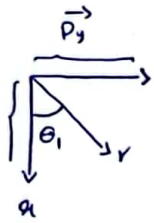
سوال اول

نمای از بالا

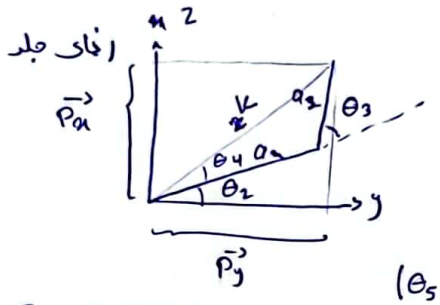


$\theta_1 = \cos^{-1}\left(\frac{P_x}{r}\right)$

$r = \sqrt{P_x^2 + P_y^2}$

$\theta = \cos^{-1}\left(\frac{P_x}{\sqrt{P_x^2+P_y^2}}\right)$

نمای جلو



$z = a_2^2 + a_3^2 - 2a_2a_3\cos(\pi - \theta_3)$

$k_z = P_z^2 + P_y^2 + P_x^2$

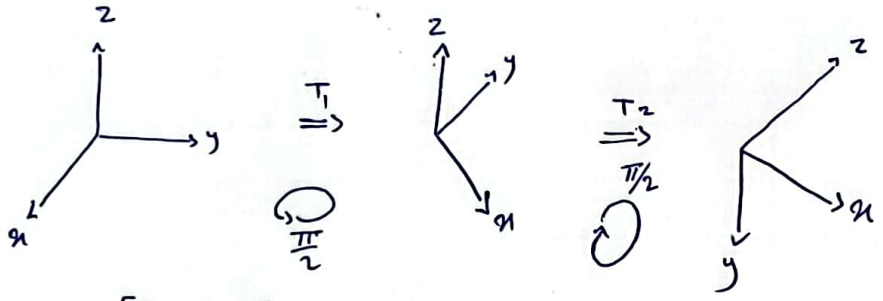
$\theta_3 = \cos^{-1}\left(\frac{P_z^2 + P_y^2 - a_2^2 - a_3^2}{2a_2a_3}\right)$

$(\theta_5 = \theta_2 + \theta_4)$ ①

$\theta_2 = \tan^{-1}\left(\frac{P_x}{P_y}\right) - \theta_4$ ②

① ② $\theta_2 = \theta_5 - \theta_4 = \tan^{-1}\left(\frac{P_x}{P_y}\right) - \tan^{-1}\left(\frac{a_2\sin\theta_3}{a_2 + a_2\cos\theta_3}\right)$

سوال دوم



$T_1 = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 0 & 1 \\ 0 & -1 & 0 \end{bmatrix}$

$T_2 = \begin{bmatrix} 0 & -1 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & 1 \end{bmatrix}$

$T_1 \times T_2 = \begin{bmatrix} 0 & 0 & -1 \\ 1 & 0 & 0 \\ 0 & -1 & 0 \end{bmatrix}$

سوال سوم

$T_{ce} = T_{cb}T_{bd}T_{de} = T_{cb}(T_{db}^{-1}T_{de})$

$T_{cb} = \begin{bmatrix} C_{R_b} & t_c \\ 0 & 1 \end{bmatrix}$

دوربین این مقدار را به ما می‌دهد

سوال چهارم

$$\begin{bmatrix} \dot{x} \\ \dot{y} \\ \dot{\theta} \end{bmatrix} = \begin{bmatrix} \cos\theta & 0 \\ \sin\theta & 0 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} V \\ w \end{bmatrix}$$

$$V = r\frac{\varphi_1 + \varphi_2}{2} = 3\frac{5+10}{2} = 22.5$$

$$w = r\frac{\varphi_1 + \varphi_2}{2L} = 3\frac{10-5}{2\times 10} = 0.75$$

حالت $\Rightarrow$ $\begin{bmatrix} \dot{x} \\ \dot{y} \\ \dot{\theta} \end{bmatrix} = \begin{bmatrix} 0 \\ 22.5 \\ 0.75 \end{bmatrix}$

سوال پنجم

$$\left.\begin{array}{l} \tan\theta_i = \dfrac{L}{R - \frac{l}{2}} \\ \tan\theta_0 = \dfrac{L}{R + \frac{l}{2}} \end{array}\right\} \quad 2R = \frac{L}{\tan\theta_i} + \frac{L}{\tan\theta_0} \Rightarrow \frac{R}{L} = \frac{1}{2}\left(\frac{1}{\tan\theta_i} + \frac{-1}{\tan\theta_0}\right)$$

$$\Rightarrow \tan\theta = \frac{L}{R} = \frac{2}{\frac{1}{\tan\theta_i} - \frac{1}{\tan\theta_0}}$$