ITR Miniproject-2

Team SINGULARITY

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Task 0 - Setup

Lengths

Length of link 1 = 107.55mm(center to center)
Length of link 2 = 112.00mm(center to tip)
Z axis distance = 66.5mm

Mass of links

Link1 = 225gm
Link2 = 70gm

D-H Parameter

Link	d	θ	a	α
1	0	θ1	107.55mm	0
2	0	θ2	112.00mm	0

Homogeneous transformation

$$H_0^1 = \begin{bmatrix} \cos(\theta1) & -\sin(\theta1) & 0 & L1 * \cos(\theta1) \\ \sin(\theta1) & \cos(\theta1) & 0 & L1 * \sin(\theta1) \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$H_1^2 = \begin{bmatrix} \cos(\theta2) & -\sin(\theta2) & 0 & L2 * \cos(\theta2) \\ \sin(\theta2) & \cos(\theta2) & 0 & L2 * \sin(\theta2) \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$H_0^2 = H_0^1 \times H_1^2$

Jacobian matrix

J = [- L1 * sin(θ1) - L2 * sin(θ2) -L2 * sin(θ2)]
[L1 * cos(θ1) + L2 * cos(θ2) L2 * cos(θ2)]

Where $\theta 1 \ and \ \theta 2 \ are \ absolute \ angles.$

End effector position(forward kinematics)

x = L1 * cos(θ1) + L2 * cos(θ1 + θ2)
y = L1 * sin(θ1) + L2 * sin(θ1 + θ2)

Joint velocities

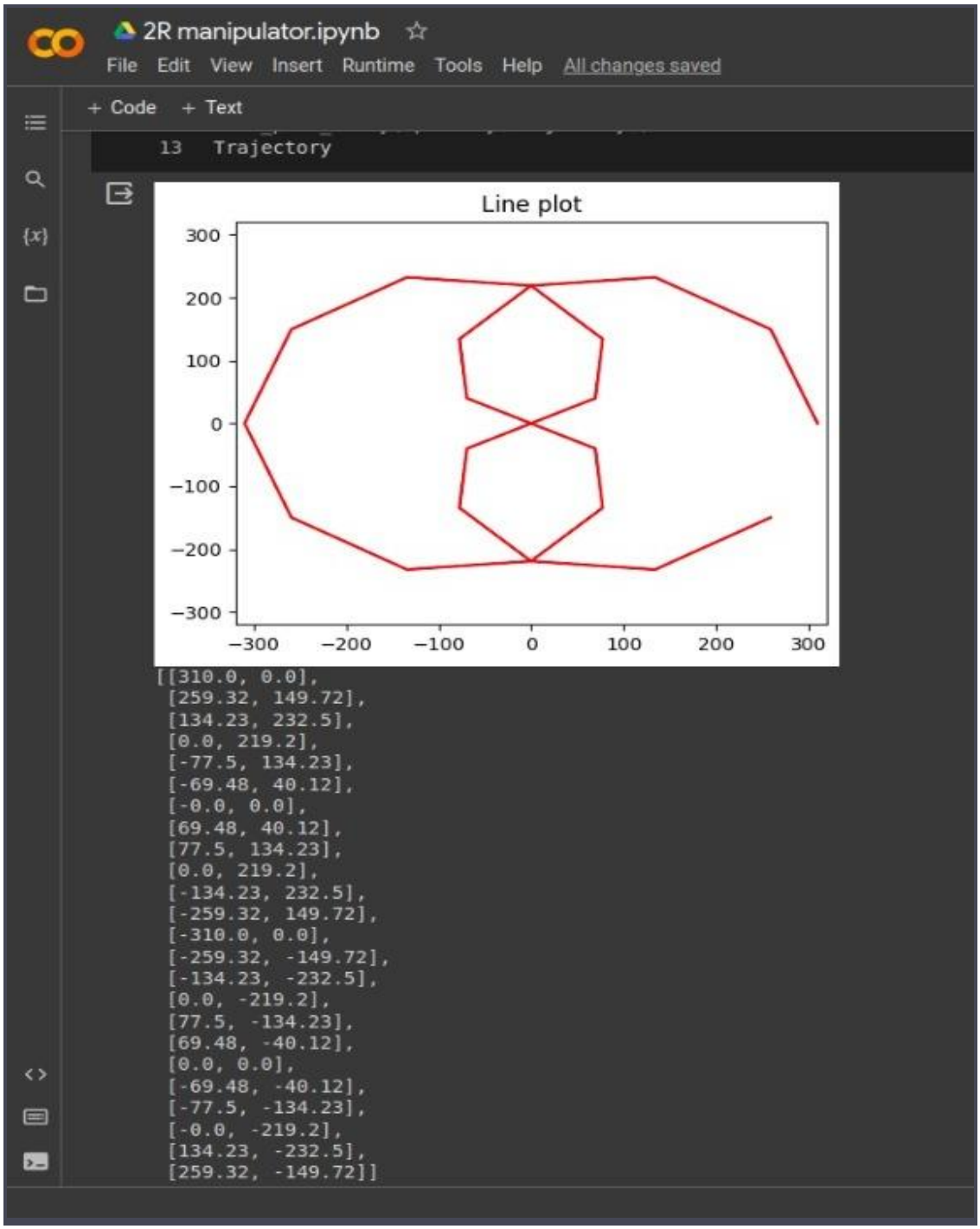
$[\theta 1\_dot, \theta 2\_dot]^T = J(\theta)^{-1}$ **x** $[dx, dy]^T$

End effector velocity

$[dx, dy]^T = J(\theta)$ **x** $[\theta 1\_dot, \theta 2\_dot]^T$

Coding :- click here

Task 1 - Position & Trajectory Control



This trajectory is made by continuously increasing the angles of link-1 by 15 degrees and link-2 by 45 degrees.

Task 2 - Apply a prespecified force of prespecified direction

ACS-**712** current sensor analog input (current in the form of Voltage difference) converted into current and then converted into torque. [shown conversion in Embedded C program].

Please note here that, due to an unknown reason, current sensor readings were fluctuating too much, showing 1-2 Amps of current even if there was no motor movement.

Task 3 - Robot end-tip acts like a virtual spring

Here we just adjusted the PID control tuning such that the Robot end tip acts like a spring.