integration
• Medical Imaging and Photo-manipulation (optical tweezers)
• Correlative, Multimodal (for example, Light and Electron) Microscopy
• High-throughput and lab-on-chip technologies

Begincompetenties

Basics of cell biology, optics and informatics

Eindcompetenties

1 Understand the basic principles of modern imaging technologies, their components and methods, and their advantages and disadvantages.
2 Apply imaging methods including selecting appropriate imaging techniques and sample preparation methods for a biological problem.
3 Apply basic image processing in ImageJ, analysis tools, and workflows for image analyses.
4 Know bio-chemical and biomolecular principles of fluorescence of molecules.
5 Be familiar with modern and recent developments in the area of instrumentation used in biological image formation.
6 Know and apply optical ray tracing and propagation in a lens system and a microscope.
7 Know the resolution limits of optical, label-free and electron microscopy in regard with applicaiton to cells and biological objects.
8 Understand the atomic structure, molecular mechanisms and principles of vibrations of atoms in bio-molecules and thier effect on the scattering of light and electrons.
9 Be able to choose appropriate operation conditions and perform alignment of a microscope.
10 Know complementarity and applicability of label-free methods versus fluorescecne microscopy in biological image formation.

Creditcontractvoorwaarde

Toelating tot dit opleidingsonderdeel via creditcontract is mogelijk mits gunstige beoordeling van de competenties

Examencontractvoorwaarde

Dit opleidingsonderdeel kan niet via examencontract gevolgd worden

Didactische werkvormen

Hoorcollege, Practicum, Zelfstandig werk

Toelichtingen bij de didactische werkvormen

The course consists of theoretical lectures, which are accompanied by practical sessions/demonstrations (including PC). Hand-out and references contain comprehensive information about all subjects.
A number of practicum sessions are planned. In one of them students build their own microscope based on their calculations. Other practicums involve either direct hands-on work or demos with commercially available instruments.
There are also presentations by groups of students on a chosen subject, which is covered in the course. Some other groups are expected to ask a question or questions related to the subject of the presentation.

Studiemateriaal

Geen

Referenties

Most references are in the handout material

Vakinhoudelijke studiebegeleiding

Evaluatiemomenten

periodegebonden en niet-periodegebonden evaluatie

Evaluatievormen bij periodegebonden evaluatie in de eerste examenperiode

Schriftelijke evaluatie

Evaluatievormen bij periodegebonden evaluatie in de tweede examenperiode

Schriftelijke evaluatie

Evaluatievormen bij niet-periodegebonden evaluatie

Participatie, Werkstuk

Tweede examenkans in geval van niet-periodegebonden evaluatie

Examen in de tweede examenperiode is mogelijk

Eindscoreberekening

end-of-term evaluation (95 %) continuous assessment (5 %)