Assignment 5

Consider the robot shown in Figure 1. You can assume the tool frame being in the center of the wrist (q_w).

1. Compute the spatial manipulator Jacobian as a function of $l_0, l_1, \theta_1, \theta_2, \theta_3, , \theta_4, \theta_5,$ and θ_6.
2. Derive all singular configurations of the robotic system. Can the robotic system reach a singular configuration within the joint boundary conditions $\theta_1 = \left[-\frac{pi}{2}, \frac{pi}{2}\right]$, $\theta_2 = \left[-pi, \frac{pi}{4}\right]$, $\theta_3 = [0,0.5]$, $\theta_4 = [-\frac{pi}{2}, \frac{pi}{2}]$, $\theta_5 = [-\frac{pi}{2}, \frac{pi}{2}]$, and $\theta_6 = [-pi, pi]$?
3. Which DOF is lost in the singular configuration/configurations? Derive the linearly dependent joint motions. Assume $l_0 = 0.2$ and $l_1 = 0.5$.
4. Determine the minimum workspace velocity that can be produced by a unit joint velocity in the configuration $\theta_1 = 0,\ \theta_2 = \frac{pi}{4}, \theta_3 = 0.05, \theta_4 = \frac{pi}{3}, \theta_5 = 0, \theta_6 = 0.$

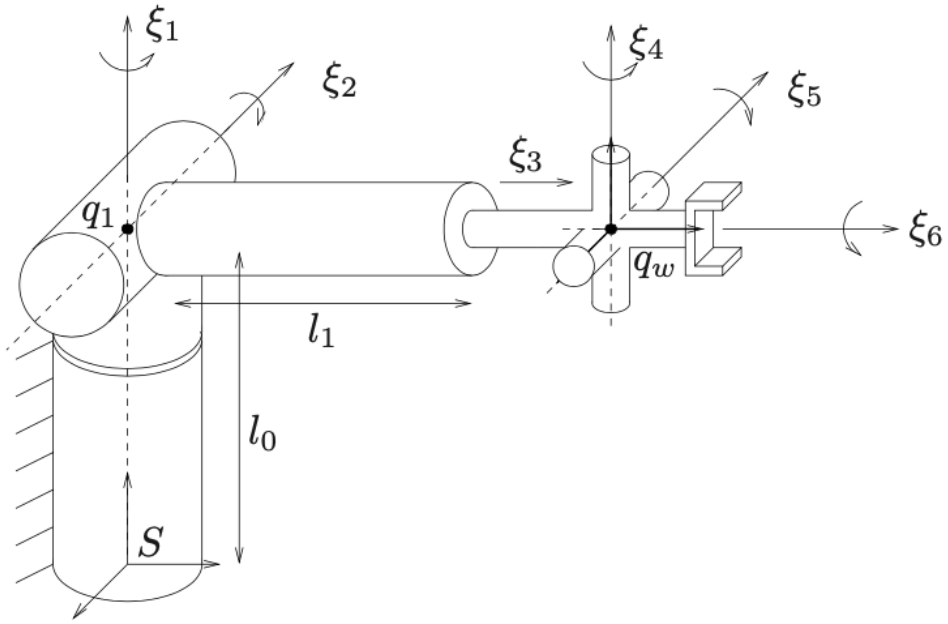

Figure 1 Stanford arm