ECE 470 (AE 482, ME 445) - Introduction to Robotics

Instructors:

The course director and lecturer is Prof. Seth Hutchinson, whose specialty is control theory. Labs are led by various TA’s.

Prerequisites:

The officially-listed prerequisites are MATH 225 (Matrix Theory), MATH 286 (Intro to Differential Equations Plus), MATH 415 (Applied Linear Algebra), or MATH 418 (Intro to Abstract Algebra II). You really do need to know matrix algebra; almost every concept taught in the class depends on it. However, differential equations aren’t really required.

When to Take It:

This course is offered in the Fall. If you’re interested in robotics, you might want to take it early after Math 286 (or equivalent prerequisite) so you can move on to further robotics courses.

Class Content:

The course offers a introduction to foundations in modern robotics. Topics include: forward kinematics (given the angles of joints, what is the position of the end effector), reverse kinematics (what angles must the joints be at to put the hand at a certain position?), and velocity kinematics (how do we move the hand at a certain direction and speed?). Finally, you will briefly study computer vision: selecting objects from an image based on threshold levels and determining their position in the world given their position in the camera’s image (and position, orientation, and focal length of the camera). Virtually all of this is done through detailed matrix algebra and repeated conversions between the coordinate frames of the different arm joints. Time permitting, the course may also briefly go over more topics such as path planning.

As you study different concepts in the lecture, you will carry them out in the lab working with an actual robot arm. The labs follow lecture concepts and require you to implement the topics learned in class. As of Fall 2016, the labs also incorporate ROS (Robot Operating System).

Work:

There are two hour-and-a-half lectures per week, plus a two-hour lab. The labs take increasingly more time, but you will probably need to spend about two more hours per week on them as the semester goes on. Also, there is one midterm and a final exam.

Most of your time in this course will probably be spent on the homework assignments which are very conceptual. Problems must be set up very carefully, and the work is quite involved; exact time spent varies dramatically between students.

Life After:

Mathematically, this course is related to control theory; students who enjoy this might wish to continue in that direction, with ECE 486 (Control Systems) and GE 420 (Digital Control Systems). The immediate follow up is ECE 489 which adds control system elements to the topics in this course. Some other robotics-related courses are CS 431 (Embedded Systems) and CS 424 (Real-Time Systems) which focus more on the software-side of things, and GE 423 (Mechatronics). At the graduate level, some related courses are ECE 550 (Advanced Robotic Planning) and ECE 549 (Computer Vision).