UDACITY

PROJECT SPECIFICATION

Robotic Arm: Pick & Place

Writeup

CRITERIA	MEETS SPECIFICATIONS
Provide a Writeup / README that includes all the rubric points and how you addressed each one. You can submit your writeup as markdown or pdf. Here is a template writeup for this project you can use as a guide and a starting point.	The writeup / README should include a statement and supporting figures / images that explain how each rubric item was addressed, and specifically where in the code each step was handled.

Kinematic Analysis

CRITERIA	MEETS SPECIFICATIONS

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Run the forward_kinematics demo and evaluate the kr210.urdf.xacro file to perform kinematic analysis of Kuka KR210 robot and derive its DH parameters.	Your writeup should contain a DH parameter table with proper notations and description about how you obtained the table. Make sure to use the modified DH parameters discussed in this lesson. Please add an annotated figure of the robot with proper link assignments and joint rotations (Example figure provided in the writeup template). It is strongly recommended that you use pen and paper to create this figure to get a better understanding of the robot kinematics.
Using the DH parameter table you derived earlier, create individual transformation matrices about each joint. In addition, also generate a generalized homogeneous transform between base_link and gripper_link using only end-effector(gripper) pose.	Your writeup should contain individual transform matrices about each joint using the DH table and a homogeneous transform matrix from base_link to gripper_link using only the position and orientation of the gripper_link. These matrices can be created using any software of your choice or hand written. Also include an explanation on how you created these matrices.

CRITERIA	MEETS SPECIFICATIONS
Decouple Inverse Kinematics problem into Inverse Position Kinematics and inverse Orientation Kinematics; doing so derive the equations to calculate all individual joint angles.	Based on the geometric Inverse Kinematics method described here, breakdown the IK problem into Position and Orientation problems. Derive the equations for individual joint angles. Your writeup must contain details about the steps you took to arrive at those equations. Add figures where necessary. If any given joint has multiple solutions, select the best solution and provide explanation about your choice (Hint: Observe the active robot workspace in this project and the fact that some joints have physical limits).

Project Implementation

CRITERIA	MEETS SPECIFICATIONS
Fill in the `IK_server.py` file with properly commented python code for calculating Inverse Kinematics based on previously performed Kinematic Analysis. Your code must guide the robot to successfully complete 8/10 pick and place cycles.	`IK_server.py` must contain properly commented code. The robot must track the planned trajectory and successfully complete pick and place operation. Your writeup must include explanation for the code and a discussion on the results.

Suggestions to Make Your Project Stand Out!

To have a standout submission, calculate and plot the error in end-effector pose generated by your joint angle commands. You can do this by calculating end-effector poses via Forward Kinematics using your code output (which is a set of joint angles) and comparing it with the end-effector poses you received as input.

Student FAQ