FSK3522 Quantitative Data Analysis and Processing for Microscopy 7.5 credits

Kvantitativ databehandling och analys för mikroskopi

This is a translation of the Swedish, legally binding, course syllabus.

Establishment

Course syllabus for FSK3522 valid from Autumn 2018

Grading scale

G

Education cycle

Third cycle

Specific prerequisites

Admitted to PhD studies in Physics, Biological physics or related fields of study.

Language of instruction

The language of instruction is specified in the course offering information in the course catalogue.

Intended learning outcomes

After completing the course, the student should be able to (with emphasis on image data from light microscopy)

- Explain and use the mathematical basis of intensity transformations and spatial filtering in up to four dimensions.
- Implement solutions based on this knowledge in Matlab, ImageJ, Imaris or similar computational toolkits, as well as use the built-in methods.
- Explain and use the mathematical basis of frequency domain filtering (Fourier methods) in up to four dimensions as well as deconvolution.
- Implement solutions based on this knowledge in the toolkit, as well as use the built-in functions
- Take into account the effects of color space choice, perform mathematically valid color space transformations and color-based transformations and segmentations
- Explain and use some basic mathematical algorithms for image compression
- Explain and use basic and coumpound morphological operations and implement solutions based on built-in methods.
- Explain and use the mathematical basis and methods of image segmentation.
- Implement solutions based on this knowledge in the toolkit, as well as use the built-in functions
- Know the advantages and challenges of working with different types of super- resolution images (STORM, PALM, SIM, STED) and the mathematical foundations of the image (re)construction algorithms
- Extract relevant data from processed images and perform mathematical analysis thereof, including nonlinear regression, simple optimization problems and fitting to partial differential equations
- Build, motivate and document a GUI in Matlab, ImageJ or similar toolkit to handle a specific multi-step image processing and analysis task (project work)

Course contents

This course focuses on the mathematical basis and implementation of microscopy image data processing, data extraction, and data analysis. The course covers intensity and color-based transformations and segmentations, Fourier methods for both filtering and analysis and morphological operations. The student will be expected to be able to both analytically solve problems and to independently choose methods and implement them to solve a "real" task.

Disposition

The course is based on 12 seminars where the theoretical aspects are addressed in parallel with the literature. The practical part of the course consists of two exercises and a larger project. The project should be related to the student's own research and process microscopy measurement data.

Course literature

RC Gonzalez & RE Woods, Digital Image Processing, 3rd ed (ISBN-13:978-0-13-505267-9)
Bioimage Data Analysis, edt Kota Miura, ePub ISBN: 978-3-527-80094-0
Handout "Analyzing fluorescence microscopy images with lmageJ", by Peter Bankhead

Examination

- INL1 - Assignment, 1.5 credits, grading scale: P, F
- INL2 - Assignment, 1.5 credits, grading scale: P, F
- PRO1 - Project work, 4.5 credits, grading scale: P, F

Based on recommendation from KTH's coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability.

The examiner may apply another examination format when re-examining individual students.

If the course is discontinued, students may request to be examined during the following two academic years.

Examination is by written assignments and a project. The project work is presented at a seminar.

Other requirements for final grade

Completed the following: Hand-in assignments 1, Hand-in assignments 2 and the Project work

Ethical approach

- All members of a group are responsible for the group's work.
- In any assessment, every student shall honestly disclose any help received and sources used.
- In an oral assessment, every student shall be able to present and answer questions about the entire assignment and solution.