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Jacobian matrix for anthropomorphic robot will look like

$$J = \begin{bmatrix} J_1 & J_2 & J_3 \dots J_n \end{bmatrix} \text{ where } J_i = \begin{bmatrix} U_{i-1} \times (O_n - O_{i-1}) \\ U_{i-1} \end{bmatrix}$$

where U_i is column vector of rotation matrix ${}^0T_i$ correspondin elementary motion in the local frame,

O_i is translation vector of matix ${}^0T_i$, i.e. 3 rows of last column

Since robot has 6 joints, matrix J will have 6 columns.

Rotations of all joints are around z axis, so for U_i we always pick 3rd column of ${}^0T_i$

U_0 is 3rd column of identity matrix: $U_0 = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$

U_1 is 3rd col. of ${}^0T_1$: $U_1 = \begin{bmatrix} \sin(q_1) \\ -\cos(q_2) \\ 0 \end{bmatrix}$

U_2 is 3rd col. of ${}^0T_2$: $U_2 = \begin{bmatrix} \sin(q_1) \\ -\cos(q_2) \\ 0 \end{bmatrix}$, since it almost coincides with previous frame

and so on

O_0 is 4th column of identity matrix : $O_0 = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$

O_1 is 4^{th} col. of ${}^0T_1$: $O_1 = \begin{bmatrix} 0 \\ 0 \\ d_1 \end{bmatrix}$

O_2 is 4^{th} col. of ${}^0T_2$: $O_2 = \begin{bmatrix} d_2\cos(q_1)\cos(q_2) \\ d_2\sin(q_1)\cos(q_2) \\ d_1 + d_2\sin(q_2) \end{bmatrix}$ and so on

To check singularity of Jacobian matrix we just need to find det(J), if it is 0, then Jacobian matrix is singular, otherwise not.

Jacobian matrix describes velocity of motion along and around each axis:

$$\begin{bmatrix} \dot{x} \\ \dot{y} \\ \dot{z} \\ \omega_x \\ \omega_y \\ \omega_z \end{bmatrix} = J_{6\times6} \cdot \begin{bmatrix} \dot{q}_1 \\ \dot{q}_2 \\ \dot{q}_3 \\ \dot{q}_4 \\ \dot{q}_5 \\ \dot{q}_6 \end{bmatrix} \Rightarrow$$

knowing velocity of each joint we can find cartesian velocity