EE 543: Models of Robot Manipulation

Blake Hannaford

Course Overview

PREREQUISITES

EE 543 is an introductory graduate course.

- Knowledge of basic Matrix multiply, inverse operations etc.
- Definitions of Eigenvalues, Eigenvectors, pseudoinverse (will be reviewed).
- Ability to program in Python strongly recommended.

- Spatial Serial Chain Mechanisms
- Using robot arms to position and orient objects
- Mathematical Analysis
- Emphasis on computational issues (not theoretical)
- Innovative and Time Efficient Course Structure

ELECTRICAL ENGINEERING
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Understand and Program Solutions to Fundamental Problems

Positioning: Q: How do we specify the position and orientation of robot arms and objects?
A: Frames, Homogeneous Transformations, and joint-space teaching.

Forward Kinematics: Find a linear transformation from end effector (P_{EE}) to base frame (P_0):

$$P_0 = T_6^0(\theta_1 ... \theta_6 P_{EE}$$

. . .

Inverse Kinematics, Incremental Kinematics (velocity and force), Inverse Dynamics, Position Control, Force Control, Trajectory Generation, Motion Planning, Sensor Based Control, Telemanipulation, etc.

Innovative Course Structure:

60-90 minutes lecture on **Pre-recorded Video** (watch at home/work prior to class)

In-Class-Active-Learning:

- **6:00PM - 8:00PM:**
- Work in teams or individually on In-Class-Problems (ICPs)
- Continuous in-person assistance from Prof. and TA's.

Symbolic Math Toolkit

- We will have access to a symbolic math toolkit in Python using the `sympy` package (all problems of 5 DOF or greater, but do hand computations for < 5 DOF).
- We will have simple programming assignments to create a library of numerical functions in Scilab or Matlab.

Homework and Final Project **NO FINAL**