Course syllabus

Medical Image Analysis
Medicinsk bildanalys

FMAN30, 7.5 credits, A (Second Cycle)

Valid for: 2026/27
Faculty: Faculty of Engineering LTH
Decided by: PLED F/Pi
Date of Decision: 2026-04-14
Effective: 2026-05-18

General Information

Depth of study relative to the degree requirements: Second cycle, in-depth level of the course cannot be classified
Elective for: BME4-sbh, BME4-bdr, C5, D4, E4-mt, E4-bg, F4, F4-bg, F4-bm, MMSR2, Pi4-biek, Pi4-bam
Language of instruction: The course will be given in English on demand

Aim

The main aim of the course is to give a basic introduction to theory and mathematical methods used in medical image analysis, to an extent that will allow the student to handle medical image processing problems. In addition the aim is to make the student develop his or her ability in problem solving, both with or without a computer. A further aim is to prepare the student for further studies and research in the border area between medicin and engineering.

Learning outcomes

Knowledge and understanding
For a passing grade the student must

- be able to explain clearly, and to independently use, basic mathematical concepts in medical image analysis, in particular regarding registration, segmentation and classification.

- be able to describe and give an informal explanation of some of the different image acquisition techniques used in medical imaging, e.g. Radiography, X-ray Computed Tomography (CT), Magnetic Resonans imaging (MR), ultrasound, Positron-EmissionsTomografi (PET), Scintigraphy (Scint) and Single-Photon Emission Computed Tomography (SPECT).
- be able to describe and give an informal explanation of the mathematical theory behind some central medical image processing algorithms
- be able to briefly describe the statistical principles that constitute the basis for machine learning.
- be able to give examples of ethical questions that arise in medical applications of image analysis.

Competences and skills
For a passing grade the student must

- in an engineering manner be able to use computer packages to solve problems in medical image analysis.
- be able to independently apply basic methods in medical image processing to problems which are relevant in medical applications or research.
- with proper terminology, in a well structured way and with clear logic be able to explain the solution to a problem in medical image analysis.

Contents

Basic concepts: Images, volume data, 4D data, pixels and voxels, file-formats, DICOM (Digital Imaging and Communications in Medicine). .

Image acquisition techniequs: Radiography, CT (x-ray Computed Tomography), MR (Magnetic Resonance imaging), ultrasound, PET (Positron Emission Tomography), Scint (Scintigraphy) and SPECT (Single-Photon Emission Computed Tomography).

Noise and Image enhancement, lossless compression

Registration: Registration of medical images. Mutual information. Landmark based methods. Deformation models.

Segmentation: Active contours in 2D, 3D and 4D, active appearance models (AAM). Graph-methods.

Machine Learning: Training, testing, generalization, hypothesis spaces.

Validation: Databases. Ethics.

Examination details

Grading scale: TH - (U, 3, 4, 5) - (Fail, Three, Four, Five)
Assessment: Compulsory assignments and oral exam.

The examiner, in consultation with Disability Support Services, may deviate from the regular form of examination in order to provide a permanently disabled student with a form of examination equivalent to that of a student without a disability.

Modules
Code: 0114. **Name:** Medical Image Analysis.

Credits: 7.5. **Grading scale:** TH - (U, 3, 4, 5).

Admission

Assumed prior knowledge: FMAN20 Image Analysis or corresponding knowledge.
The number of participants is limited to: No

Reading list

- Material provided by the department.

Contact

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Course homepage: https://canvas.education.lu.se/courses/20384