Control and Robotics in Medicine
2019-2020

New solution generalized coordinates D2

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This deliverable is based on the robot of Figure 1.

Figure 1: Laboratory robot.

The degrees of freedom, rotations and reference axes of the robot must be represented as shown in Figure 2. Dimensions of the robot are shown in Table 1 and the mechanical constraints of the rotational angles in Table 2

segment	**length (mm)**
l0	86.8
l1	31.0
l2	150.2
l3	146.3
l4	70.0
l5	66.3

Table 1: Dimensions of the robot.

rotation	**minimum (rad)**	**maximum (rad)**
q1	-2.62	2.62
q2	-0.33	2.97
q3	-2.89	0.26
q4	-1.86	1.86
q5	-1.05	4.19

Table 2: Mechanical constraints of every joint.

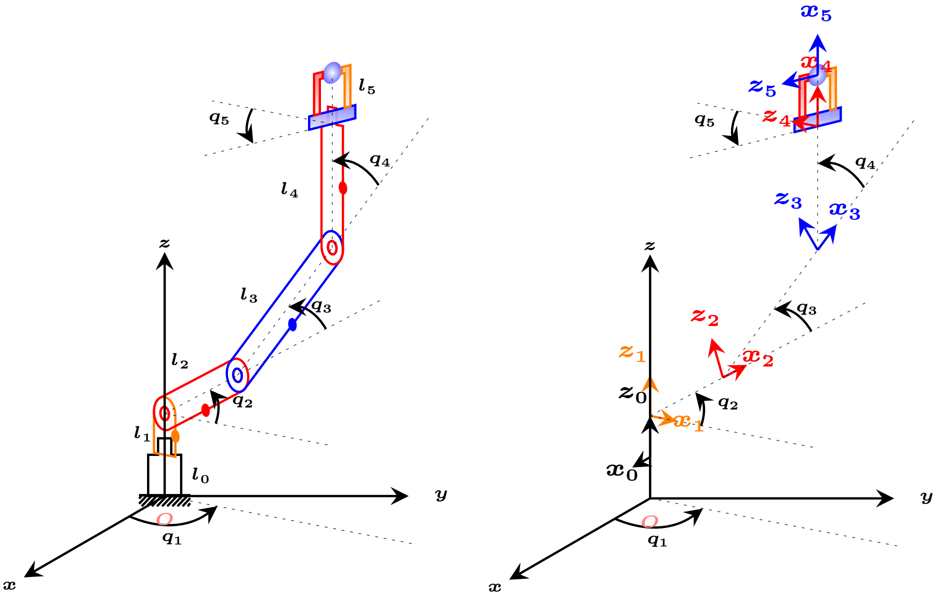

Figure 2: Representation of the degrees of freedom and local coordinate axes of the robot.

Solve the inverse kinematics problem when $Q(t_g) = (270, 50, 150)$**,** $a(t_g) = \begin{bmatrix}0.9833 & 0.1821 & 0\end{bmatrix}^T$ **and** $s(t_g) = \begin{bmatrix}-0.1821 & 0.9833 & 0\end{bmatrix}^T$.

$C(t_g) = Q(t_g) - (l_4 + l_5)a = \begin{bmatrix}270 - 0.9833(l_4 + l_5) & 50 - 0.1821(l_4 + l_5) & 150\end{bmatrix}^T = \begin{bmatrix}135.98 & 25.18 & 150\end{bmatrix}^T$.
$n = s \text{ x } a = \begin{bmatrix}0 & 0 & -1\end{bmatrix}^T$

By applying the equations obtained in the previous section and based on the values defined in Table 1, we obtain:

$$\begin{cases} q_1 = 0.1831 \\ q_2 = 1.2762 \\ q_3 = -2.1431 \\ q_4 = 0.8669 \\ q_5 = \pi/2 \end{cases} \tag{0.1}$$

that belong to the limits defined in Table 2.