EL2520 Control Theory and Practice, Advanced Course 7.5 credits

Reglerteknik, fortsättningskurs

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 EL2520 valid from Spring 2019

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: 120 credits and documented proficiency in 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

This course introduces basic theories and methodologies required for analyzing and designing advanced control systems. After the course, you should be able to

- Understand basic properties of multivariable linear systems, such as multivariable poles, zeros, system gains and associated critical input and output directions.
- Compute signal norms and system gains, and analyze closed-loop stability using the small gain theorem.
- Perform a thorough analysis of a closed-loop control system in terms of the critical transfer functions, including the sensitivity and complementary sensitivity function.
- Quantify fundamental limitations on control system performance due to time-delays, right-half plane zeros and poles and understand their implications on controller design.
- Derive frequency-dependent description of model uncertainty using the multiplicative uncertainty model and analyze robust stability and performance.
- Use the relative gain array to analyze interactions and propose decentralized control structures.
- Derive LQG-optimal controllers for scalar systems, and understand how the design parameters influence the closed-loop system properties.
- Understand how mixed H_inf control can be formulated in terms of an extended system, and propose reasonable performance weights.
- Develop anti-windup control strategies to deal with control signal limitations
- Understand the basic principles behind model-predictive control, including how the design parameters influence the closed-loop performance and how the basic problem can be transformed into an associated optimization problem.

Course contents

Mathematical descriptions of linear multivariable systems, design of multivariable controllers, fundamental limitations on achievable performance, robustness to model uncertainties, design of multivariable controllers, linear quadratic control, H2- och H8-optimal control, model predictive control.

Disposition

Lectures, Exercises, Computer exercises, Laboratory work. Homeworks

Course literature

Torkel Glad and Lennart Ljung, Control Theory - Multivariable and Nonlinear Methods, Taylor and Francis Ltd, ISBN 0748408789
(Swedish version: T. Glad and L. Ljung, Reglerteori, flervariabla och olinjära metoder, Studentliteratur, 2:a upplagan, ISBN 91-44-03003-7

Examination

- LAB1 - Laboratory Work, 1.5 credits, grading scale: P, F
- LAB2 - Laboratory Work, 1.5 credits, grading scale: P, F
- TEN1 - Examination, 4.5 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.

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.