EL2620 Nonlinear Control 7.5 credits

Olinjär reglering

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 EL2620 valid from Autumn 2013

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

After finished course, the students will have knowledge in analysis of nonlinear dynamical systems using tools from control theory, such as linearization, Lyapunov methods, and describing functions. They will be able to use computer-based tools for modeling, simulation and control design of nonlinear systems. They will have knowledge about advanced nonlinear control design methods. The theory is illustrated by many examples from mechanical, electrical, chemical and aeronautical engineering, as well as from bioengineering and finance.

In particular, the students should be able to:

- Solve problems using classical methods for analysis of nonlinear dynamical systems, such as linearization and phase-plane analysis, equilibria and oscillations.
- Use Simulink for modeling and simulation of nonlinear systems.
- In depth knowledge on how to solve stability problems using Lyapunov and LaSalle methods.
- In depth knowledge about input-output stability using the circle criterion and describing function analysis. The students should be able to apply this theory to compensation for saturation (anti-windup), friction, back-lash and quantization.
- Basic knowledge about passivity theory.
- Be able to solve simpler control design problems using high-gain design methods, such as linearization by high gain and sliding modes.
- Be able to solve simpler control design problems using Lyapunov design methods and feedback linearization.
- Determine controllability for nonlinear systems.
- Have basic knowledge about optimal control theory, and how to solve standard optimal control problems.

Course contents

Lecture 1-2: Nonlinear models, computer simulation; Lecture 3-6:Feedback analysis: linearization, stability theory, describing function; Lecture 7-10; Control design: compensation, high-gain design, Lyapunov methods; Lecture 11-13: Alternative methods: gain scheduling, optimal control, neural networks, fuzzy control.

Course literature

Lecture notes and exercises sold by the department. An highly recommended textbook is Khalil, H. K., Nonlinear Systems (3rd ed., 2002, Prentice Hall, ISBN 0-13-067389-7).

Examination

- LABA - Laboratory Work 1, 2.0 credits, grading scale: P, F
- LABB - Laboratory Work 2, 2.0 credits, grading scale: P, F
- LABC - Laboratory Work 3, 2.0 credits, grading scale: P, F
- TENA - Examination, 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

LABA 2.0 cr, LABB 2.0 cr, LABC 2.0cr, TEN 1.5 cr

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.