EK 505 Introduction to Robotics and Autonomous Systems (Fall 2021)

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Time and location: MW, 2:30 – 4:15, Wed 130

Description: This course will provide the foundation for the study of robotics and autonomous systems. Topics to be covered include modeling techniques (kinematics and dynamics) for a variety of robotic systems, ranging from manipulator arms to car-like vehicles, an introduction to control and motion planning for such systems, and concepts of sensing and perception. The course will also discuss the basics of machine learning techniques in robotics.

Prerequisites: There are no specific prerequisites for this course. We will provide the necessary mathematical background. However, a certain level of mathematical maturity is necessary, such as familiarity with linear algebra at the level of EK 102 and differential equations at the level of CAS MA 226.

Grading: The grade will be based on homework (60%) and final projects (40%).

Textbook: None required. Recommended textbook: Choset, Lynch, Hutchison, Kantor, Burgard, Kavraki, Thrun, "Principles of robot motion: theory, algorithms and implementation", MIT Press, 2005

Tentative schedule:

1. Introduction
2. Configuration space
    - Definition, dimension, examples
    - The topology of the configuration space
    - Rigid body motion
3. Motion planning
    - Potential and navigation functions
    - Cell decompositions
4. Robot dynamics
    - Lagrangian dynamics
    - Standard forms for dynamics
    - Velocity constraints
    - Dynamics of a rigid body
5. Robot control
    - Linear systems and control
    - Nonholonomic and underactuated systems
6. Filtering and Estimation
    - Probabilistic estimation
    - Kalman filtering
7. Introduction to Machine Learning in Robotics