Robotics design challenge
(MATLAB/SIMULINK)

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1 Introduction

Our product is a type of mechanical equipment used for automated welding. Our robotic arm can be widely used in various welding operations in the manufacturing industry, including automotive manufacturing, aerospace, construction, and manufacturing.

Our product has many adavantages. Firstly, it can improve production efficiency and quality by reducing the negative impact of human factors on production through automated welding operations. Secondly, it can reduce the danger of the work environment.

In summary, the four-arm welding robot is an efficient and accurate welding device with many advantages. It will become an important part of automated production in the manufacturing industry, providing a reliable solution for various production operations.

2 Task 1

2.1 How original and unique is the designed robot?

After discussion and doing some references, our group decide to make our robot arm as a four-arm robot and define the robot arms and joints, because there are some advantages of four-arm robot:

- better accuracy and stability of the movement;

- bigger working arrangement;
- better loading allowance;
- better collaboration.

And there are also some unique assessments of our four-robot arms can meet:

- The welding robot arm allows more precise control of the welding position and angle.
- The stability in high temperature, low temperature and hazardous gas environments ensure safe and stable welding.
- Compared to manual welding, welding robots can automate welding work, thus increasing productivity and reducing labor costs.
- To make sure the arms and joints will not clash into each other.
- Risk of joint interference: Do kinematic analysis to determine the minimum spacing and range of the movements between the joints and the robot arms, so that we can avoid the interference of the clash of the joints.
- Simulation analysis: After setting the exact parameters of the arms and joints, we use MATLAB to do simulation of real situations, and make sure the clash of the joints and arms won't happen.
- Design concept: After doing some researches of designing the robots, we consider the working arrangement, the stability of the robots and its operability. In order to achieve the function of welding in an exact area, we finally make the definitions of the parameters of all the arms and joints.

2.2 All the arms and the joints:

robot arms: [name, mass, center of mass, Inertia]

Name	Body Mass (kg)	Center of mass	Inertia (I_{xx} I_{yy} I_{zz}) ($kg \cdot m^2$)
R1	10	(0 0 0)	(0.27 0.27 0.8)
R2	10	(0 0 0)	(0.27 0.27 0.8)
P1	1.5	(0 0 0)	(0.07 0.07 0.07)
P2	1.5	(0 0 0)	(0.07 0.07 0.07)
Tool	1.2	(0 0 0)	(0.002 0.002 0.004)

Table 2.1: Experiment parameters

Joint angles:(The limit of the joint, Type of the joints)

Joint	Type	Position Limit (rad & m)	Joint Axis
1	revolute	$[-5\frac{\pi}{180}, 5\frac{\pi}{180}]$	[0 0 1]
2	revolute	$[-30\frac{\pi}{180}, 30\frac{\pi}{180}]$	[0 1 0]
3	prismatic	[-0.5,0.5]	[1 0 0]
4	prismatic	[-1, 1]	[0 1 0]
Fixed	revolute	N/A	N/A

(Unit: mm)

Table 2.2: Experiment parameters

3 Task 2

Here are the reachable workspace for the robot designed in Task 1.

4 Task 3

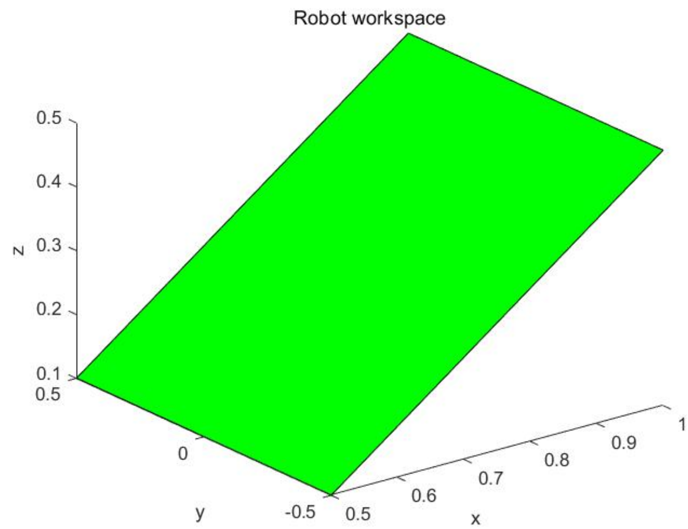

Figure 3.1: Experimental results

Here are the drawing of the kinematic diagram using the Denevit-Hartenberg frame rules for the robot designed in task 1.

5 Task 4

6 Conclusion