

CSCI 545 – Summer 2009

Homework 2

Due Date:07/17/09 5:00 PM

Please submit the hard copy of your answers at the class time or at the SAL 245.

- 1- Consider Articulated Manipulator and Cartesian Manipulator. List 4 different robot application and describe which of these manipulator are well suited for each of them and why.
- 2- Solve question 1-14 and 1-15 of the textbook and compare the results
 - 1-14 For the single arm revolute arm shown in Figure 1.25, if the length of the link is 50 cm and the arm travels 180 degrees, what is the control resolution obtained with an 8 bit encoder?
 - 1-15 Repeat problem 1.14 assuming that the 8-bit encoder is located on the motor shaft that is connected to the link through a 50:1 gear reduction. Assume perfect gear.

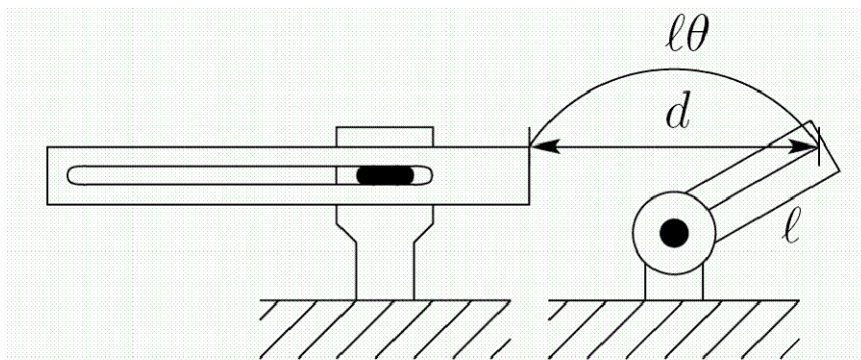


Figure 1.25: Diagram for Problem 1-15.

- 3- Solve question 1-19, parts 1 and 2 (from the text book).
 - 1-19 For the two-link manipulator of Figure 1.20 suppose $a_1=a_2=1$.
 1. Find the coordinates of the tool when $\theta_1 = \pi/2$ and $\theta_2 = \pi/2$
 2. If the joint velocities are constant at $\dot{\theta}_1 = 1, \dot{\theta}_2 = 2$, what is the instantaneous tool velocity when $\theta_1 = \theta_2 = \frac{\pi}{4}$?
- 4- Suppose that the frame $o_1x_1y_1z_1$ is rotated through an angle θ about the z_0 - axis, and then is rotated through an angle φ about the y_0 - axis. Find the resulting transformation matrix, R_1^0 .
- 5- Briefly define each of the following terms: repeatability, resolution, accuracy.
- 6- Draw a symbolic representation for the robot at figure 1.18. What is the closest shape to its workspace?



Figure 1.18: The ABB IRB940 Tricept parallel robot. Parallel robots generally have much higher structural rigidity than serial link robots. (Photo courtesy of ABB.)

7- Solve question 2-39 from the book

2-39 consider the diagram of Figure 2.14. A robot is set up 1 meter from a table. The table top is 1 meter square. A frame $o_1x_1y_1z_1$ is fixed to the edge of the table as shown. A cube measuring 20 cm on a side is placed in the center of the table with frame $o_2x_2y_2z_2$ established at the center of cube as shown. A camera is situated directly above the center of the block 2 meters above the table top with frame $o_3x_3y_3z_3$ attached as shown. Find the homogeneous transformation relating each of these frames to the base frame $o_0x_0y_0z_0$. Find the homogeneous transformation relating the frame $o_2x_2y_2z_2$ to the camera frame $o_3x_3y_3z_3$.

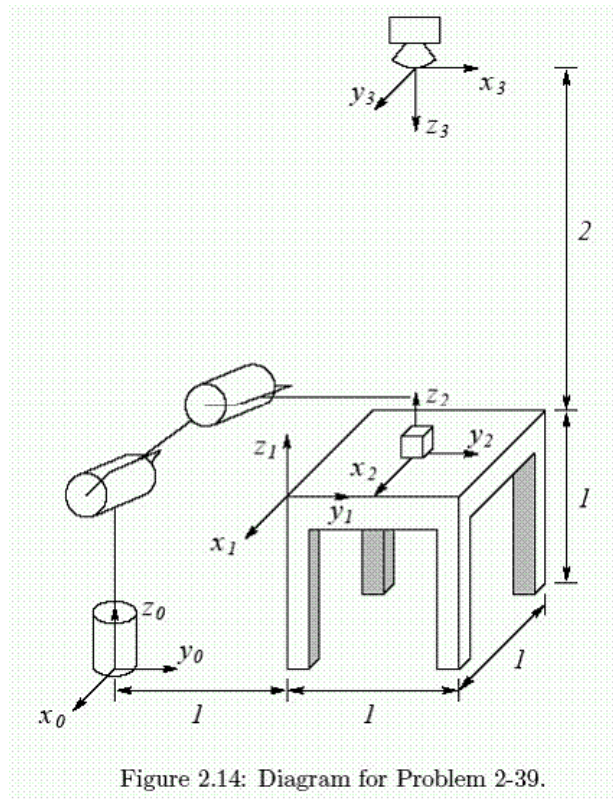


Figure 2.14: Diagram for Problem 2-39.

