Yaw

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

Pitch

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

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

$$T_{xyz}(x, y, z) := \begin{bmatrix} 1 & 0 & 0 & x \\ 0 & 1 & 0 & y \\ 0 & 0 & 1 & z \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Etteantud lineaarkoordinaadid (x,y,z) ja Euleri nugar (Roll, Pitch, Yaw)
Given Cartesian coordinates and Euler angles (Roll, Pitch, Yaw)

$$T_{tool0} := T_{xyz}(466.6762, 330.5157, 400.4998) \cdot R_z(154.5681 \cdot deg) \cdot R_y(54.1632 \cdot deg) \cdot R_x(148.1864 \cdot deg)$$

$$T_{tool0} = \begin{bmatrix} -0.5287 & -0.021 & 0.8485 & 466.6762 \\ 0.2514 & 0.9509 & 0.1802 & 330.5157 \\ -0.8107 & 0.3086 & -0.4975 & 400.4998 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Leitavate muutujate deklareerimine / Declaration of variables for find

$$\gamma 1 := 0 \qquad \gamma 2 := 0 \qquad \gamma 3 := 0 \qquad \gamma 4 := 0 \qquad \gamma 5 := 0 \qquad \gamma 6 := 0$$

Võrrand / Equation

"Equals to" sign (from Boolean toolbar, etc)

DH matrixes

$$R_z(\gamma 1) \cdot \begin{bmatrix} 1 & 0 & 0 & 150 \\ 0 & 0 & 1 & 0 \\ 0 & -1 & 0 & 486.5 \\ 0 & 0 & 0 & 1 \end{bmatrix} \cdot R_z(\gamma 2) \cdot \begin{bmatrix} 0 & 1 & 0 & 0 \\ -1 & 0 & 0 & -700 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \cdot R_z(\gamma 3) \cdot \begin{bmatrix} -1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \cdot R_z(\gamma 4) \cdot \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & -1 & 0 & 600 \\ 0 & 0 & 0 & 1 \end{bmatrix} \cdot R_z(\gamma 5) \cdot \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 0 & -1 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \cdot R_z(\gamma 6) \cdot \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 65 \\ 0 & 0 & 0 & 1 \end{bmatrix} = T_{tool0}$$

Constraints

Joint limits

$$-180 \cdot deg \le \gamma 1 \le 180 \cdot deg$$

$$-90 \cdot deg \le \gamma 2 \le 90 \cdot deg$$

$$-245 \cdot deg \le \gamma 3 \le 65 \cdot deg$$

$$-200 \cdot deg \le \gamma 4 \le 200 \cdot deg$$

$$-115 \cdot deg \le \gamma 5 \le 115 \cdot deg$$

$$-400 \cdot deg \le \gamma 6 \le 400 \cdot deg$$

Guess Values

$$\gamma 4 := 24$$

Võrrandi ja võrratuste süsteemi ligikaudne lahend (manipulaatori lülide nurgad) / Solution (angles of manipulator joints)

Solver

$$\mathbf{Find}(\gamma 1, \gamma 2, \gamma 3, \gamma 4, \gamma 5, \gamma 6) = \begin{bmatrix} 37.764 \\ 39.267 \\ 57.673 \\ -155.706 \\ 66.453 \\ 204.128 \end{bmatrix} deg$$

$$204.128 - 360 = -155.872$$

Cfg: (0,-2,-2,0)	Cfg: (0,0,0,1)	Cfg: (-2,0,-2,6)	Cfg: (-2,-2,0,7)
J1: 37.76	J1: 37.76	J1: -142.24	J1: -142.24
J2: 39.27	J2: 39.27	J2: -42.78	J2: -42.78
J3: 57.67	J3: 57.67	J3: -208.24	J3: -208.24
J4: -155.71	J4: 24.29	J4: 33.17	J4: -146.83
J5: 66.45	J5: -66.45	J5: 43.57	J5: -43.57
J6: -155.87	J6: 24.13	J6: -170.99	J6: 9.01