

EGR 545 - Spring 2023 - Lab 1

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1 Question 5

Table 1: Axis and Joint Information

		Axis/Joint (+/-)	Description (In/Out/Up/Down/Left/Right)
1	Axis	X-axis (+)	Out
2	Axis	X-axis (-)	In
3	Axis	Y-axis (+)	Left
4	Axis	Y-axis (-)	Right
5	Axis	Z-axis (+)	Up
6	Axis	Z-axis (-)	Down
7	Wrist	N/A	No Wrist Joint
8	Wrist	N/A	No Wrist Joint
9	Waist	Joint 1 (-)	Clockwise in XY-plane
10	Waist	Joint 1 (+)	Counter clockwise in XY-plane
11	Shoulder	Joint 2 (-)	(In) Diagonal upwards in the XZ-plane
12	Shoulder	Joint 2 (+)	(Out) Diagonal downwards in the XZ-plane
13	Elbow	Joint 3 (+)	(Down) Counterclockwise in the XZ-plane
14	Elbow	Joint 3 (-)	(Up) Clockwise in the XZ-plane

2 Question 6: Are the axis defined as you expected? Explain.

At first the axis did not seem to match the right hand triad. However, we needed to rotate the triad to match the positive directions of the robot arm. After matching them, the newly rotated right hand triad correctly matched and defined the given axis.

3 Question 7: How do the XYZ movements differ from the J movements?

The XYZ movements move in a 1D-direction respective to their planes. The J movements move in a 2D-direction respective to their joints. For example, 1 moves in the positive X direction while 12 uses the positive X direction and negative Z direction to diagonally move downward.

4 Question 9: What do you think is this the best way to write the letters CIM (order of movement)? Did you take time into consideration? How?

The best way to write the letters CIM, starting from A, would be A-B-C-D-F-E-G-H-I-J-K. It is important to take into consideration the amount of time required. Picking up and placing the pen as well as traveling between letters take time. If the requirement to start at A did not exist, the best way to write the letters would be D-C-B-A-E-F-G-H-I-J-K. This minimizes distances between writing and the number of times the pen would need to be picked up.

5 Question 11: What is the length of these two line segments? How do you know? Explain below.

The length of one big square is 10mm. There are 5 smaller squares that make up the length of the big square, that means that each of those squares are 2mm. Using this finding, the length and width of line segment HI is 16mm and 20mm respectively. Plugging these values into Pythagorean's Theorem, the hypotenuse, or in our case the length of the line segment, will be approximately 25.613mm. Then, by using the same understanding for line segment IJ, the length will be 24.413mm.

6 Question 13

X = 255.31, Y = 34.26, Z = -8.0

7 Question 17

X = 255.31, Y = 64.26, Z = -8.0

8 Question 19

Table 2: Axis and Joint Information

Name	X	Y	Z
Point A	255.31	34.26	-68.0
Point B	255.31	64.26	-68.0
Point C	215.31	64.26	-68.0
Point D	215.31	34.26	-68.0
Point E	255.31	14.26	-68.0
Point F	215.31	14.26	-68.0
Point G	215.31	-14.26	-68.0
Point H	255.31	-14.26	-68.0
Point I	235.31	-30.26	-68.0
Point J	255.31	-44.26	-68.0
Point K	215.31	-44.26	-68.0

9 Question 28: How accurate was your robot at reproducing the word CIM five times? Describe it below. What happens to the ACCURACY if you increase speed to 75? Try it and see.

The robot was able to reproduce the word CIM five times with almost 100% accuracy. There were no major differences between each loop. When we increase the speed to 75, the accuracy remains the same.

10 Conclusion

10 Question 1: Why are RELATIVE COORDINATES important in robotics? Explain.

Relative coordinates are important in robotics because it allows us to teach the robot positions without needing to manually record each point. Since we know where B is relative to A, we can quickly calculate and program that new position without needing to position the arm first.

10 Question 2: Explain the difference between MOVJ and MOVL MotionStyles.

The MOVL motion style causes the robot movement to follow straight lines, which is known as a linear move. The MOVJ motion style moves all of the joints to the necessary angles without worry for the path of the end effector.

10 Question 3: Does speed influence ACCURACY with your robot?

The speed will influence the accuracy of our robot if the new speed is significantly larger than the current speed.

10 Question 4: What would be the effect on the robot's accuracy at higher speeds if the mass of the pen was greatly increased.

The effect on the robot's accuracy at higher speeds if the mass of the pen was greatly increased would be that it will significantly decrease.

10 Question 5: After completing this activity, how would you define the difference between a robot's accuracy versus its repeatability?

The accuracy of the robot is how close the positioning of the end effector is to where it is programmed to be. Repeatability is the variance on the positioning of the end effector over multiple runs, regardless of the accuracy.

10 Question 6: How would you calculate point I in this activity using mathematics if it were not given?

If Point I was not given, we would use the given line segments GH and JK to find the point. We would find our needed values by halving one of the line segment's length, and then find the distance between these two line segments. These values would then be plugged into Pythagorean's Theorem where the hypotenuse will be the distance we would need to travel in the XY-plane (negative X and Y directions) from Point H to get our calculated Point I.