330: 512 Nonlinear and Adaptive Control Theory— Spring 1998

Text books: H. Khalil, *Nonlinear Systems*, 2nd edition, Prentice Hall, 1996., and K. Astrom and B. Wittenmark, *Adaptive Control*, 2nd edition, by Addison Wesley 1995.

Instructor: Zoran Gajic, ECE 222, tel. 3415, email: gajic@ece.rutgers.edu, Office hours: Tu 7:30–9:00, F by appointment.

Part 1. Nonlinear Control Systems

- Week 1: Nonlinear Phenomena; Second-Order Systems; Linearization; Limit Cycles (Introduction, Section 1.2)
- *Week 2:* Mathematical Preliminaries; Existence and Uniqueness Theorems; Continuous Dependence on Initial Conditions and Parameters; Sensitivity Equations (Sections 2.1–2.4)
- Week 3: Lyapunov Stability Theory (3.1–3.3)
- Week 4: Stability of Nonautonomous Systems; Time-Varying Systems and Linearization; (3.4-3.5)
- *Week 5:* Analysis of Feedback Systems: Lure's problem; Popov Criterion; Passivity Approach, Describing Function Method (Chapter 10)
- *Week 6:* Control of Nonlinear Systems via Linearization; Full-state based; Output-based, Observer-based and Integral Control (Section 11.1–11.2)
- Week 7: Exact Feedback Linearization (Sections 12.1-12.3)
- Week 8: Exam 1 (Nonlinear Control Systems)

Part 2. Adaptive Control

- *Week 9:* Adaptive control schemes; Robust and high gain control; Real time parameter estimation (Sections 1.1–1.2, 1.4; 2.1–2.4)
- Week 10: Deterministic self-tuning regulators (Sections 3.1-3,3, 3.5)
- Week 11: Stochastic self-tuning regulators; Diophantine equation (Sections 4.1-4.3, 4.5; 11.4)
- Week 12: Model reference adaptive systems (Sections 5.1-5.2; 5.5; 5.8-5.9)
- Week 13: Adaptive nonlinear systems and backstepping; Auto-tuning (5.10; 8.1–8.5)
- Week 14: Gain scheduling; Controller Implementation; Adaptive signal processing (Sections 9.1–9.2; 11.2; 13.2)Exam 2 (Adaptive Control)

Grading:

Exam 1 50% Exam 2 50%