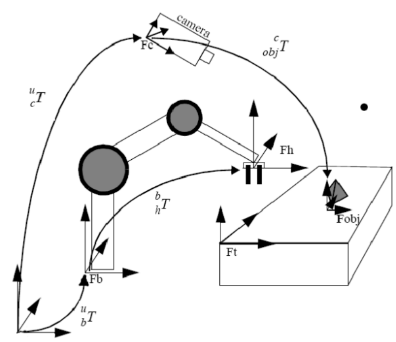
Course Introduction - EE 543 Models of Robot Manipulation

(WF 2:30 PM - 4:20 PM, THO 325)

For a robot arm, if the joints are given a certain rotation and velocity, what will be the movement and rotation of the end effector (grasper)? Conversely, if we want to move and rotate the grasper for a picking task, how can we drive the joint motors to achieve this task?

EE 543 focuses on the analytical and computational methods of robot arm manipulation. The following topics will be covered in this course:

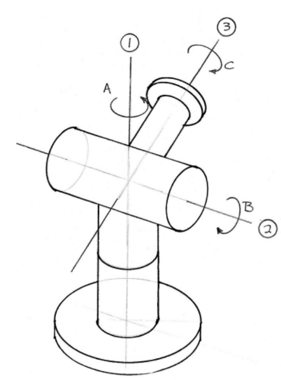
Coordinate Transformations & Rigid Body Motions



This chapter addresses the problem of representing the position and orientation of rigid bodies and frames of reference in useful ways. Before we can program their motions, we must learn how to usefully and carefully represent position and orientation in 3D space.

To achieve higher flexibility, many robot arms have more than 6 joints, which results in a highly non-linear relationship between joint space and cartesian space.

Forward & Inverse Kinematics



For serial manipulators, it is important to know the grasper pose given the joints' poses and vice versa. Forward kinematics assigns a coordinate system to each link in a standardized manner. Links are modeled with Denavit-Hartenberg parameters which easily give the homogeneous transform to match joints with the end-effector. Reversely, the more difficult inverse kinematics problem is to find the joint poses for a given end effector configuration.

Differential kinematics & Manipulator dynamics

This chapter defines the linear and angular velocity of a rigid body, extracts a Jacobian Matrix from the velocity propagation calculation and finds the relationship between joint velocity and end effector velocity, as well as the relationship of manipulator motion to the forces and torques applied to the joints.

Trajectory Generation, Motion Planning, and Teleoperation will also be covered!