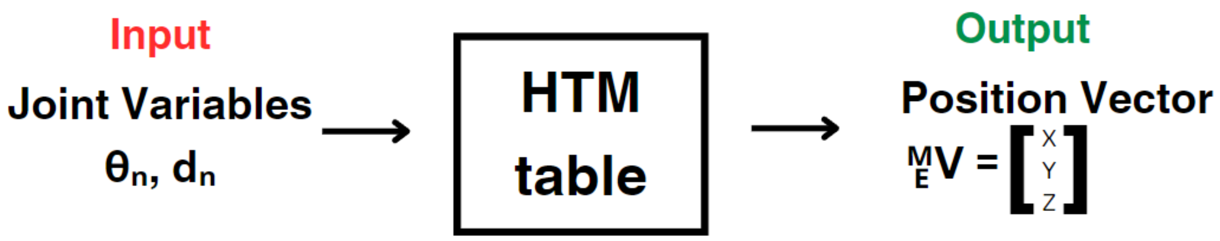
VI. INVERSE KINEMATICS USING GRAPHICAL METHOD

Inverse Kinematics is the technique of computing joint angles using the end-effector's location and orientation. In addition, Inverse kinematics simply requires a static set of joint angles to position a certain point (or combination of points) of the character (or robot) at a specific location.

In comparison, Forward kinematics computes the chain's configuration using the joint parameters, whereas inverse kinematics reverses this computation to determine the joint parameters that produce the desired configuration. In contrast to the concept of forward kinematics, which involves determining the workspace coordinates of a robot based on a given configuration, inverse kinematics (IK) represents the inverse process. It entails calculating the appropriate configuration(s) to achieve a desired workspace coordinate. This operation holds significant value in various robotics applications, including the movement of tools along specified paths, object manipulation, and capturing scenes from desired viewpoints.

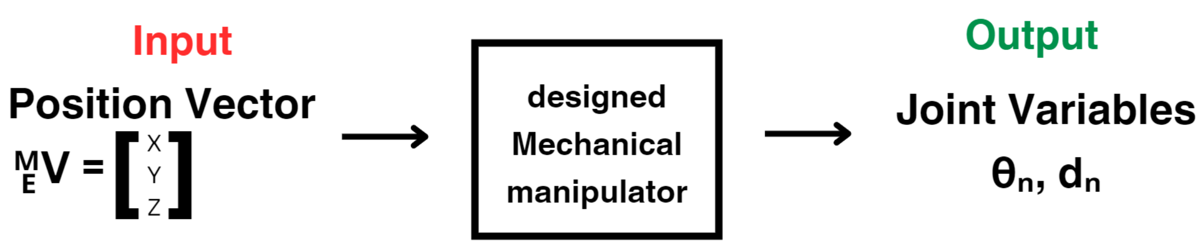
In forward kinematics the given inputs are the joint variables, using the homogeneous transformation matrix, we will obtain the output, position vector.

Forward Kinematics



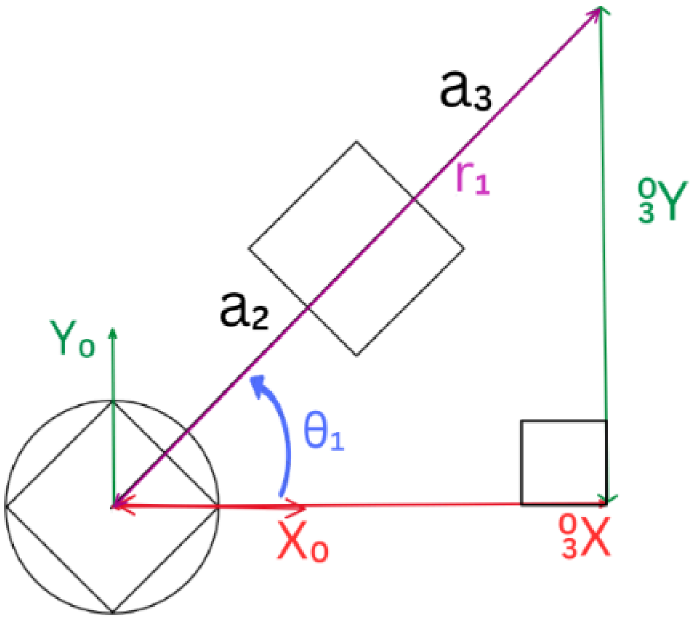
While in inverse kinematics, the given input is the position vector, while the output is the joint variable, the method to obtain the output depends on the design of difficulty of the mechanical manipulator.

Inverse Kinematics



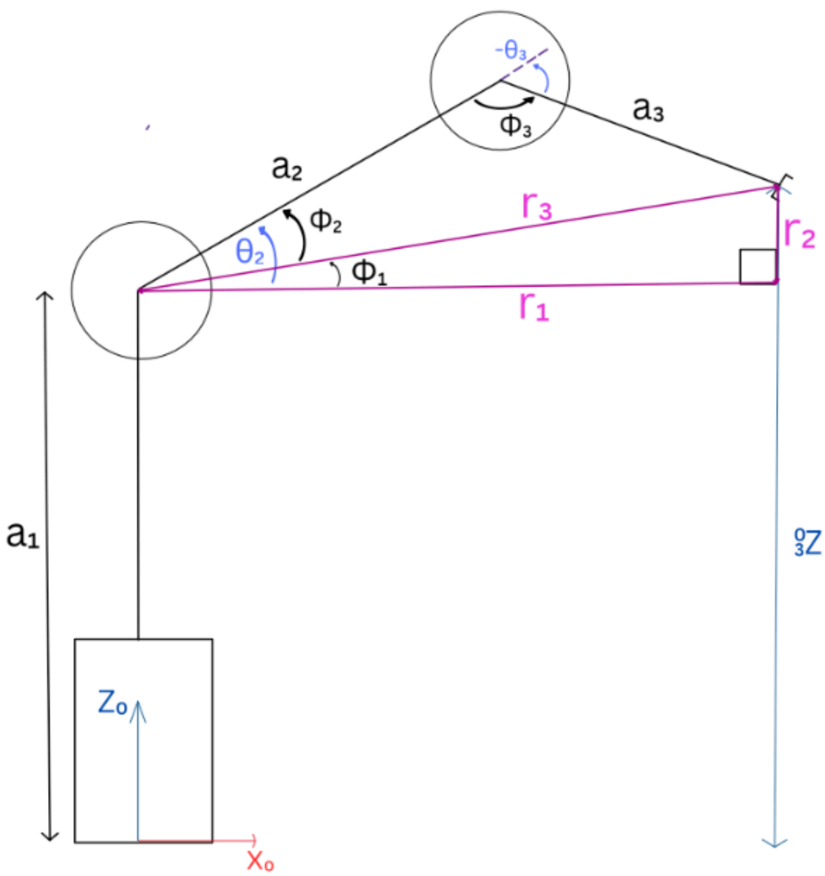
INVERSE KINEMATICS CALCULATION OF ARTICULATED MANIPULATOR (RRR)

Inverse Kinematic Diagram (Front View)



$$\theta_1 = \tan^{-1}\left(\frac{^0_3Y}{^0_3X}\right) \quad (1)$$

$$r_1 = \sqrt{(^0_3Y)^2 + (^0_3X)^2} \quad (2)$$



$$r_2 = {}^0_3Z - a_1 \quad (3)$$

$$\Phi_1 = \tan^{-1}\left(\frac{r_2}{r_1}\right) \quad (4)$$

$$r_3 = \sqrt{(r_2)^2 + (r_1)^2} \quad (5)$$

$$\Phi_2 = \cos^{-1}\left(\frac{a_3^2 - r_2^2 - r_3^2}{-2a_2r_3}\right) \quad (6)$$

$$\theta_2 = \Phi_1 + \Phi_2 \quad (7)$$

$$\Phi_3 = \cos^{-1}\left(\frac{r_3^2 - a_2^2 - a_3^2}{-2a_2a_3}\right) \quad (8)$$

$$\theta_3 = \Phi_3 - 180° \quad (9)$$

Supplementary Video about the Inverse Kinematics of Articulated Manipulator

To further understand how to get the Inverse Kinematics, here is a supplementary video explaining how to get it.

(https://drive.google.com/file/d/1-gFm7NqfxsCYq6r9rKb2YGz5jvkMfqIG/view?usp=sharing)