

University of Dayton
Dept. Electrical and Computer Engineering

ECE 645 Adaptive Control

Instructor: Prof. Raul Ordoñez, KL341-E, raul.ordonez@notes.udayton.edu.

Office Hours: T, Th 14h00 – 15h30, but generally please e-mail me for an appointment.

Text book: *Stable Adaptive Control and Estimation for Nonlinear Systems*, Spooner, Maggiore, Ordonez, Passino, Wiley Inter-Science, 2002.

Reference: *Nonlinear Systems*, Hassan K. Khalil, Prentice Hall, NJ, 3rd edition, 2002.

Additional reference texts:

- Walter Rudin: Principles of Mathematical Analysis, McGraw-Hill, 1976
- Chi-Tsong Chen: Linear System Theory and Design, 3rd ed., Oxford, 1999
- Wilson Rugh: Linear Systems Theory, 2nd ed., Prentice Hall, 1995
- Slotine, Li: Applied Nonlinear Control, Prentice Hall, 1991

Pre-requisites: ECE509 and ECE547, or permission from the instructor.

Course Objective: This is an application-oriented class that will introduce you to on-line approximation based adaptive control techniques for nonlinear systems. Basic nonlinear system and Lyapunov stability concepts will be reviewed, together with an introduction to neural networks and fuzzy systems as part of the control loop, leading to a diversity of advanced methods for controlling and stabilizing nonlinear systems subject to uncertainties. The course will include a significant Matlab simulation component, and will encourage the application of the concepts learned.

Outline of topics

- 1) Overview: linear and nonlinear systems, nonlinear phenomena, Lyapunov stability
- 2) Mathematical fundamentals
- 3) Neural networks and fuzzy systems as function approximators
- 4) Training of function approximators
- 5) Feedback linearization based techniques
- 6) Direct and indirect adaptive control
- 7) Backstepping based techniques – adaptive backstepping
- 8) (*) Discrete time systems, adaptive control for discrete time systems
- 9) (*) Decentralized adaptive control
- 10) (*) Observers for nonlinear systems – adaptive observers
- 11) (*) Output feedback and adaptive output feedback
- 12) (*) Advanced topics in adaptive control

Topics marked with an asterisk will be included at the discretion of the instructor.

Grading:	Homework	—	20%
<i>(Tentative)</i>	Projects	—	30%
	Midterm exam	—	25%
	Final exam	—	25%