Student Information

Full Name : Beste Burhan
Id Number : 2171395

Answer 1

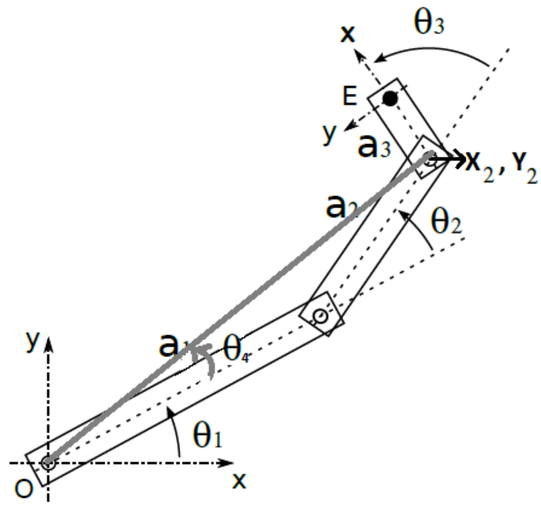

Figure 1: Three joint planar robot arm.

$x_2 = x^* + a_3cos(\pi - \theta^*) = x^* - a_3cos(\theta^*)$
$y_2 = y^* - a_3sin(\pi - \theta^*) = y^* - a_3sin(\theta^*)$
$x_2^2 + y_2^2 = a_1^2 + a_2^2 - 2a_1a_2cos(\pi - \theta_2)$
$\theta_2 = cos^{-1}\Big(\dfrac{x_2^2 + y_2^2 - a_1^2 - a_2^2}{2a_1a_2}\Big)$
$tan^{-1}\Big(\dfrac{y_2}{x_2}\Big) = \theta_1 + \theta_4$
$\theta_1 = tan^{-1}\Big(\dfrac{y_2}{x_2}\Big) - tan^{-1}\Big(\dfrac{a_2sin\theta_2}{a_1 + a_2cos\theta_2}\Big)$
$\theta^* = \theta_1 + \theta_2 + \theta_3$
$\theta_3 = \theta^* - \theta_1 - \theta_2$

Answer 2

$E_{\underset{y}{\rightarrow}} = \dfrac{d(c(\gamma))}{d\gamma} = \dot{c}(\gamma)$
$\dot{c}(\gamma) = \begin{bmatrix} (32.\pi.cos(2\pi.\gamma).cos(8.\pi.\gamma).sin(8.\pi.\gamma))/5 - 2.\pi.sin(2.\pi.\gamma).((2.sin(8.\pi.\gamma)^2)/5 + 9/10) \\ 2.\pi.cos(2.pi.\gamma).((2.sin(8.\pi.\gamma)^2)/5 + 9/10) + (32.\pi.cos(8.\pi.\gamma).sin(2.\pi.\gamma).sin(8.\pi.\gamma))/5 \end{bmatrix}$

$\theta^* = tan^{-1}\Big(\dfrac{\dot{c}(\gamma)(2)}{\dot{c}(\gamma)(1)}\Big) - \dfrac{\pi}{2}$

$^oT_E(\gamma) = \begin{bmatrix} cos\theta^* & -sin\theta^* & c(\gamma)(1) \\ sin\theta^* & cos\theta^* & c(\gamma)(2) \\ 0 & 0 & 1 \end{bmatrix}$

Answer 3

hw3_e2171395_scr1

Answer 4

hw3_e2171395_scr2

Answer 5

hw3_e2171395_scr3

Answer 6

The approximate distance from farthermost point which I get from the graphic of matlab script in the previous solution is 1.3. If the sum of the lengths of all links is 1.3,then robot arm can reach the farthermost point. Therefore, the approximate minimum value of a_1 is 0.6.