PMP EE547 Linear Systems Theory
Tuesdays 6:00pm - 9:50pm (lecture 6:00 – 8:15; laboratory 8:30 – 9:50)
2016 Autumn Quarter
Lecture: Sieg 232
Lab: Sieg 232

Instructor:
Professor Linda Bushnell
email: LB2@uw.edu
office hours: 5pm – 6pm Tuesdays

TA:
TBD

Textbook:
Joao Hespanha, "Linear Systems Theory," Princeton University Press, 2009

Grading:
Homework 40%, Take-home Midterm 20%, Project 40%

Topics Covered:
- System Representation: modeling, transfer function, state space, linearization, causality, time invariance, linearization
- System Response: LTV and LTI systems, impulse response, step response, frequency response, Bode Plots
- Stability: Lyapunov, Input-Output
- Controllability: concept of controllability, controllable subspaces, decompositions
- Observability: concept of observability, output feedback, minimal realizations
- State-variable Feedback: PID control, LQR control, LQG control
- State Observers/Estimators: full-state observers, reduced-state observers
- Use of Matlab and Simulink to explore concepts covered above.
- Implementation of above concepts on a MinSeg robot.

Schedule:
Lecture 1: Introduction, transfer function and state-space representation, linearization
Laboratory 1: Matlab: introduction to Matlab, linearization in state-space
Minseg: setting up laptops and connections to the Minseg, accessing the LED

Lecture 2: Basic properties of a system, impulse response, converting state-space to transfer function and vice versa, equivalent systems
Laboratory 2: Matlab: State-space and transfer function, Simulink
Minseg: Accessing the gyroscope

Lecture 3: Solutions to the LTV DE, solutions to the LTI DE, Fundamental matrix, State Transition matrix, matrix exponential, Cayley-Hamilton Theorem, characteristic polynomial
Laboratory 3: Matlab: Matrix exponential of LTI system
Minseg

Lecture 4: More ways to solve the DE: Similarity transformation, eigenvalues, eigenvectors, Jordan Form, Function of a square matrix

Laboratory 4: Matlab: Eigenvalues and Jordan Form
Minseg

Lecture 5: Lyapunov Stability, Input/Output Stability
Laboratory 5: Matlab: Lyapunov stability
Minseg

Lecture 6: Controllability, Observability, Kalman Decomposition
Laboratory 6: Matlab: System controllability, observability, Kalman decomposition
Minseg

Lecture 7: State-variable feedback
Laboratory 7: Matlab: System state feedback
Minseg

Lecture 8: Observers
Laboratory 8: Matlab: State estimators in Simulink
Minseg

Lecture 9: Combining feedback and observers
Laboratory 9: Feedback with state observers
Minseg

Class 10: Project Presentations (PPT) and demos of balancing MinSeg robot