RangeAero Assignment

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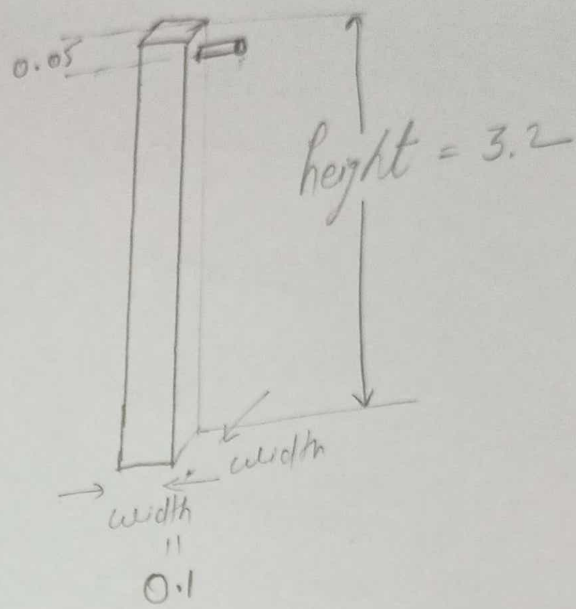
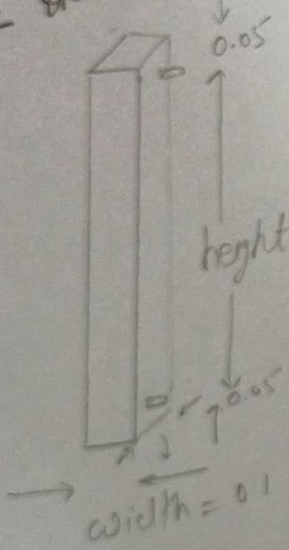
Robot Description:-

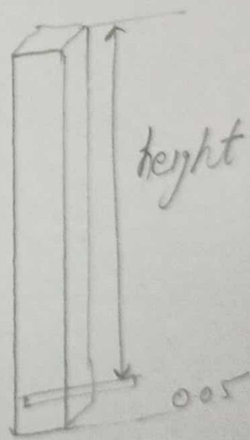
Link-1 → Base link

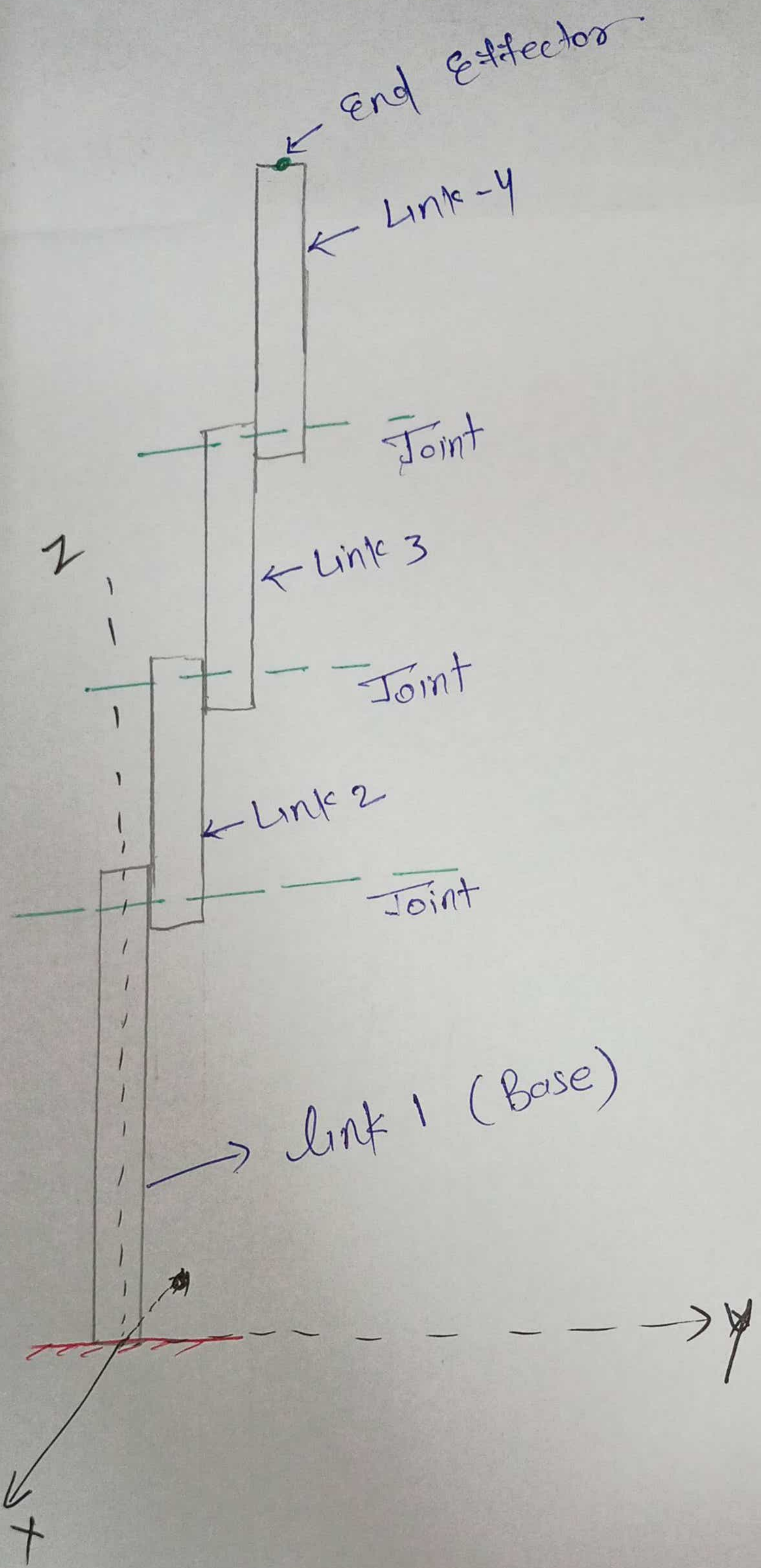


Link-2 and 3



link-4





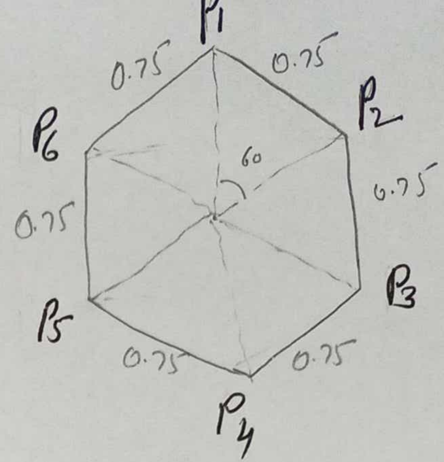
End Effector
Link-4
Joint
Link 3
Joint
Link 2
Joint
link 1 (Base)
Z
Y
X

Approach To follow Hexagonal way points:-

let: $\boxed{P_{i+1} = P_i + \Delta t\, u_i}$

where

$P = [x, z]$



To move from point 1 to point 2

I took the velocity vectors from P_1 to P_2 such as:

$$u_1 = (P_2 - P_1) \quad \text{———} \quad (1)$$

with this robot's end Effector can move from Point 1 to point 2. after reaching Point P_2.

The Control input will be.

$$u_2 = (P_3 - P_1)$$

Similarly for segments $P_3 \to P_4$, $P_4 \to P_5$, $P_5 \to P_6$, $P_6 \to P_1$

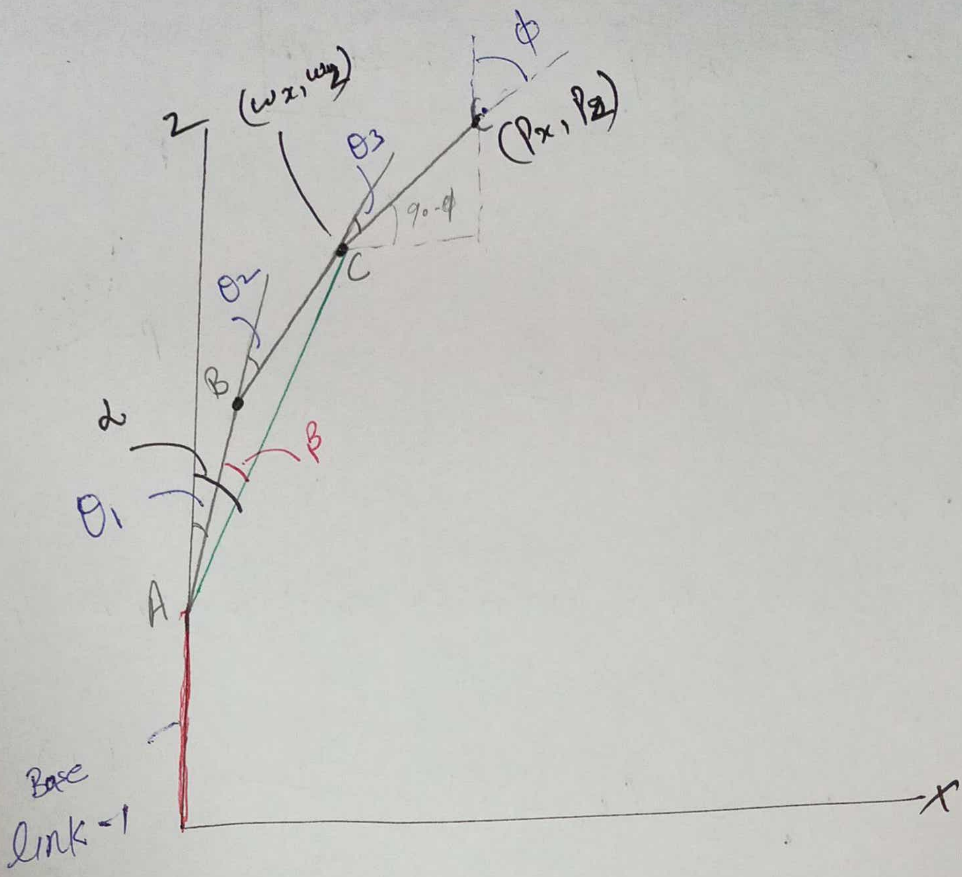
$$u_3 = (P_4 - P_3)$$

$$u_4 = P_5 - P_4$$

$$u_5 = P_6 - P_5$$

$$u_6 = P_1 - P_6$$

Inverse kinematics:-



from geometry:-

$$P_x = w_x + l_3 \sin\phi$$

$$P_z = w_z + l_3 \cos\phi$$

In ~~tring~~ triangle ABC,

$$\cos(\pi - \theta_2) = \frac{l_1^2 + l_2^2 - (w_x^2 + w_y^2)}{2 l_1 l_2}$$

$$\cos\theta_2 = \frac{w_x^2 + w_y^2 - l_1^2 - l_2^2}{2 l_1 l_2} = D \text{ (say)}$$

$$\sin\theta_2 = \pm\sqrt{1-\cos^2\theta_2}$$

$$\sin\theta_2 = \pm\sqrt{1-D^2}$$

Hence

$$\tan\theta_2 = \frac{\sin\theta_2}{\cos\theta_2}$$

$$\theta_2 = \tan^{-1}\left(\frac{\pm\sqrt{1-D^2}}{D}\right)$$

two solution of θ_2, I have taken only 1 solution.

$$\theta_1 = \alpha - \beta$$

$$\theta_1 = \tan^{-1}\left(\frac{w_x}{w_z}\right) \cancel{+} + \tan^{-1}\left(\frac{l_2 \sin\theta_2}{l_1 + l_2\cos\theta_2}\right)$$

<u>finialy</u>

$$\theta_1 + \theta_2 + \theta_3 = \phi$$

$$\theta_3 = \phi - \theta_1 - \theta_2$$

Now since from Controller ~~we~~ ~~will~~ ~~get~~ Output will be $P_i \rightarrow$ Position of end Effector

we need to find all joint angles θ_1 θ_2 θ_3

which can be achieved from inverse kinematics