SH2314 Medical Imaging, Signals and Systems 7.5 credits

Medicinsk avbildning, signaler och system

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

Establishment

The course syllabus is valid from Spring 2022 according to the school principal's decision: S-2022-0529 Decision date: 2022-02-24

Grading scale

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

Education cycle

Second cycle

Main field of study

Engineering Physics

Specific prerequisites

English B / English 6

Language of instruction

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

Intended learning outcomes

After completion of the course, the student should be able to:

- Explain the physical and technological principles behind various types of radiation detectors and imaging modalities.
- Use the signals and systems approach to describe and estimate the quality of an imaging system.
- Display understanding of the Fourier space representation of images.
- Use the physics of radiation absorption and generation together with the geometries of the different imaging modalities to solve numerical problems.
- Perform image reconstruction for Computed Tomography and understand the sinogram representation of images.

The student is required to use a mathematical programming language such as MATLAB for the hand-ins and laboratory work.

To qualify for the highest grades, the student should also demonstrate the ability to:

- Identify physical and current technological limitations of medical imaging systems.
- Apply knowledge from imaging modalities within the course content on novel imaging techniques.
- Solve medical imaging problems that relate to statistics and probability theory.
- Show understanding of the connection between the image quality metrics (e.g. PSF, MTF, NPS, SNR) and the final image.

Course contents

The course treats the physical, mathematical and technological aspects of medical imaging systems from a signals-and-systems point of view. Modalities (imaging types) covered include:

- Projection Radiography
- Computed tomography (CT)
- Planar Scintigraphy
- Single photon emission computed tomography (SPECT)
- Positron emission tomography (PET)
- Ultrasound imaging (briefly)
- Magnetic resonance imaging (MRI) (briefly)

Numerical methods to quantify the performance of medical imaging systems are presented. The design of medical imaging systems usually involves a number of trade-offs involving parameters such as: contrast, spatial resolution, noise, image acquisition time, size and cost. It is a major goal of the course to provide an understanding of these relations.

Examination

- TEN1 - Examination, 4.5 credits, grading scale: A, B, C, D, E, FX, F
- LAB1 - Laboratory Work, 3.0 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.

One written exam (TEN1; 4,5 university credits) and laboratory/project work (LAB1; 3 university credits). Hand-in assignments during the course give bonus points for the written exam.

Other requirements for final grade

Passing grade (A-E) in the written exam and passing grade (P) in the lab part.

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.