Course Number: EECE665 / MECH654

Course Title: Adaptive Control

Credit Hours: 3.0

Instructor: Naseem Daher
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Text Book: Astrom, K., and Wittenmark, B., 2008, *Adaptive Control*, Dover Mineola, NY, USA.

Course Description: The course covers adaptive control theory and its application to linear systems. The main topics that will be covered include, but are not limited to: introduction to adaptive control, real-time parameter estimation, self-tuning regulators, model-reference adaptive control, stability of adaptive control algorithms, and an introduction to adaptive robust control.

Topics:
Real-time Parameter Estimation
Self-tuning Regulators (STR)
Model Reference Adaptive Control (MRAC)
Stability Theory (Lyapunov, Input-Output, Passivity)
Introduction to Adaptive Robust Control (ARC)

Prerequisites: Undergraduate Control Systems (EECE460 / MECH435)

Goals: The goals of this course are to introduce students to adaptive control theory and its applications, become familiar with various adaptive control schemes (e.g. STR, MRAC, ARC) and how to apply each one, understand the advantages as well as the limitations of adaptive control, and learn how to apply adaptive control theory to practical problems.

Learning Outcomes:

At the end of the course, students will be able to:

- Estimate parameters in dynamical systems
- Design indirect self-tuning regulators (ISTR) via minimum degree pole placement (MDPP)
- Design direct self-tuning regulators (DSTR) via minimum degree pole placement (MDPP)
- Design Model Reference Adaptive Controllers (MRAC) via the MIT Rule
- Design Model Reference Adaptive Controllers (MRAC) via Lyapunov's stability theory
- Design adaptive controllers using input-output (I/O) stability theory

- Become familiar with the basic principles of nonlinear adaptive robust control (ARC)
- Implement in simulation, and possibly implementation, adaptive control laws

Grading:

Attendance & Participation	10%
Homework Assignments	15%
Midterm Exam	20%
Final Exam	25%
Final Project	30% (5% Presentation, 25% Report)

Course Policy:

General: Cheating will not be tolerated and will result in a failing grade and reporting to the Dean. All electronic devices must be turned off or silenced during lecture and exam times. Interaction and participation in classroom discussions are highly encouraged as part of two-way active learning process.

Attendance: Attendance will be recorded. Students must attend all lectures and show up on time. No absences are allowed, except in the case of justified circumstances. There will be drop quizzes at certain points in the semester, which count towards the "Attendance & Participation" grade.

Homework: Assignments will be provided two weeks prior to the due date. Solutions must be submitted at the beginning of class. Late assignments will NOT be accepted.

Exams: No make-up will be given, except for extenuating circumstances as deemed by the course instructor.

Project: Projects can either be individual or in teams (preferred) of two or three. Individual effort is **required**, but teamwork is encouraged and recommended. Project topics and partners must be identified as soon as possible, and a proposal must be submitted to the instructor for approval by the specified deadline. Project reports (especially of graduate students) must meet peer-reviewed journal paper standards relative to quality, format, and guidelines.

Resources:

Moodle, textbook, handouts, MATLAB, library, internet, others

References:

- Astrom, K., and Wittenmark, B., 2008, *Adaptive Control*, Dover Publications, Mineola, NY, USA.
- Ioannou, P., and Sun, J., 1995, *Robust Adaptive Control*, Prentice Hall, Upper Saddle River, NJ, USA.
- Yao, B., 2013, *ME689 - Adaptive Control*, Lecture Notes, Purdue University, West Lafayette, IN, USA.