Imperial College London

Team Machina: OpenMANIPULATOR-X Coursework Report

Authors

Khayle Torres
CID: 01753211
kt1719@ic.ac.uk

Xin Wang
CID: 01735253
xw2519@ic.ac.uk

Yuna Valade
CID: 01765409
yv19@ic.ac.uk

February 16, 2022

Contents

1 Task 1 - Modelling

1.1 Assigning Coordinate Frames

The OpenMANIPULATOR-X robotic arm has 4-DOF and a 1-DOF gripper. The choice of assigned coordinate frames to represent this robotic arm is important to how the user would interact with the robotic arm. To assign the coordinate frames, there are several important aspects the team took into consideration:

- The team used CAD[1] and Matlab[2] models of the robotic arm in order to obtain precise measurements and insight to how the robotic joints interacts.

- Where the robotic arm has a joint, the team assigned a coordinate frame to it as shown in the images below
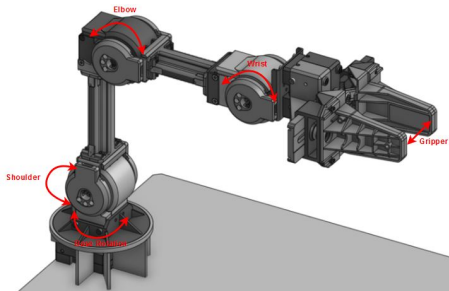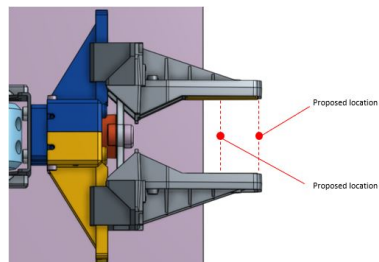

(a) Location of robotic arm joints
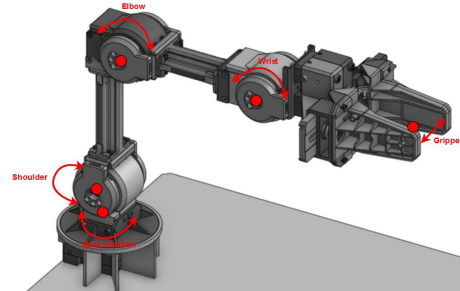
(b) Proposed locations of joint coordinate frames

- Particular care has been placed on the position of the robotic arm's end effector. Particularly, the team discussion has been whether the end effector should be at the tip or the middle of the gripper.


Design decisions:

- Base servo is vertically raised by 0.0613m from the base frame to coincide with the rotating joint

- End effector is chosen to be assigned to "Proposed location 2" as that gives the most secure grip with picking up items. **Care has to be taken to account for the extra** 0.0152**m space from "Proposed location 2" to "Proposed location 1"**
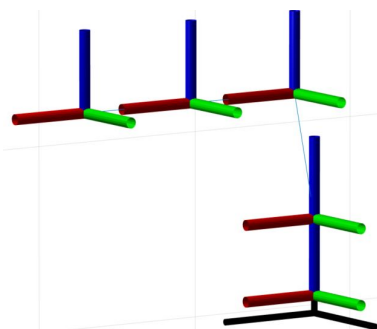
(a) open-MANIPULATOR X Line model
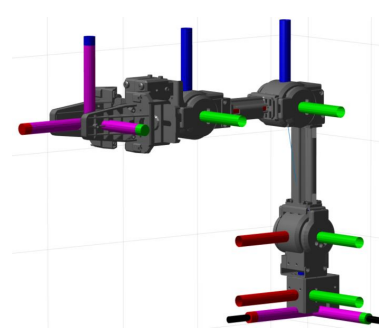
(b) open-MANIPULATOR X 3D model

---

[1] https://emanual.robotis.com/docs/en/platform/openmanipulator_x/specification
[2] https://uk.mathworks.com/matlabcentral/fileexchange/65316-designing-robot-manipulator-algorithms

1.2 Simulation: Graphical simulation of coordinate frames

1.3 Inverse Kinematics

The Denavit-Hartenberg Parameter Table for the open-MANIPULATOR X robotic arm is defined as:

1.4 Simulation: Tracing a square on each cartesian plane