

# Nonlinear Control Systems

---

## Dates and time

18-01; 25-01; 01-02; 08-02; 15-02; 01-03; 08-03; 15-03 2021

from 13.45-16.00

## Course location

Cursus-en vergadercentrum Domstad, Utrecht

## ECTS

6 ECTS if the homework is completed successfully.

1.5 ECTS for auditing the 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.