Instructor
Eugene Lavretsky, eugene.lavretsky@boeing.com
Office Hours: Fridays, by appointment

Grading
Pass / Fail.

Prerequisites
Linear systems and control, basic understanding of nonlinear dynamics, Lyapunov stability theory, numerical methods, MATLAB.

Course Outline
The main goal of this course is to give a self-contained mathematical treatment of robust adaptive control theory and its current state of the art. Aerospace applications of adaptive flight control will be discussed. We will cover Part II, chapters 7 through 14 of the course textbook [1]. Homework will be assigned once a week. Mid-term and Final exams (in class) will be given.

Course material
The following is a tentative outline of the material to be covered.
Part II  Robust Adaptive Control

7  Direct Model Reference Adaptive Control: Motivation and Introduction ........................................ 211
   7.1 Model Reference Control: Motivational Example ........................................ 211
   7.2 Introduction to Direct Model Reference Adaptive Control ........................................ 215
   7.3 Direct Model Reference Adaptive Control of Scalar Linear Systems with Parametric Uncertainties ........................................ 220
   7.4 Historical Roots and Foundations of Model Reference Adaptive Control ........................................ 221
   7.5 Exercises ........................................ 222
   References ........................................ 223

8  Lyapunov Stability of Motion ........................................ 225
   8.1 Dynamical Systems ........................................ 225
   8.2 Existence and Uniqueness of Solutions ........................................ 227
   8.3 System Equilibrium ........................................ 233
   8.4 Lyapunov Stability Definitions ........................................ 235
   8.5 Lyapunov Stability Theorems ........................................ 240
   8.6 Uniform Ultimate Boundedness ........................................ 247
   8.7 Barbalat’s Lemma ........................................ 254
   8.8 Summary and Historical Remarks ........................................ 259
   8.9 Exercises ........................................ 259
   References ........................................ 261

9  State Feedback Direct Model Reference Adaptive Control ........................................ 263
   9.1 Introduction ........................................ 263
   9.2 Command Tracking ........................................ 264
   9.3 Direct MRAC Design for Scalar Systems ........................................ 265
   9.4 Dynamic Inversion MRAC Design for Scalar Systems ........................................ 274
   9.5 MRAC Design for Multi-Input Multi-Output Systems ........................................ 281
   9.6 Summary ........................................ 291
   9.7 Exercises ........................................ 291
   References ........................................ 292
Course Textbook:

Supplementary Textbooks