Syllabus for MAE281b
Nonlinear Control - Spring 2008

Jorge Cortés

June 5, 2008

This is the Syllabus for MAE281b - Nonlinear Control, Spring 2008. This course covers analysis and design of nonlinear control systems, and is the continuation of MAE281a. Topics include: small-gain theorem, passivity, describing functions, nonlinear controllability, feedback linearization, input-state and input-output linearization, zero dynamics, stabilization, Brockett's necessary conditions (local), control Lyapunov functions, Sontag's formula (global). Prerequisite: MAE 281A.

Instructor

Jorge Cortés, `cortes at ucsd.edu`. Office at Engineering Building I, # 1608

Course Objectives

By the end of the course, you would/should have:

1. learned and used various tools for the analysis and control of nonlinear systems.
2. got a feeling and gained insight into the complexity of nonlinear systems.
3. known and played around with a wide variety of interesting, inherently nonlinear examples.

Prerequisites

MAE281a. Knowledge of calculus, linear algebra, and ordinary differential equations is assumed. Familiarity with simulation software of your choice (e.g., Matlab/Mathematica/Maple).

Text

Our main reference will be H. K. Khalil. *Nonlinear Systems*. Prentice Hall, Englewood Cliffs, NJ, 3 edition, 2002.

Additional recommended texts and readings

You will also find great insight in

- A. Isidori. *Nonlinear Control Systems*. Communications and Control Engineering Series. Springer Verlag, New York, 3 edition, 1995
- S. S. Sastry. *Nonlinear Systems: Analysis, Stability and Control*. Number 1 in Interdisciplinary Applied Mathematics. Springer Verlag, New York, 1999.
- H. Nijmeijer and A. J. van der Schaft. *Nonlinear Dynamical Control Systems*. Springer Verlag, New York, 1990
- E. D. Sontag. *Mathematical Control Theory: Deterministic Finite Dimensional Systems*, volume 6 of *TAM*. Springer Verlag, New York, 2 edition, 1998

Calendar (this version: June 5, 2008)

The following calendar is tentative.

Date	Topics	Reading	*Tests & Deadlines*
(1st wk) Apr 1 Apr 3	Syllabus and intro Feedback control	 Khalil-Ch. 12	
(2nd wk) Apr 8 Apr 10	Feedback linearization (SISO)	Khalil-Ch. 13	
(3rd wk) Apr 15 Apr 17			 *Hmwk #1 due on 4/17*
(4th wk) Apr 22 Apr 24	Feedback linearization (MIMO)		
(5th wk) Apr 29	Nonlinear controllability		*Hmwk #2 due on 5/1*

End Part I

Midterm			*Thursday, May 1* *(in class)*
(6th wk) May 6 May 8	Midterm review Control Lyapunov funcs		
(7th wk) May 13 May 15	Input-output stability	Khalil-Ch. 5	
(8th wk) May 20 May 22	Passivity	Khalil-Ch. 6	 *Hmwk #3 due on 5/22*
(9th wk) May 27 May 29	Frequency domain		
(10th wk) Jun 3 Jun 5			 *Hmwk #4 due on 6/5*

End Part II

Final			*Monday, June 9* *in class: 11:30am-2:30pm*

Homework

There will be a set of homework problems every other week. Due dates for the assignments are listed in the calendar of this syllabus. No late homework will be accepted.

Grading policy

Homework: 30%
Midterm: 30%
Final exam: 40%

In exceptional cases, I reserve the right to give extra points for excellent performance on the midterm and final. Please do not count on it as a way to avoid doing the other assignments.

Room location and hours

Lectures take place at University Center, Building 413A, room 1, Tuesdays and Thursdays, from 12:30pm to 1:50pm.

Office hours

Instructor: Wednesdays, from 6:00pm to 7:00pm. Please, send me email describing the problem before coming to office hours. Be prepared to show attempts at solving the problem.

If you have any questions about the course, please send me email. I will try to respond as quickly as possible. Additionally, I will share questions that are particularly good (and their answers) with the rest of the class by broadcasting my answer to the entire class.

Course webpage

`http://tintoretto.ucsd.edu/jorge/teaching/mae281b/`

The webpage contains this syllabus and the list of homework due. Please check it periodically for updates and other announcements related to the course.