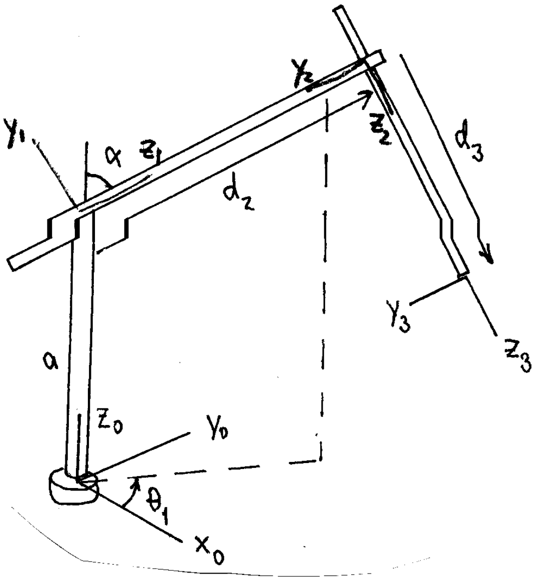
5.

$$A_1 = \begin{pmatrix} -s_1 & -c_\alpha c_1 & s_\alpha c_1 & 0 \\ c_1 & -c_\alpha s_1 & s_\alpha s_1 & 0 \\ 0 & s_\alpha & c_\alpha & a \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

$$A_2 = \begin{pmatrix} -1 & 0 & 0 & 0 \\ 0 & 0 & -1 & 0 \\ 0 & -1 & 0 & d_2 \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

$$A_3 = \begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & d_3 \\ 0 & 0 & 0 & 1 \end{pmatrix}$$



$$T = A_1 A_2 A_3 = \begin{pmatrix} s_1 & -s_\alpha c_1 & c_\alpha c_1 & d_2 s_\alpha c_1 + d_3 c_\alpha c_1 \\ -c_1 & -s_\alpha s_1 & c_\alpha s_1 & d_2 s_\alpha s_1 + d_3 c_\alpha s_1 \\ 0 & -c_\alpha & -s_\alpha & a - d_2 c_\alpha - d_3 s_\alpha \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

6. $p_x = d_2 \qquad p_y = a \sin\theta_3 \qquad p_z = d_1 - a\cos\theta_3$

a) $p_x = a,\ p_y = a/2,\ p_z = a$ ger direkt

$d_2 = a \qquad \theta_3 = 30^\circ \qquad d_1 = a(1 + \sqrt{3}/2)$

b)

$$J = \begin{pmatrix} \frac{\partial p_x}{\partial d_1} & \frac{\partial p_x}{\partial d_2} & \frac{\partial p_x}{\partial \theta_3} \\ \frac{\partial p_y}{\partial d_1} & \frac{\partial p_y}{\partial d_2} & \frac{\partial p_y}{\partial \theta_3} \\ \frac{\partial p_z}{\partial d_1} & \frac{\partial p_z}{\partial d_2} & \frac{\partial p_z}{\partial \theta_3} \end{pmatrix}$$

$$= \begin{pmatrix} 0 & 1 & 0 \\ 0 & 0 & a\cos\theta_3 \\ 1 & 0 & a\sin\theta_3 \end{pmatrix}$$