CMPSCI 403: Introduction to Robotics: Perception, Mechanics, Dynamics, and Control

HW 03: 3D open-chain robot representation

Due Online, Sunday, Sept. 19th, 11:30 PM

Answer the questions below with text, mathematical statements, and supporting sketches where appropriate. You should use MATLAB to perform intermediate symbolic computations. Include a commented copy of your MATLAB code.

1. Make a function in MATLAB to convert ZYX Euler angle to an orientation matrix, and find the orintation matrices coincide to:

   $$\text{ZYX} = (0.3, 0.2, 0.5),\ (0.7,\ \pi,\ \tfrac{\pi}{2}),\ (\tfrac{\pi}{3},\ 0, 0)$$

   Matrices:

   Code:

2. Make a function in MATLAB to construct SE(3) from rotation matrix and translation vector, and make a function to multiply two SE(3)s and make a function to invert SE(3), then find the transformation matrix of frame{3} to frame{0} T_{03} from the following Euler angles and translation vectors:

   frame{0}: Euler angle ZYX = (0, 0, 0), position: (0, 0, 0).

   frame{1}: Euler angle ZYX = (0.3, 0.2, 0.5), position: (0.4, 0.8, 1.2).

   frame{2}: Euler angle ZYX = (0.7, π, $\pi/2$), position: (-0.4, 0.5, 1.0).

   frame{3}: Euler angle ZYX = ($\pi/3$, 0, 0), position: (0.5, -0.8, 1.2).

   Matrix:

   Code:

3. Plot above frame{1}, frame{2}, frame{3} in global coordinate frame{0}. You can use the given "drawCoordinat3D.m" funtion to plot and refer to "matlab_test3D.m" for instruction.

   Figure:

   Code:

4. Show the animation of frame EE at frame 3. Let frame EE has the same rotation matrix as frame 3 and the translation vector is [x, y, z] where x=0.1sin(ωt)+0.05, y=0.3cos(ωt)+0.08, z=sin(ωt)+0.5. t lasts a few seconds. Refer to "animation2D.m" for instruction. Please provide several screen shots to represent the animation.

   Snapshots of motion:

   Code: