HW #5

$$X_0 = (X_2 + a_1)\,c\theta_1 - (Y_2 + d_2)\,s\theta_1$$

$$Y_0 = (X_2 + a_1)\,s\theta_1 + (Y_2 + d_2)\,c\theta_1$$

$$X_0 c\theta_1 = (X_2 + a_1)\,c\theta_1^2 - (Y_2 + d_2)\,s\theta_1 c\theta_1$$

$$Y_0 s\theta_1 = (X_2 + a_1)\,s\theta_1^2 + (Y_2 + d_2)\,c\theta_1 s\theta_1$$

$$X_0 c\theta_1 + Y_0 s\theta_1 = (X_2 + a_1)(c\theta_1^2 + s\theta_1)^2$$

Let $X_0 = R c\delta \qquad Y_0 = R s\delta$

$$R(c\theta_1 c\delta + s\theta_1 s\delta) = X_2 + a_1$$

$$R\cos(\theta_1 - \delta) = X_2 + a_1$$

$$A = \cos(\theta_1 - \delta) = \frac{X_2 + a_1}{\sqrt{X_0^2 + Y_0^2}}$$

$$\tan\delta = \frac{Y_0}{X_0}$$

$$\delta = \tan^{-1}\left(\frac{Y_0}{X_0}\right)$$

$$\sin(\theta_1 - \delta) = \pm\sqrt{1 - A^2}$$

$$\theta_1 - \delta = \tan^{-1}\left(\frac{\pm\sqrt{1-A^2}}{A}\right)$$

$$\theta_1 = \tan^{-1}\left(\frac{\pm\sqrt{1-A^2}}{A}\right) + \tan^{-1}\left(\frac{Y_0}{X_0}\right)$$

$$-X_0 + (X_2 + a_1)c\theta_1 - Y_2 s\theta_1 = d_2 s\theta_1$$

$$Y_0 - (X_2 + a_1)s\theta_1 - Y_2 c\theta_1 = d_2 c\theta_1$$

$$-s\theta_1 X_0 + (X_2 + a_1)s\theta_1 c\theta_1 - Y_2 s^2\theta_1 = d_2 s^2\theta_1$$
$$c\theta_1 Y_0 - (X_2 + a_1)s\theta_1 c\theta_1 - Y_2 c\theta_1^2 = d_2 c^2\theta_1$$

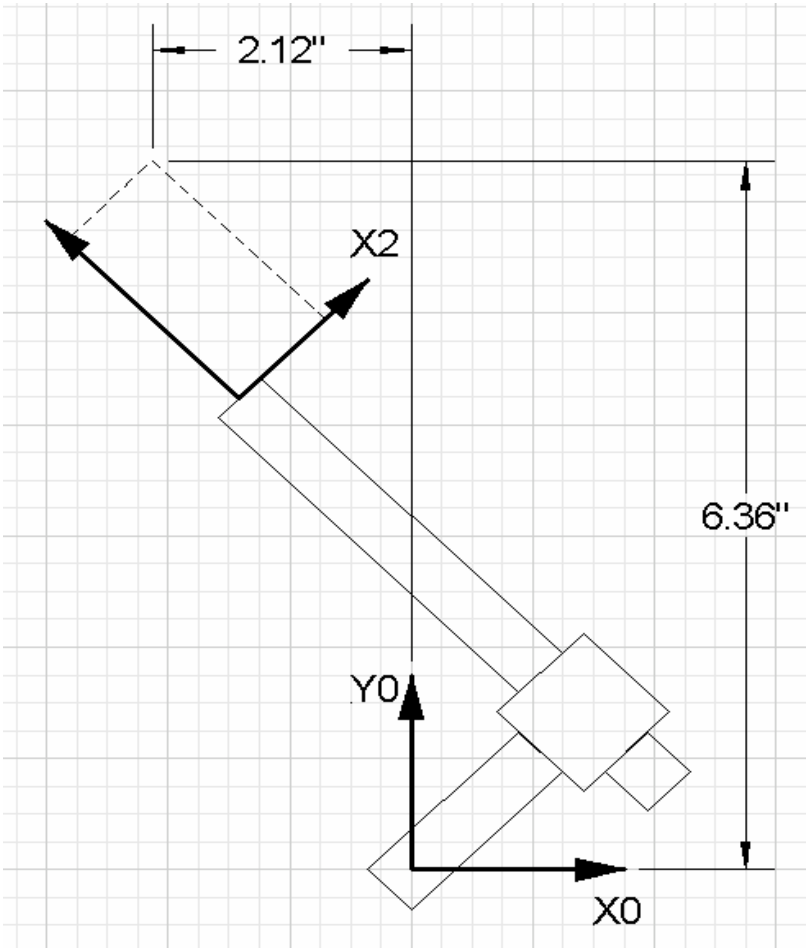
$$\boxed{(c\theta_1 Y_0 - s\theta_1 X_0 - Y_2) = d_2}$$

x0	-2.121	
y0	6.364	
a1	2	
d2	4	
x2	1	
y2	2	
th1	0.7854	45
d2r	0.0175	

Forward Kinematics Solution

A	term1	term2	θ1	d2
0.4472	63.43	108.43	171.87	-8
	-63.43	108.43	45	4

Inverse Kinematics Solution



x0	6.598	
y0	5.428	
a1	2	
d2	6	
x2	1	
y2	2	
th1	5.7596	330
d2r	0.0175	

Forward Kinematics Solution

A	term1	term2	θ1	d2
0.3511	69.44	39.44	108.89	-10
	-69.44	39.44	-30	6

Inverse Kinematics Solution