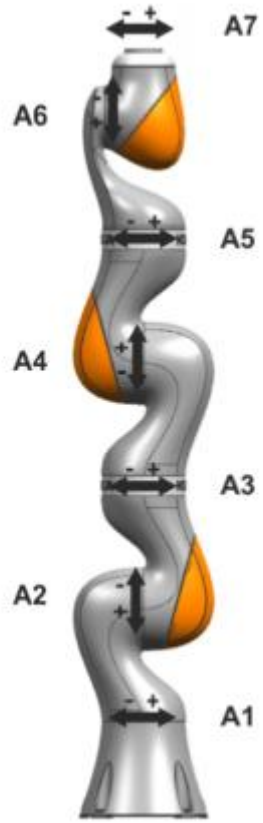
Report

Description of robot



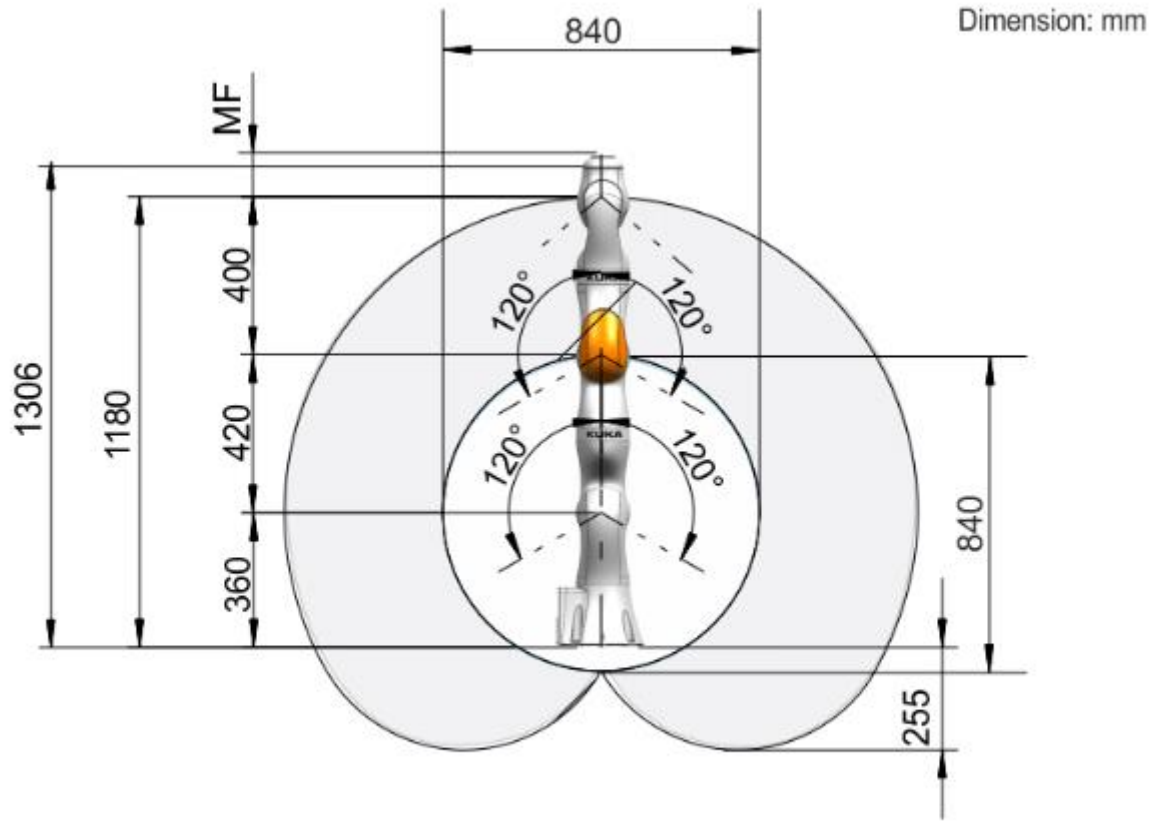


Fig. 4-7: LBR iiwa 14 R820 working envelope, side view

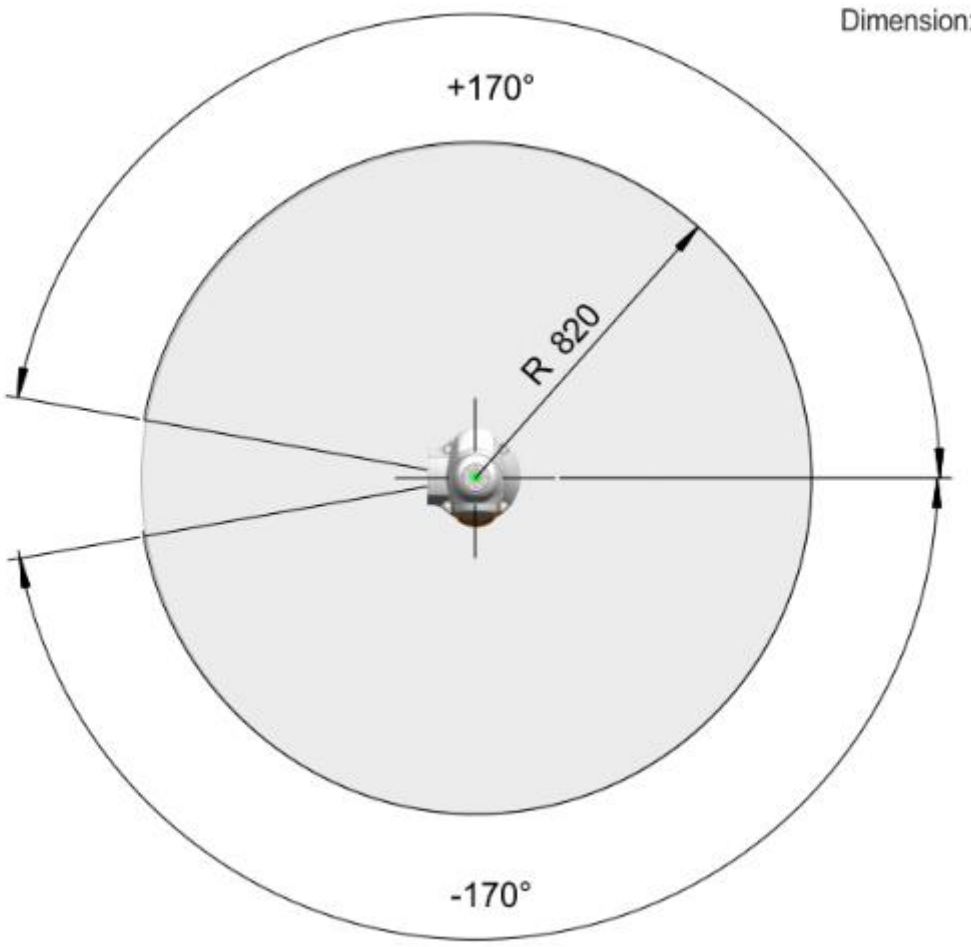
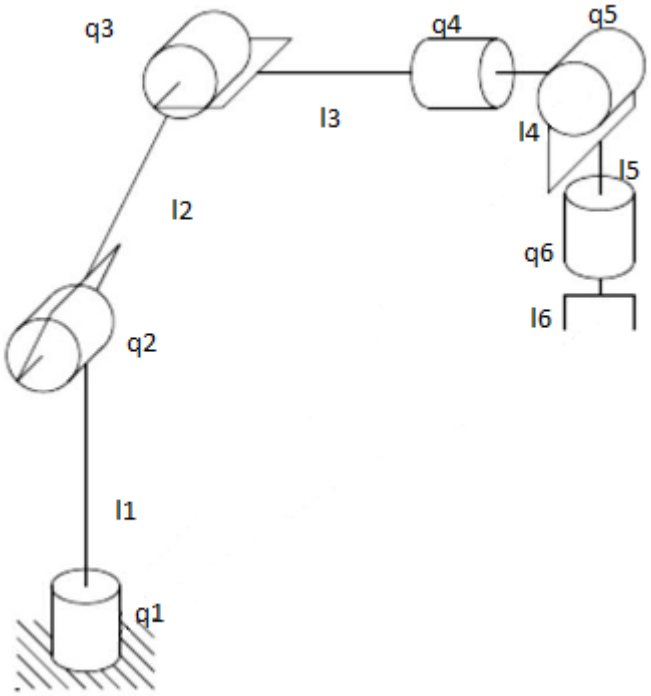


Fig. 4-8: LBR iiwa 14 R820 working envelope, top view

Kinematic scheme



Description

Q	Min angle	Max angle
Q1	-170	170
Q2	-120	120
Q3	-120	120
Q4	-170	170
Q5	-120	120
Q6	-170	170

L	length
L1	360
L2	400
L3	200
L4	200
L5	126
L6	20

Formulas of forward kinematic solution

Rx = $\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & cq & -sq & 0 \\ 0 & sq & cq & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$ Ry = $\begin{bmatrix} cq & 0 & sq & 0 \\ 0 & 1 & 0 & 0 \\ -sq & 0 & cq & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$ Rz = $\begin{bmatrix} cq & -sq & 0 & 0 \\ sq & cq & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$ T = $\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & a \\ 0 & 0 & 0 & 1 \end{bmatrix}$

Step by step explaining of inverse kinematics

xg, yg and zg is the coordinates of goal

Q1 = atan2(xg/yg)

Rc = $\sqrt{xg^2 + yg^2}$

Cos(Q3) = $\frac{Rc^2+zc^2-l1^2-l2^2}{2*l1*l2}$

Q3 = atan2(cos(q3),sin(q3))

Q2 = atan2(zc, rc)-atan2(l2*sin(q3),l1+l2*cos(q3))

P = transposed rotation part of (Rz(q0) * T(l1) * Ry(q1) * T(l2) * Ry(q2) * T(l3))

Q4 = atan2(p[1,2], p[0,2])

Q5 = atan2(sqrt((p[0, 2])**2+(p[1, 2])**2),p[2,2])

Q6 = atan2(p[2,1],p[2,0])

Link to github

https://github.com/EriKarasik/HW22