EQ2801 Optimal Filtering 7.5 credits

Optimal filtrering

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 EQ2801 valid from Autumn 2018

Grading scale

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

Education cycle

Second cycle

Main field of study

Electrical Engineering

Specific prerequisites

For single course students: 180hp and English B or equivalent

Language of instruction

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

Intended learning outcomes

After successfully completing the course, the student should be able to

- Understand to which type of estimation problems linear estimation can be applied.
- Understand the relationship between computational complexity, filter structure, and performance.
- Understand the relationship between optimal filtering, linear estimation, and Wiener/Kalman filtering.
- Approach estimation problems in a systematic way.
- Compute, analyze, and modify state space models.
- Derive and manipulate the time discrete and time continuous Wiener filter equations and compute the Wiener filter for a given estimation problem.
- Derive and manipulate the time discrete Kalman filter equations and compute the Kalman filter for a given estimation problem.
- Analyze properties of optimal filters.
- Implement Wiener and Kalman filters (time discrete) and state space models using Matlab.
- Simulate state space models and optimal filters, analyze the results, optimize the filter performance, and provide a written report on the findings.
- Know about common methods for optimal filtering in the case of non-Gaussian noise or non-linear models, such as Extended Kalman filter, sigma point filtering and particle filtering.
- Formulate logical arguments, orally and in writing, in a way that is considered valid in scientific publications and presentations within the topic area.

Course contents

This course gives thorough knowledge of linear estimation theory. The main theme of the course is optimal linear estimation, Kalman and Weiner filtering, which are systematic methods to solve estimation problems with applications in several technical disciplines, for example in telecommunications, automatic control and signal processing but also in other disciplines, such as econometrics and statistics.The course also provides an introduction to optimal filtering for non-linear systems. The course assumes familiarity with basic concepts from matrix theory, stochastic processes, and linear systems theory. The course is directed towards the students who intend to work with development and research within these fields.

The following topics are covered; Basic estimation theory, time discrete and time continuous Wiener filters, time discrete Kalman filters, properties of Wiener and Kalman filters, smoothing, Extended Kalman filters, sigma-point filters and particle filters.

Course literature

D. Simon "Optimal State Estimation", Wiley, 2006, or similarly (to be announced before course start).

Examination

- INL1 - Homework assignments, 4.5 credits, grading scale: A, B, C, D, E, FX, F
- PRO1 - Project assignment, 1.5 credits, grading scale: A, B, C, D, E, FX, F
- PRO2 - Project assignment, 1.5 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.

Other requirements for final grade

- PRO1 – Project assignment, 1.5, grade scale: A, B, C, D, E, FX, F
- PRO2 – Project assignment, 1.5, grade scale: A, B, C, D, E, FX, F
- INL1 – Homework assignments, 4.5, grade scale: A, B, C, D, E, FX, F

Final grade based on 70% from INL1 and 15% each from PRO1 and PRO2, respectively.

The course requires significant individual effort. Solving the homework problems requires good familiarity with the theory but also an ability to formulate a practical problem using suitable mathematical models and applying the theory to these. The written presentation of solutions and project also provide training in the ability to formulate logical arguments in a way that is considered valid in scientific publications. One of the project assignments is presented in a technical report, the other one in an oral presentation.

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.