

ASSIGNMENT - 4

classmate

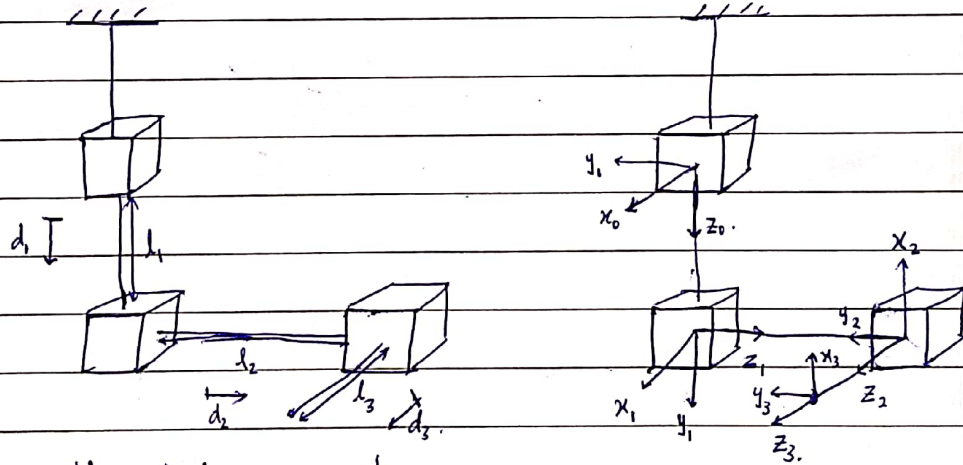
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Name: Rohan Shirodkar

Roll no: 18110142

- 7) A 3D printer has the following PPP linkage. It is exactly similar to the cartesian manipulator. ~~We have~~ The only difference that would occur is that the ground is set at the top of the 3D printer frame. Hence the first prismatic joint would go down instead of moving up. Hence, the only change will be that the displacement d_1 would be considered +ve in the downward direction. The rest will be exactly similar to the three link cartesian manipulator. Since d_1 is a variable, we can adjust the sign according to our needs. We get the 3D printer to be same as the cartesian robot with d_1 being negative. We have:-



We have the DH parameters as:-

Link	θ_i	d_i	a_i	α_i
1	0	$l_1 + d_1^*$	0	90
2	-90	$l_2 + d_2^*$	0	-90
3	0	$l_3 + d_3^*$	0	0

* = variable

∴ Writing the transformation matrices, we get:

$$A_1 = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 0 & -1 & 0 \\ 0 & 1 & 0 & l_1 + d_1 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$A_2 = \begin{bmatrix} 0 & 0 & 1 & 0 \\ -1 & 0 & 0 & 0 \\ 0 & -1 & 0 & l_2 + d_2 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$A_3 = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & l_3 + d_3 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Writing the forward kinematic equations, we get in matrix form :-

$$\begin{bmatrix} p_x \\ p_y \\ 1 \end{bmatrix} = A_1 A_2 A_3 \begin{bmatrix} p_x \\ p_y \\ 1 \end{bmatrix}$$

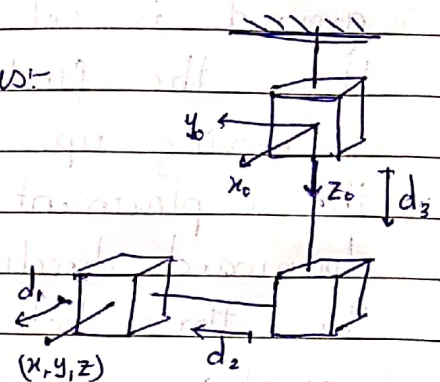
- 8) In a 3-D printer, three prismatic joints are perpendicular to each other. Hence the net motion of the end effector is a result of three independent motions along three perpendicular directions. Hence we can directly separate the displacements in all three directions.

From the diagram, we can write the inverse kinematic equations as:-

$$d_1 = x$$

$$d_2 = y$$

$$d_3 = z$$



These equations are defined as per the ground axis choice as shown in the above diagram & the end effector position is given as shown.