Report Assignment II - Kinematics II

Nils Becker

Fundamentals of Robotics - FS 2021

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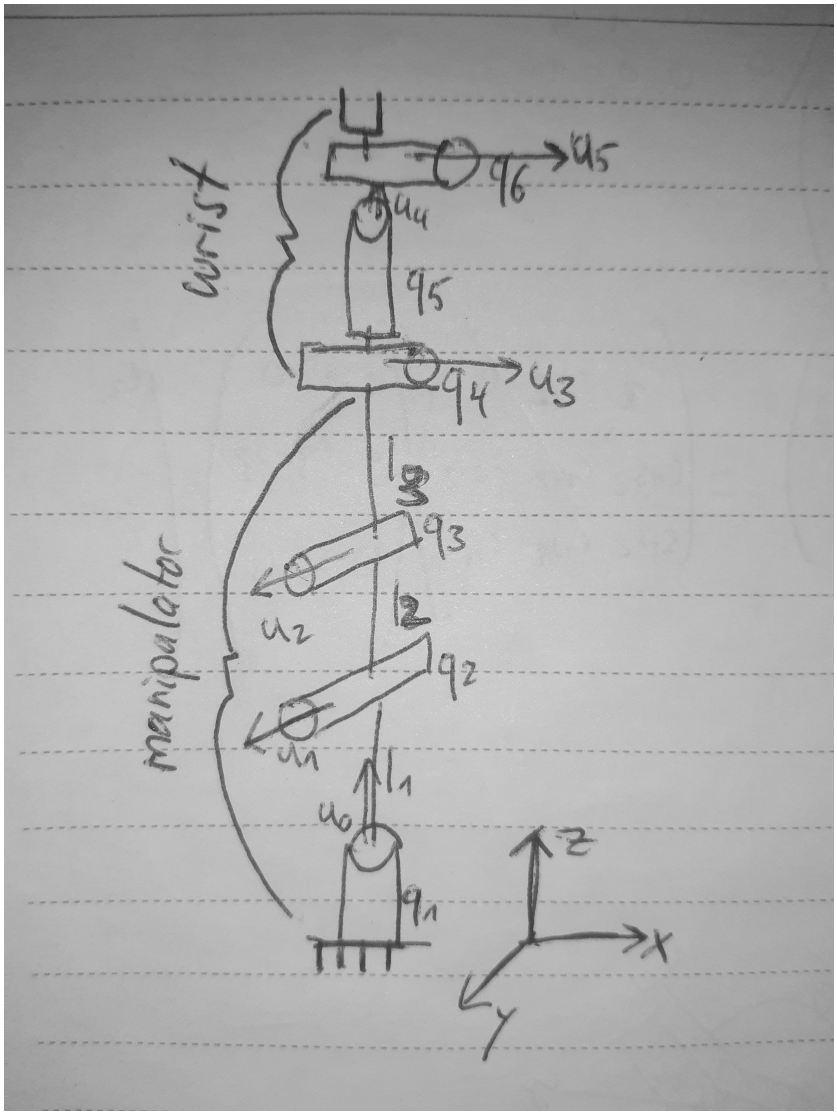
1 Robot

1.1 Description

The selected robot is a 6 DoF antropomorphic robot with a XZX wrist, which satisfies Euler Angle arrangement.

1.2 Model



2 Differential Kinematics

2.1 Finding the Jacobian

Note that all tranformation matrices are of form:

$$T_i = \begin{pmatrix} R_i & O_i \\ 0 & 1 \end{pmatrix} \tag{1}$$

The Jacobian matrix is of form:

$$J = \begin{pmatrix} J_1 & J_2 & ... & J_n \end{pmatrix} \tag{2}$$

Where:

$$J_i = \begin{pmatrix} u_{i-1} \text{ x } (O_n - O_{i-1}) \\ u_{i-1} \end{pmatrix} \tag{3}$$

We get u_{i-1} in three different ways from R_{i-1}:

1) If the i^{th} joint rotates around X-axis:

$$u_{i-1} = \begin{pmatrix} R_{1,1} \\ R_{2,1} \\ R_{3,1} \end{pmatrix} \tag{4}$$

2) If the i^{th} joint rotates around Y-axis:

$$u_{i-1} = \begin{pmatrix} R_{1,2} \\ R_{2,2} \\ R_{3,2} \end{pmatrix} \tag{5}$$

3) If the i^{th} joint rotates around Z-axis:

$$u_{i-1} = \begin{pmatrix} R_{1,3} \\ R_{2,3} \\ R_{3,3} \end{pmatrix} \tag{6}$$

2.2 Singularity check

To find out if the configuration is singular, we check the determinant. We have a singularity if:

$$det(J) = 0 \tag{7}$$

2.3 Finding cartesian velocities

We find cartesian velocities $\dot{x}$ with the following equation:

$$\dot{x} = J\dot{q} \tag{8}$$