ENME 606 (Spring 96)

NONLINEAR CONTROL DESIGN

Instructor: Prof. Miroslav Krstic
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Course Objective: A continuous demand for performance improvement is pushing engineering systems to operate in highly nonlinear regimes, turning nonlinear control into probably the most attractive current area of controls research. The course will introduce students to state-of-the-art tools for control of nonlinear systems with uncertain models. The emphasis is on design—how to develop constructive systematic methods which work in the presence of modeling uncertainties. Current literature is abundant with applications of techniques presented in the course, and we will frequently use them to motivate and validate theoretical developments. To bring students up to speed for the *design* part of the course, the first part of the course will give a thorough introduction to *analysis* of nonlinear control systems. Students who have taken ENEE 661 are encouraged to enroll, as the two courses have no more than 30% overlap.

Topics: Lyapunov stability, input-to-state stability, passivity. Geometric methods, feedback linearization, inverse dynamics. Backstepping designs: state- and output-feedback, robust, adaptive, tuning functions and modular designs. Nonlinear optimal control and differential games. Time permitting: Center manifolds, bifurcations, singular perturbations, averaging. Describing functions.

Texts:

- Khalil, *Nonlinear Systems* (2nd edition), Prentice Hall, 1995, ISBN 0471127329.
- Krstic, Kanellakopoulos, and Kokotovic, *Nonlinear and Adaptive Control Design*, John Wiley and Sons, 1995, ISBN 0132280245.

Optional: Isidori, *Nonlinear Control Systems* (2nd edition), Springer-Verlag, 1995, ISBN 3540199160.

Prerequisite: ENME 605 or equivalent (e.g., ENEE 663) or permission of instructor

Time and Place: MonWed 5:00–6:15, Room EGR 3106

Office Hours: TueFri 5:00–6:00 or by appointment

Grading: 50% Homework
25% Midterm
25% Project

For the project, the students will select a nonlinear application problem (from ME, EE, AE, ChE) to which they can apply a design method studied in class. Research-quality theoretical projects also OK.