# nonlinear control systems

## lecturers

Prof. dr. C. De Persis, University of Groningen
Prof. dr. B. Jayawardhana, University of Groningen

## objective

The course aims at introducing basic properties of nonlinear systems, fundamental stability notions in nonlinear systems and a set of self-contained results on the control design of nonlinear systems.

## contents

**Lecture 1** (Introduction to nonlinear systems). During this lecture, the students will be given examples on nonlinear systems, and several fundamental properties and stability notions of nonlinear systems will be introduced.
*References*
H. Khalil, *Nonlinear Systems*, 3rd edition, Prentice Hall, 2002, Chapter 1, 2, and 3.

**Lecture 2** (Lyapunov stability). The students will learn Lyapunov converse theorem and characterization of input-to-state stability notion.
*References*
H. Khalil, *Nonlinear Systems*, 3rd edition, Prentice Hall, 2002, Section 4.7 – 4.9.
E.D. Sontag, "Input to state stability: basic concepts and results," P. Nistri & G. Stefani (eds.), Nonlinear and Optimal Control Theory, pp. 163-220, Springer-Verlag, Berlin, 2006.

**Lecture 3** (Feedback linearization). In this lecture, the students will be introduced to the concept of relative-degree and normal forms. The application of these notions to feedback linearization and for control design will be given.
*References*
H. Khalil, *Nonlinear Systems*, 3rd edition, Prentice Hall, 2002, Chapter 13.

**Lecture 4** (Nonlinear control design). During this lecture, the students will learn the backstepping control design approach.
*References*
H. Khalil, *Nonlinear Systems*, 3rd edition, Prentice Hall, 2002, Section 14.3.

## lecture notes

The lecture notes will be distributed during the course.

## prerequisites

The students are expected to be familiar with ordinary differential equations,
linear control systems and linear algebra.

## homework assignments

A set of homework assignments will be distributed at the end of each lecture.