FEM3200 Optimal Filtering 10.0 credits

Optimal filtrering

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

Establishment

Course syllabus for FEM3200 valid from Spring 2019

Grading scale

P, F

Education cycle

Third cycle

Specific prerequisites

Doctoral students at the School of Electrical Engineering. External participation by admission of the examiner.

Language of instruction

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

Intended learning outcomes

After the course, each student is expected to:

- Show a good working knowledge of some fundamental tools (specified by the course content) in optimal filtering.
- 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 and time continuous 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.
- Be familiar to the basic theory and 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.
- Use the acquired knowledge to more easily apprehend research papers in engineering.
- Identify research problems in which linear and non-linear estimation tools may be powerful.
- Apply the knowledge to solve the identified filtering problems.
- Combine several sub problems and solutions to solve more complex problems.
- Show improved skills in problem solving and proof writing as well as in critical assessment of proofs and solutions.
- Show improved skills in oral presentation of technical contents.

Course contents

1.Basic estimation theory and geometric interpretations

2.Wiener filters; continuous time and discrete time

3.Kalman filters; continuous time and discrete time

4.The innovations Process

5.Stationary Kalman Filter, spectral properties

6.Smoothing (fixed-point, fixed-lag, fixed-time)

7.Numerical and computational issues in Kalman filtering

8.Non-linear filtering

Additional topics selected for the student presentations

Examination

- EXA1 - Examination, 10.0 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.

Other requirements for final grade

- Individual solutions to weekly written homework assignments, 70% of max score
- Written take-home exam
- Peer-review grading of assigned problem sets
- Presentation of assigned topic and actively participating during other students presentations

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.