

## Stochastic Modeling and Control ME 225AV

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### Practical Information

- Lectures Karl Åström Tue, Th 9.30-10.45 Engr I, 2162
- Introduction to Stochastic Control + papers
- Lectures, home-works, and projects
- Computing and simulation - Matlab/Simulink
- Computer tools: Matlab with control system toolbox
- Office hours: Room 2332 Eng II, Tuesday Thursday, 11-12
- [astrom@engineering.ucsb.edu](mailto:astrom@engineering.ucsb.edu)
- Midterm: To be set
- Final: March 15, 8-11

## Goals of the Course

- A good intuitive understanding of mathematical models of dynamic stochastic phenomena (stochastic processes)
- Ability to formulate dynamics stochastic models and determine their parameters
- Ability to analyse linear stochastic systems
- Ability to simulate dynamical systems with stochastic disturbances - Matlab Simulink
- Know the language and the mathematics
- Prediction and filtering
- Linear quadratic gaussian control (LQG)
- Find a problem in your research area where this can be used, make a project that can be developed into a paper

## Topics

1. Introduction
2. Stochastic Processes
3. State Models - Stochastic Differential Equations
4. Analysis of Linear Stochastic Systems
5. Stochastic Optimal Control
6. Input-output Models
7. Prediction and Minimum Variance Control
8. Kalman Filtering and LQG
9. Models from Data - Identification
10. Adaptive Control

## Main Themes

- Stochastics is everywhere: MEMS, electronics, biology
  - A fascinating development:
    - Brownian motion: Brown and Einstein
    - Circuit noise: Johnson and Nyquist
    - Interesting theory: Kolmogorov, ....
- Stochastic processes can be quite complicated but significant simplifications can be made by exploiting knowledge about dynamical systems!
- Most processes can be viewed as outputs of dynamical systems where the input is white noise!
  - The stochastic aspects are thus distilled into one process only all the rest is dealt with by using dynamics.