CS289 Mobile Manipulation

Fall 2024

Assignment 2

Due: 23:59, Nov. 14, 2024

Submit your solution as a notebook (hw2_2.ipynb) and a PDF

(hw2.pdf; derived from this file) to GitLab

Dear students,

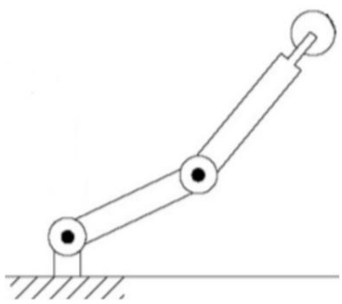
This semester, we will be using the rvc3python package for practical assignments. This library, originally known as the Robotics Toolbox, was initially designed for MATLAB. However, in our course material, we will be utilizing its Python version to better align with our teaching objectives.
As there is relatively limited online information available about the rvc3python package, we encourage all of you to carefully read the course materials and dedicate time and effort to learning this library.

This assignment is related to Chapter I Foundations – 2 Representing Position and Orientation. (Starting from page 23) There is an installing tutorial at page 716 or you can go to its github website for reference:
https://github.com/petercorke/RVC3-python/tree/main

Problem 1:

For the arm below,

1. draw lines and arcs in the image (or a copy) below for a and θ, explain why not α and d
2. Give the final transformation matrix of the end effector. Keep your calculation process. (Assuming the first joint is at the origin of world coordinate and x-axis is parallel to the ground). Add the equations and matrix to this file.



Problem 2:

1. Read Through Chapter 7.1.1-7.1.2 (Starting from page 256), use pose graph or chain of robot links method to draw a "Z" like robot arm like below in 2D. Add the code to the notebook (hw2_2.ipynb) and add a picture of the result to this file!

2. Please create something simple but meaningful in 3D in RVC3, with branches. At least 6 DoF. （You can download this notebook and play with it: https://github.com/petercorke/RVC3-python/blob/main/notebooks/chap7.ipynb）. Add the code to the notebook and add a screen shot to this file!

Problem 3:

1. List the methods to solve inverse kinematics problems and what are their advantages and disadvantages. (In this file).
2. Since you solved Problem 1, you have the forward kinematics function to get the position of the end effector: x = f(q). Now what you need to solve is the inverse kinematics of a 2-link planar robot. Given the final pose of the end effector, how to solve $q = f^{-1}(x)$? Please explain your answer step by step. Use the model shown below. Add your answer to this file.