Lecture Information
Lectures: 60-61H, TTh 11:00-12:30pm.

Contacts
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Course Description
This course is a second graduate course in nonlinear systems, organized into three parts as described below. The course is structured to emphasize some of the recent research activity in nonlinear analysis and control. We will use concepts from differential geometry, however the course is self contained in that this mathematics will be taught as part of the course. As always, willingness to think in a sophisticated fashion is more important than formal prerequisites in mathematics.

Part 1: Advanced Topics in Feedback Linearization
- Review of SISO and MIMO Feedback Linearization.
- Involutivity, Lie Brackets, Frobenius’ Theorem.
- Design examples (ie. when Jacobian Linearization is not controllable).
- Robust Linearization, Sliding Mode, Backstepping, Switched Nonlinear Control.

Part 2: Geometric Nonlinear Control
- Introduction to Differential Geometry.
- Matrix Lie groups, properties, associated Lie algebras, examples.
- Control of Systems on Lie Groups.
- Design examples: satellite control; quantum control (control of particles on $su(n)$).

Part 3: Input-Output and Advanced Stability Analysis
- Small gain theorems, passivity, Lurè problem, Popov and Circle criteria.
- Constructive Lyapunov Theorems.
- Application to adaptive control of nonlinear systems.
Prerequisites

Evaluation
There will be 4 problem sets to complete throughout the course, as well as a course project. The project should be a substantial piece of work: independent research work in any area covered in the course, accompanied by a short paper, is the optimal project; however a review of the literature is also possible, and this should involve a body of papers and be accompanied by a report in a uniform notation consistent with that of the course.

Course References:
The course is based on a set of lecture notes which will be made available throughout the term. References to relevant research papers will also be given.

The following are recommended reference texts: