1. Course Introduction

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Basic info

Course engr207b: linear control systems 2

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Web-page `www.stanford.edu/class/engr207b`
all class info, lecture notes, homeworks, solutions.

Grading roughly: homework 20%, midterm 30%, final 50%.
weekly homeworks

Relationship with other courses

- part of depth sequence in control.
- there is no *linear control systems 1*. It has been replaced by ee263.
- prerequisites: ee263 and prior exposure to probability
- ee263: linear algebra and least-squares to solve control and estimation problems.
- engr207b: focus on *randomness*. classification, estimation, filtering, response of systems to noise, minimizing the effects of noise on control systems.
- course will provide theoretical background useful for research in flight-control, GPS, robotics, unmanned vehicles, ...

Topics

- review of probability theory:

  sample spaces, events, conditional probability, random variables independence, expectation, correlation and covariance, simulation.

- classification, decision and estimation problems:

  Bayesian classification on finite sample spaces. MAP classifiers. error analysis. operating characteristics. detection with Gaussian measurements.

- Gaussians and mean square errors:

  behavior under linear transformations. confidence ellipsoids. marginal and conditional distributions. minimum mean-square-error estimators. bias-variance trade-off. Fisher estimation. recursive estimation.

- random processes and linear systems:

  IID and Gaussian random processes. stationarity, autocorrelation, and power spectral density. white noise. linear systems driven by Gaussian noise. Kalman filtering. stochastic optimal control and filtering. H_2 control.

References

complete notes will be handed out, so there is no required textbook.

the following books are good references:

probability and signals:

- Leon-Garcia, *Probability and Random Processes for Electrical Engineering*

classification and decision:

- Duda, Hart and Stork, *Pattern Classification*

continuous estimation:

- Kay, *Fundamentals of Statistical Signal Processing, Volume I: Estimation Theory*
- Bar-Shalom et al, *Estimation with Applications to Tracking and Navigation*

LQG and H_2 control:

- Burl, *Linear Optimal Control*