SF2529 Inverse Problems 7.5 credits

Inversa problem

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

Establishment

Course syllabus for SF2529 valid from Autumn 2024

Grading scale

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

Education cycle

Second cycle

Main field of study

Mathematics

Specific prerequisites

English B / English 6

Differential equations, mathematical statistics and numerical methods on basic level

Language of instruction

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

Intended learning outcomes

After the course, the student shall be able to:

- formulate and apply concepts related to linear inverse problems to analyze theoretical issues

- formulate and propose methods for linear inverse problems to solve concrete problems with given data

- implement and apply computational methods for linear inverse problems

Course contents

This course provides an introduction to inverse problems with an emphasis on linear problems in finite dimensions. Special focus is placed on high-dimensional ill-posed inverse problems, such as those encountered in image processing, like inverse convolution and tomographic image reconstruction.

A central method employed is the use of regularization to handle ill-posedness and large condition numbers. The course covers mathematical and computational aspects of classical regularization methods, including truncated singular value decomposition, iterative methods, and variational models.

In addition to these classical approaches, the course also addresses the statistical perspective. Statistical models for the noise in data and the unknown signal are introduced. Techniques from Bayesian statistics can now be used to calculate the distribution of the signal based on the measured data. The course covers computational methods to simulate random outcomes from such a distribution, based on Markov-chain Monte Carlo methods and Bayesian inference. The course also explores alternative approaches to compute appropriate estimates related to the maximum likelihood method.

Examination

- LAB1 - Laboratory work, 3.5 credits, grading scale: P, F
- TEN1 - Written exam, 4.0 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.

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

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.