

## RRR-Derivation :

RRR-Planar  
22 October 2025 18:11

(2R) config

(ROBotic Arm)

$$x = x_1 + x_2$$

$$y = y_1 + y_2$$

forward kinematics:

$$x_1 = l_1 \cos \theta_1$$

$$x_2 = l_2 \cos(\theta_1 + \theta_2)$$

$$y_1 = l_1 \sin \theta_1$$

$$y_2 = l_2 \sin(\theta_1 + \theta_2)$$

$$x = l_1 \cos \theta_1 + l_2 \cos(\theta_1 + \theta_2)$$

$$y = l_1 \sin \theta_1 + l_2 \sin(\theta_1 + \theta_2)$$

$\cos \theta_1 = \frac{x_1}{l_1}$   
 $\theta = \arccos \frac{x_1}{l_1}$

inverse kinematics

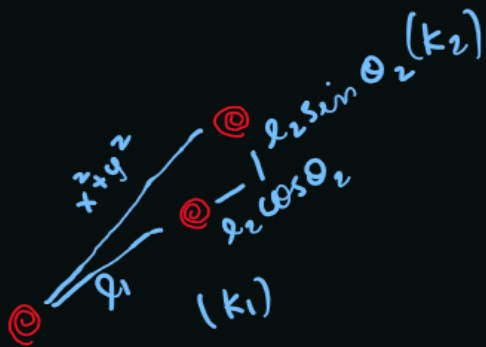
$x_2 = l_2 \cos \theta_2$   
 $y_2 = l_2 \sin \theta_2$

$$x^2 + y^2 = (l_2 \sin \theta_2)^2 + (l_1 + l_2 \cos \theta_2)^2$$

$$x^2 + y^2 = l_2^2 \sin^2 \theta_2 + l_1^2 + l_2^2 \cos^2 \theta_2 + 2l_1 l_2 \cos \theta_2$$

$$x^2 + y^2 = l_1^2 + l_2^2 + 2l_1 l_2 \cos \theta_2$$

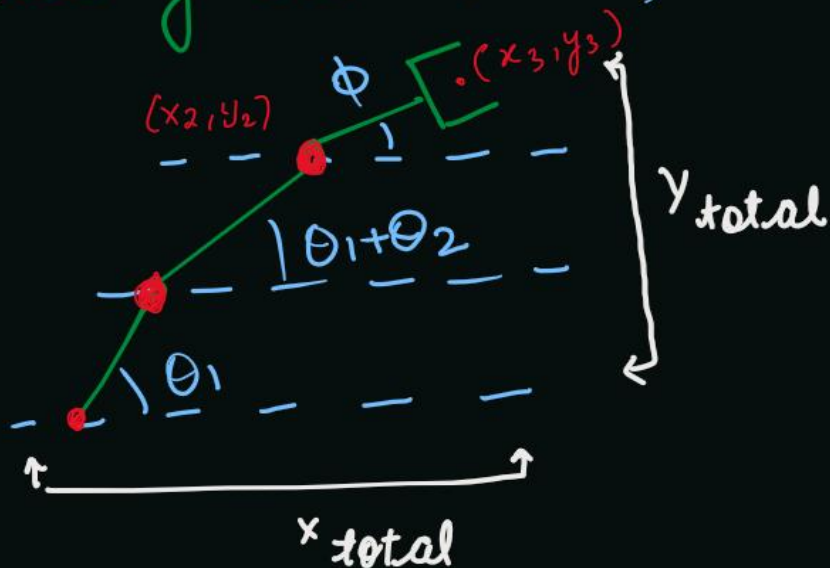
$$\theta_2 = \left( \frac{x^2 + y^2 - l_1^2 - l_2^2}{2l_1 l_2} \right) \cos^{-1}$$



$\theta_1 \Rightarrow$

$$\tan(y/x) = \tan\left(\frac{k_2}{k_1}\right)$$

in case of 3R: ( $\phi = \sum \theta$ )



$$\begin{aligned} \text{So } y - l_3 \sin \phi &= y_2 \\ x - l_3 \cos \phi &= x_2 \end{aligned}$$

after  $x_2, y_2$  its similar }  $x, y$  in  
as 2R configuration } 2R in  
now  $(x_2, y_2)$

for 3R we give  $(x, y, \phi)$   
and get  $(T_1, T_2, T_3)$

Making angles absolute :

$MT_1 \rightarrow$  its absolute angle

$MT_2 \rightarrow$  its  $90 + t_1 + t_2$



but Motor is  
already in 90 so  
its  $90 + \theta_1 + \theta_2$

$MT_3 \rightarrow$  its relative to  $t_2$

