

Nonlinear Control Systems

Dates and time

15-01-2024

22-01-2024

29-01-2024

05-02-2024

from 13.45-16.00

12-02-2024

04-03-2024

11-03-2024

18-03-2024

from 10.15-12.30

Course location

Cursus- en vergadercentrum Domstad, Utrecht

ECTS

6 ECTS if the homework is completed successfully

1,5 ECTS for auditing the entire course

Lecturers

Prof. dr. B. Jayawardhana, University of Groningen

Dr. B. Besselink, University of Groningen

Objective

The course aims at introducing methods for the analysis and control of nonlinear systems, including fundamental results on stability and dissipativity, geometric control theory as well as a set of self-contained results on the control design of nonlinear systems.

Contents

Stability and dissipativity of nonlinear control systems

Lecture 1 Introduction to nonlinear systems, nonlinear differential equations, Lyapunov stability theory, LaSalle's invariance principle

Lecture 2 Dissipativity theory, passivity, L2 gain stability, input-to-state stability

Lecture 3 Interconnected systems, passivity theorem, small-gain theorem, circle criterion

Analysis of nonlinear control systems

Lecture 4 Introduction to nonlinear control systems and fundamentals of geometric control theory

Lecture 5 Feedback linearization (relative degree, zero dynamics)

Lecture 6 (High-gain) Observer design

Nonlinear control design

Lecture 7 Control Lyapunov functions and backstepping

Lecture 8 Nonlinear output regulation theory and internal model principle

Course materials

The lecture notes will be distributed during the course.

Prerequisites

The students are expected to be familiar with linear control systems and functional analysis.

Homework assignments

There are four homework assignments (once every two lectures) that will be distributed during the lectures. Each assignment must be handed in within two weeks.