Exam 2

Intro to Robotics

Name:

1

1. What is the equivalent quaternion to $R_{y'x'z'}(90°, 180°, 45°)$?(foil has easiest arithmetic)

2. rotate the 3d vector $v_1 = \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix}$ by the quaternion you obtained in part 1(use quaternion matrix multiplication for easiest arithmetic: formula 1).

2

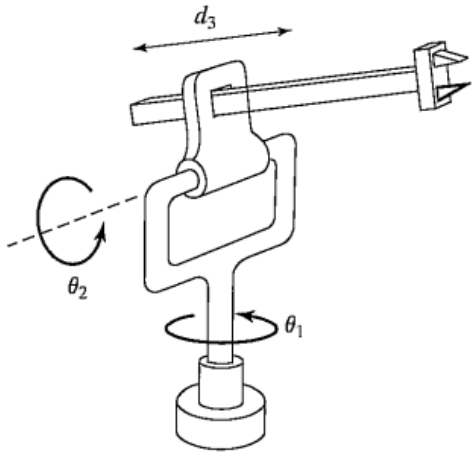

Figure 1: Order of joints: revolute, revolute, prismatic(from bottom to top)

1. Draw the frames.
2. Compute DH table.

DH table				
Frame {i}	a_{i-1}	α_{i-1}	d_i	θ_i
1				
2				
3				

3. Compute all transformation matrices.

3

Design a system using the publisher-subscriber model, for a robot that identifies boxes, picks them up, then takes them to a drop off location.

4

Assume you are given the functions move(speed, distance, is_forward), rotate(angular_speed, angle_to_rotate , is_clockwise) :
1. Write a function that draws the letter H (make sure you draw nothing else on the grid, hint:you can retrace lines already drawn).

5 formulas

1. $\begin{bmatrix} a & -b & -c & -d \\ b & a & -d & c \\ c & d & a & -b \\ d & -c & b & a \end{bmatrix}$

2. ${}^{i-1}_{i}T = \begin{bmatrix} c\theta_i & -s\theta_i & 0 & a_{i-1} \\ s\theta_i c\alpha_{i-1} & c\theta_i c\alpha_{i-1} & -s\alpha_{i-1} & -s\alpha_{i-1}d_i \\ s\theta_i s\alpha_{i-1} & c\theta_i s\alpha_{i-1} & c\alpha_{i-1} & c\alpha_{i-1}d_i \\ 0 & 0 & 0 & 1 \end{bmatrix}$

3. $i^2 = j^2 = k^2 = ijk = -1$ and

Multiplication Rules for Quaternions			
	i	**j**	**k**
i	-1	k	-j
j	-k	-1	i
k	j	-i	-1