Robotics [IIT-Jodhpur]
Practical 4: Inverse Kinematics of 3 Link Robot

s 1 Write a program to perform inverse kinematics of the 3-link planar robot shown in Fig. 1 using geometric method. Assume link lengths as $a_1 = 1$ m, $a_2 = 1$ m, $a_3 = 0.5$ m.

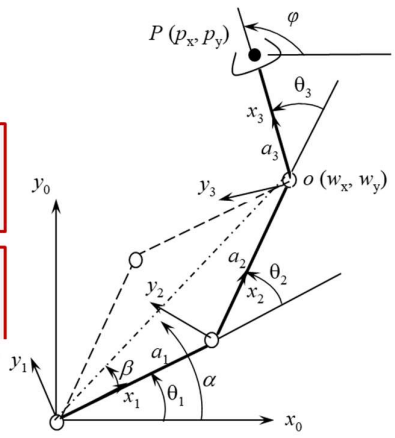
- Given the end-effector pose (p_x, p_y, φ), within the workspace, find inverse kinematics solution, i.e., joint angles $(\theta_1, \theta_2, \theta_3)$. (You can use expressions given below).
- Sketch both configuration in the same window

$$p_x = w_x + a_3 c\varphi \qquad p_y = w_y + a_3 s\varphi \quad \Rightarrow \quad w_x = p_x - a_3 c\varphi \qquad w_y = p_y - a_3 s\varphi$$

$$\theta_2 = \tan^{-1}\left(\pm\frac{\sqrt{1-D^2}}{D}\right) \text{ where } D \equiv \frac{w_x^2 + w_y^2 - a_1^2 - a_2^2}{2a_1 a_2}$$

$$\theta_1 = \alpha - \beta = \tan^{-1}\left(\frac{w_y}{w_x}\right) - \tan^{-1}\left(\frac{a_2 \sin(\theta_2)}{a_1 + a_2 \cos(\theta_2)}\right)$$

$$\theta_3 = \varphi - (\theta_1 + \theta_2)$$



$$\varphi = \theta_1 + \theta_2 + \theta_3$$

2 Extend the inverse kinematics program developed above to follow a circular path within the workspace of the robot. Input would be center, and radius of a circle. Perform the following

- Plot joint angles.
- Animate the robot and trace end effector's motion