

Ex-03 Forward-kinematics-using-robo-analyzer

› AIM:

To analyze the forward kinematics using DH parameters for a 4 and 6 dof robot using roboanalyzer and plot the graph for link coordinates and joint angles

› COMPONENTS REQUIRED:

1. Robo analyzer software

› THEORY:

Forward Kinematics

A manipulator is composed of serial links which are affixed to each other revolute or prismatic joints from the base frame through the endeffector. Calculating the position and orientation of the endeffector in terms of the joint variables is called as forward kinematics. In order to have forward kinematics for a robot mechanism in a systematic manner, one should use a suitable kinematics model. Denavit-Hartenberg method that uses four parameters is the most common method for describing the robot kinematics. These parameters are a_i , α_i , d_i and θ_i the link length, link twist, link offset and joint angle, respectively. A coordinate frame is attached to each joint to determine DH parameters. Z_i axis of the coordinate frame is pointing along the rotary or sliding direction of the general manipulator.

Denavit Hartenberg Parameters With DH Parameters, solving for the Forward Kinematics is easy. Only need to take four parameters for each joint i : θ_i for the joint angle, α_i for the link twist, d_i for the link offset, and a_i for the link length. Once I've obtained them, I can just plug them in to this transformation matrix:

$$T_{i-1}^i = \begin{bmatrix} \cos(\theta_i) & -\cos(\alpha_i) \cdot \sin(\theta_i) & \sin(\alpha_i) \cdot \sin(\theta_i) & a_i \cdot \cos(\theta_i) \\ \sin(\theta_i) & \cos(\alpha_i) \cdot \cos(\theta_i) & -\sin(\alpha_i) \cdot \cos(\theta_i) & a_i \cdot \sin(\theta_i) \\ 0 & \sin(\alpha_i) & \cos(\alpha_i) & d_i \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

For the Stanford Arm, here are the DH Parameters:

Joint	Joint Angle	Link Offset	Link Length	Link Twist
1	θ_1	d_1	0	-90
2	θ_2	d_2	0	-90
3	-90	d_3	0	0
4	θ_4	d_4	0	-90
5	θ_5	0	0	90
6	θ_6	d_6	0	0

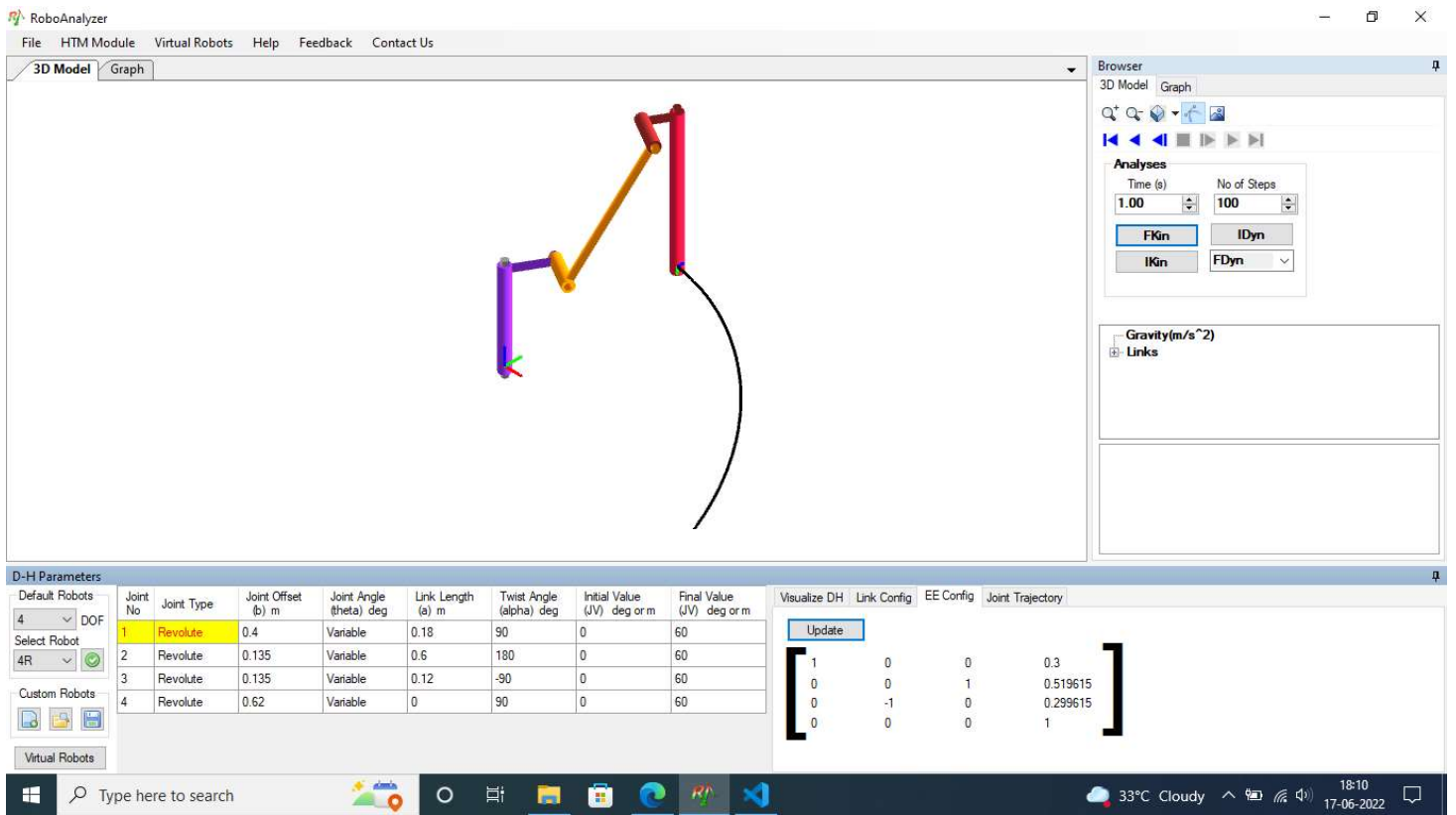
Table 1: DH Parameters for the Stanford Arm

› PROCEDURE:

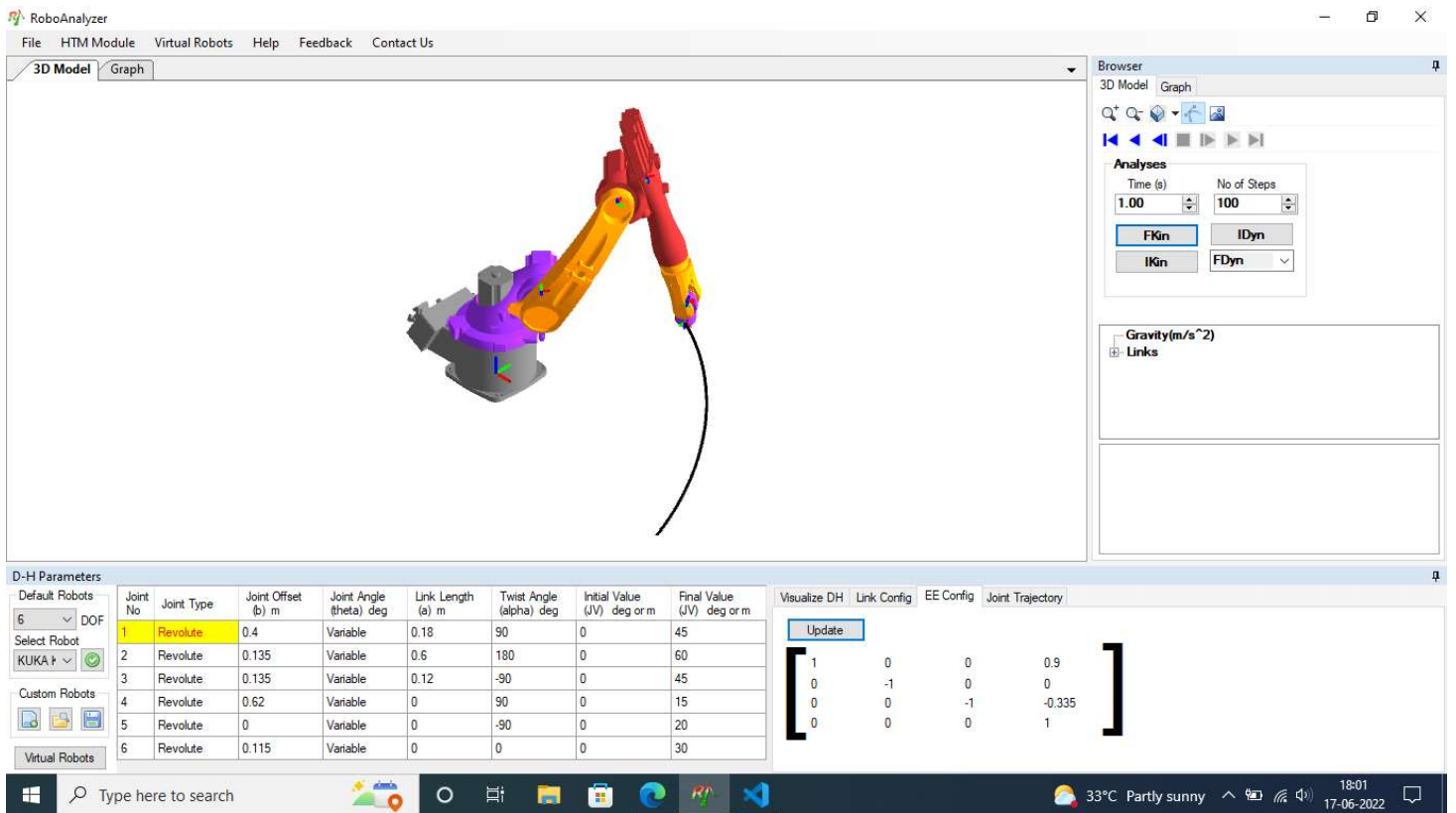
- › 1.open the roboanalyzer software.
- › 2.select the robot and its degrees of freedom.
- › 3.change the values with the link lenght wherever necessary.
- › 4.simulate the model for forward kinematics.
- › 5.plot the graph between the link and the joints.
- › 6.update the DH parameters of the link configuration and end effector configuration.

› SIMULATION

› 4 DOF

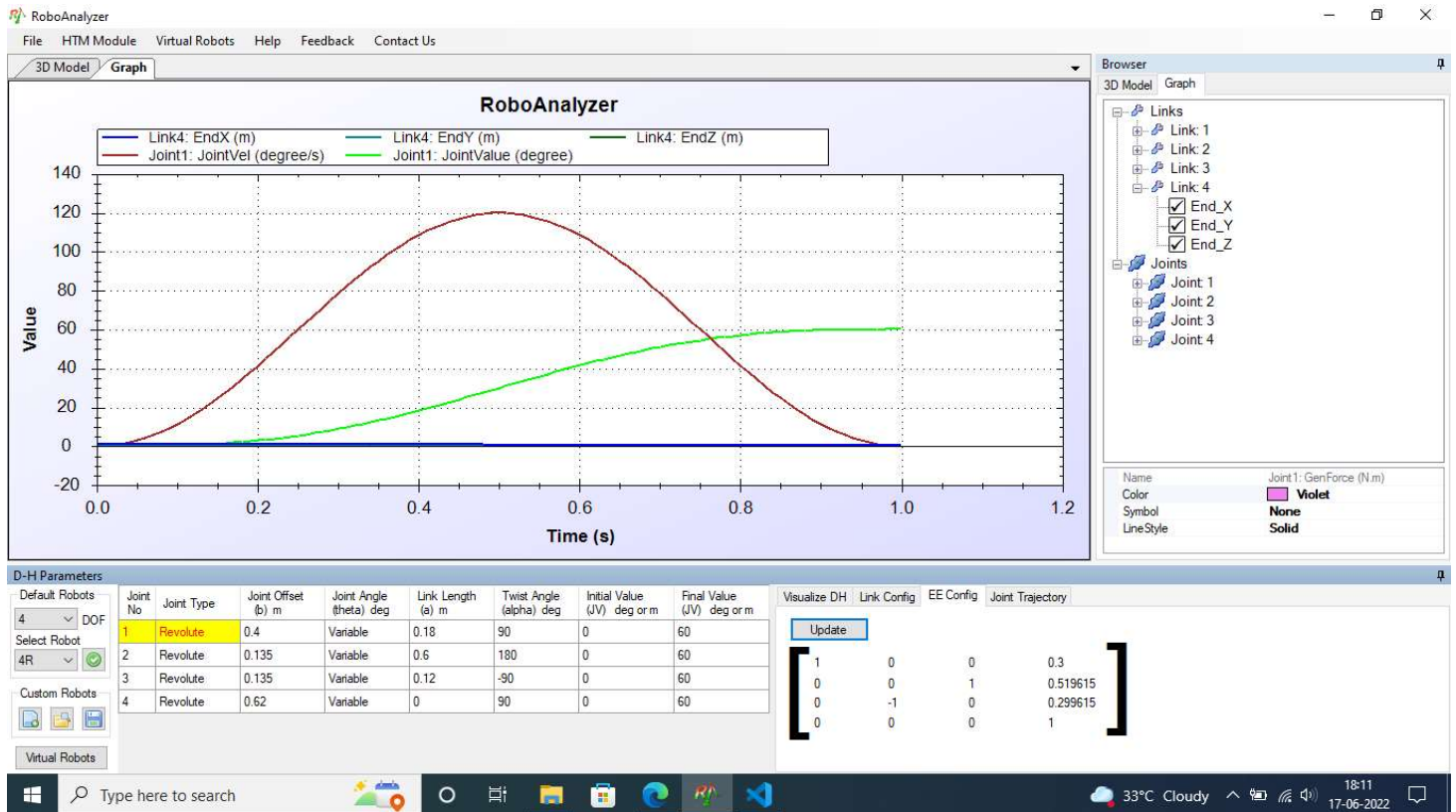


6 DOF

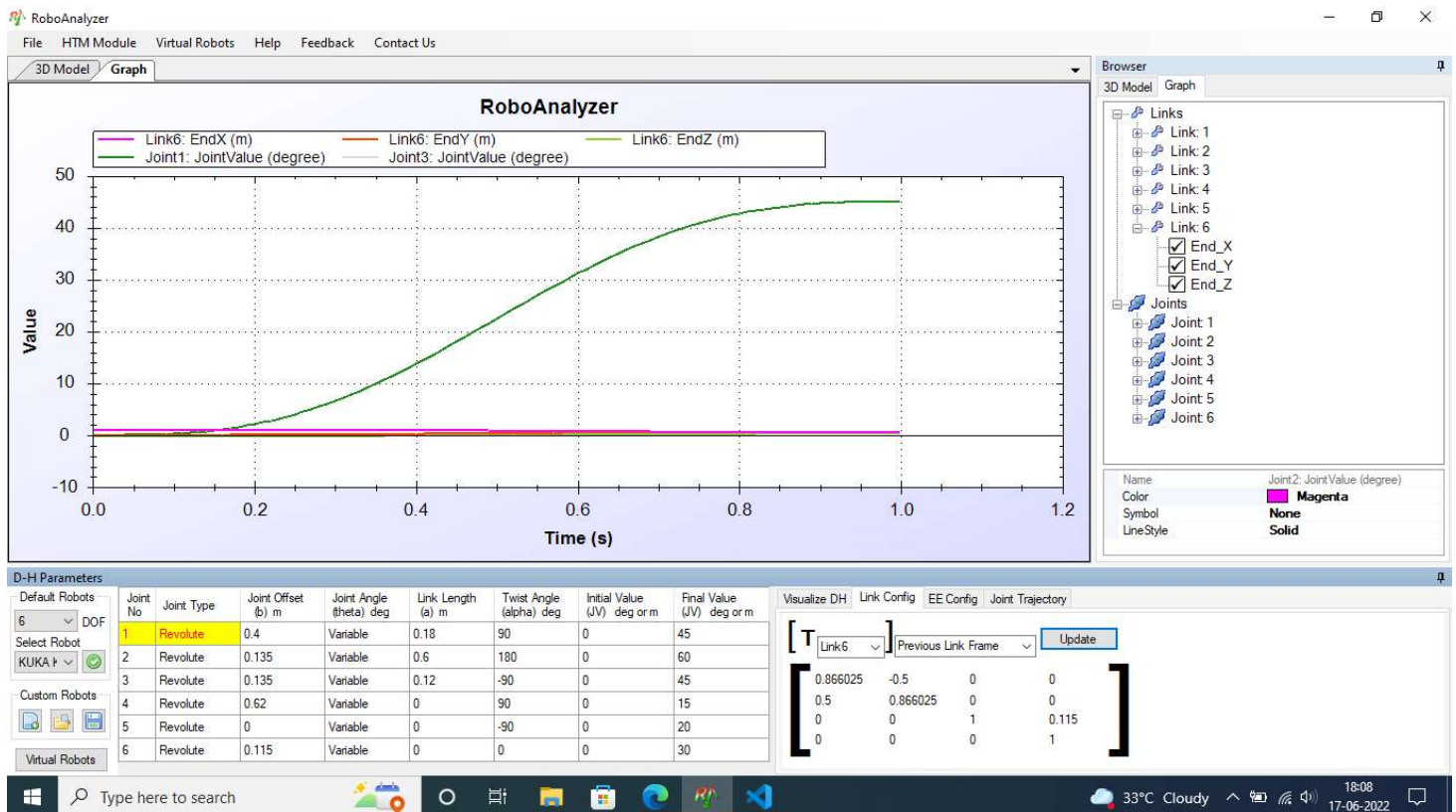


PLOT

4 DOF



6 DOF



› RESULTS :

Thus, the forward kinematics using DH parameters for a 4 and 6 dof robot using roboanalyzer is analysed and the graph for link coordinates and joint angles is plotted.