EE222 Nonlinear Systems: Analysis, Stability, and Control
http://inst.eecs.berkeley.edu/∼ee222/
Course Outline

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Lecture Information

Lectures: TuTh 2-3:30, 105 North Gate

Contacts

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Course Description

First graduate level course in nonlinear systems and control. Introduction to nonlinear phenomena: multiple equilibria, limit cycles, bifurcations, complex dynamical behavior. Planar dynamical systems, analysis using phase plane techniques. Describing functions. Input-output analysis and stability. Lyapunov stability theory. The Lure problem, Circle and Popov criterion. Control Lyapunov Functions. Feedback linearization, sliding mode control.

The course will be punctuated by a rich set of examples, ranging from violin strings to jet engines, from heart beats to artificial neurons, and from population growth to nonlinear flight control.

- Introduction to Nonlinear Phenomena: Multiple Equilibria, Limit Cycles, Complex Dynamics, Bifurcations
- Second Order Nonlinear Systems: Phase Plane Techniques, Limit Cycles - Poincare-Bendixson Theory, Index Theory
- Input-output analysis and stability: Small Gain Theorem, Passivity, Describing Functions
- Lyapunov Stability Theory: Basic stability and instability theorems, LaSalle's theorem, Indirect method of Lyapunov
- Control Lyapunov Functions
- Nonlinear Control: Linearization by State Feedback for SISO and MIMO systems, Involutivity, Lie Brackets, Frobenius' Theorem, Zero Dynamics, Inversion, Tracking, Stabilization

Prerequisites

EE221A: Linear System Theory (or equivalent)

Evaluation

Problem sets will be put on the web Thursdays (due the following Thursdays).

Course Grades: HW (30%); Midterm (30%); Final (40%)

Policies

It is encouraged that you work in groups, however each person must hand in his/her own HW. HW will be due by 5pm on the due date.

Course References:

The course is based on a set of lecture notes which will be made available throughout the term.

The course textbook is:

S. S. Sastry. Nonlinear Systems: Analysis, Stability, and Control. Springer-Verlag, 1999.

A recommended reference text is:

H. K. Khalil. Nonlinear Systems, 3rd Edition. Prentice-Hall, 2002.