GE422 / ME 446 / ECE 489
Robot Dynamics And Control

Fall 2015

Summary:

This course is intended for seniors and 1st year graduate students from a wide variety of engineering disciplines. We will emphasize the basics of motion and force control for robotic manipulators. Transformations from task space to joint space will allow for the joint level control. The study of forward and inverse kinematics, along with differential kinematics will provide a foundation for developing robot controllers. We will examine robots operating in free spaces as well as in contact with environments. Advanced topics will look at mobile robotic systems and their motion through an environment. It is assumed the student has a basic knowledge of control systems including feedback and feedforward control. Additionally, the student should know dynamics of multi-body systems well.

Webpage:	Compass (notes, homework) Coecsl.ece.illinois.edu/ME446 (labs)
Instructors:	Prof. Andrew Alleyne (alleyne@illinois.edu) Prof. Placid Ferreira (pferreir@illinois.edu) Prof. Hae Won Park (tbd)
Office Hours:	Monday 3-5pm (Alleyne) TBD for Ferreira and Park 4-6 pm 349 MEB for Hyung Jin Yoon
Lecture Hours:	Time: Tu/Th 9:30-11:00 am Location: 2017 ECEB
Lab Location	1223 MEL
Teaching Assistant:	Hyung Jin Yoon Chuanzheng Li
Text:	Robot Modeling and Control Spong, Hutchinson & Vidyasagar Wiley
References:	Notes
Grading	50 % Homework 40 % Labs 10 % Class Participation

Course Outline

Module 1: Review of Kinematics (Chapter 2, 3 and 4 and notes)

- Examples of Robotic Systems
- Transformations: Joint/Task space
- Forward Kinematics
- Inverse Kinematics
- Jacobians
- Trajectory Generation
- Serial and Parallel Kinematics

Module 2: Robot Dynamics (Chapter 7)

- Euler Lagrange Equations of Motion
- Actuator and Sensor Dynamics
- Properties of Robot Dynamics

Module 3: Independent Joint Control (Chapter 6)

- Basic Feedback Control
- PD, PID Control
- Feedback and Feedforward Control

Module 4: Position/Motion Control (Chapter 8)

- Inverse Dynamics/Computed Torque
- Motion Control Principles (some from Chapter 5)

Module 5: Force/Torque Control (Chapter 9 and notes)

- Stiffness and compliance
- Impedance control
- Hybrid Force/Position control

Module 6: Mobile Robots, time permitting (Notes)

- Unicycle models
- Other mobile systems