HL2027 3D Image Reconstruction and Analysis in Medicine 9.0 credits

Medicinsk bildanalys och rekonstruktion i 3D

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

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

Establishment

Course syllabus for HL2027 valid from Spring 2012

Grading scale

A, B, C, D, E, FX, F

Education cycle

Second cycle

Main field of study

Medical Engineering

Specific prerequisites

Bachelor's degree in Engineering Physics, Electrical Engineering, Computer Science or equivalent. Programming in Matlab. Basic knowledge of anatomy.

Language of instruction

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

Intended learning outcomes

Three dimensional (3D) imaging plays a central role in medical imaging. 3D images (which may consist of 2D slices) are used for both diagnosis and treatment. For several imaging modalities, data are acquired digitally as 1D or 2D projections of the object. In order to obtain a 2D or a 3D image from these projections, a reconstruction operation must be implemented. This course deals with basic methods for digital image processing and commonly used methods for 2D and 3D reconstructions. The course also introduces the basic mathematical methods used in the context of medical imaging. The course is organized as a project course that provides practical knowledge about 2D and 3D image reconstruction in medicine. It also provides experience in problem solving as well as assessing and presenting research result both orally and in writing.

Upon completion of this course the participant should understand:

- Digital image registration and factors affecting image quality
- Image filtering in space and frequency domains
- Image restoration
- Image segmentation
- Image classification and analysis
- 2D and 3D image reconstruction

Course contents

The course includes the following elements:

- An introduction to digital image processing, including digital image filtering both in room (image space) and frequency domains, Fourier Transform, Radon Transform, image restoration, registration, segmentation, classification and analysis (image understanding).
- The presentation of Gauss and Poisson noise, the sinogram, Fourier slice theorem.
- Different image reconstruction techniques such as the filtered back projection technique, iterative methods, algebraic methods, Maximum Likelihood, ordered subsets as well as a Maximum a Posteriori.
- Mathamatical methods and theories used in the context of 2D and 3D image processing, reconstruction and analysis.

In parallel, students will work in small groups with projects aimed at solving a 3D image reconstruction problems and implementing the solutions in Matlab code, in addition to writing reports, reviewing and evaluating them as well as presenting and discussing these project works orally for other course participants at seminar sessions.

Course literature

The course literature consists of lecture notes as well as current research articles that will be given out when the course starts, in addition to the book:

Gonzalez, Woods & Eddins, Digital Image Processing Using Matlab, Prentice Hall 2004, ISBN 0130085197

Examination

- PRO1 - Project Work, 9.0 credits, grading scale: A, B, C, D, E, FX, 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.

PRO1 - Project works (including reviewing and evaluation) and seminars, 9 credits, grade scale: A, B, C, D, E, F

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.