

Defineerime DH-maatrisi komponendid

$$R_x(\alpha) := \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & \cos(\alpha) & -\sin(\alpha) & 0 \\ 0 & \sin(\alpha) & \cos(\alpha) & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$R_z(\theta) := \begin{bmatrix} \cos(\theta) & -\sin(\theta) & 0 & 0 \\ \sin(\theta) & \cos(\theta) & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$T_x(r) := \begin{bmatrix} 1 & 0 & 0 & r \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$T_z(d) := \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & d \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$T_{DH}(r, d, \theta, \alpha) := T_z(d) \cdot R_z(\theta) \cdot T_x(r) \cdot R_x(\alpha)$$

Valige programmis Ciros Studio

"Model Explorer" Model->Objects->robot ja sellel "Properties -> Axes -> DH parameters"

$$d := \begin{bmatrix} 0.4865 \\ 0 \\ 0 \\ 0.600 \\ 0 \\ 0.065 \end{bmatrix} \quad \theta := \begin{bmatrix} 0 \\ -90 \cdot \text{deg} \\ 180 \cdot \text{deg} \\ 0 \\ 0 \\ 0 \end{bmatrix} \quad r := \begin{bmatrix} 0.150 \\ 0.700 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix} \quad \alpha := \begin{bmatrix} -90 \cdot \text{deg} \\ 0 \\ 90 \cdot \text{deg} \\ -90 \cdot \text{deg} \\ 90 \cdot \text{deg} \\ 0 \end{bmatrix}$$

Leiame DH-parameetrite põhjal koordinaatteljestike maatriksid

$$T_{DH}(r_0, d_0, \theta_0, \alpha_0) = \begin{bmatrix} 1 & 0 & 0 & 0.15 \\ 0 & 0 & 1 & 0 \\ 0 & -1 & 0 & 0.487 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$T_{DH}(r_1, d_1, \theta_1, \alpha_1) = \begin{bmatrix} 0 & 1 & 0 & 0 \\ -1 & 0 & 0 & -0.7 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$T_{DH}(r_2, d_2, \theta_2, \alpha_2) = \begin{bmatrix} -1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$T_{DH}(r_3, d_3, \theta_3, \alpha_3) = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & -1 & 0 & 0.6 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$T_{DH}(r_4, d_4, \theta_4, \alpha_4) = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 0 & -1 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$T_{DH}(r_5, d_5, \theta_5, \alpha_5) = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0.065 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Anname ette manipulaatori liigendite nurgad

$$\gamma := \begin{bmatrix} 10 \cdot \text{deg} \\ 10 \cdot \text{deg} \\ 10 \cdot \text{deg} \\ 10 \cdot \text{deg} \\ 10 \cdot \text{deg} \\ 10 \cdot \text{deg} \end{bmatrix}$$

Lahendame kinemaatilise otseteisenduse etteantud liigendite nurkade korral

$$tool0 := \prod_{n=0}^5 \left(R_z(\gamma_n) \cdot T_{DH}(r_n, d_n, \theta_n, \alpha_n) \right) \quad tool0 = \begin{bmatrix} -0.529 & -0.021 & 0.849 & 0.878 \\ 0.251 & 0.951 & 0.18 & 0.157 \\ -0.811 & 0.309 & -0.498 & 0.938 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Kinemaatilise otseteisenduse lahendi komponendid - lõpplüli koordinaadid ja suunistuse (orientatsiooni) maatriks

$$\text{submatrix}(tool0, 0, 2, 3, 3) = \begin{bmatrix} 0.878 \\ 0.157 \\ 0.938 \end{bmatrix} \quad \text{submatrix}(tool0, 0, 2, 0, 2) = \begin{bmatrix} -0.529 & -0.021 & 0.849 \\ 0.251 & 0.951 & 0.18 \\ -0.811 & 0.309 & -0.498 \end{bmatrix}$$