PMP EE547 Linear Systems Theory
Wednesdays 6:00pm - 9:50pm
Winter Quarter 2016
Lecture: EEB 045
Lab: TBD

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

Grading:
Homework 40%, Midterm 20%, Project 40%

Topics Covered:
- System Representation: modeling, linearization, state space, transfer function, causality, time invariance
- 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
- 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

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

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

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

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

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

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

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

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

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