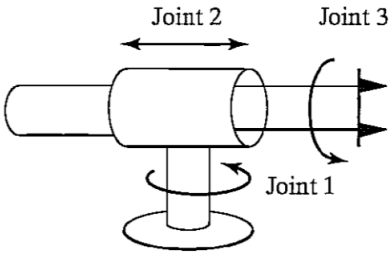
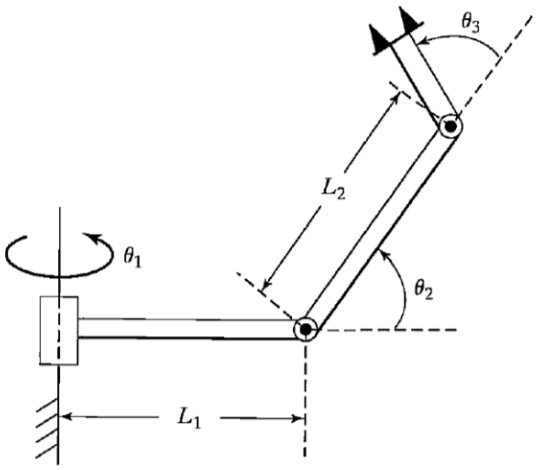
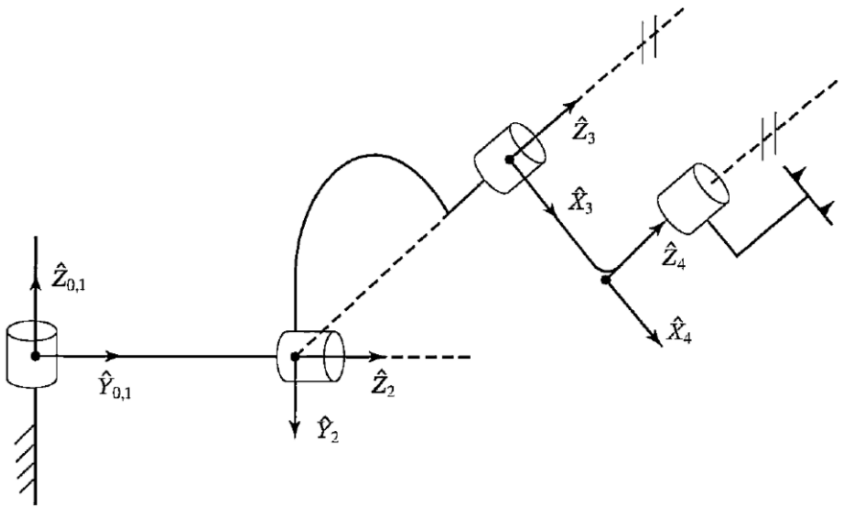
1 Sketch the fingertip workspace of the manipulator shown in the figure.



2 Derive the inverse kinematics of the three-link manipulator shown in the figure.



3 A 4R manipulator is shown schematically in the figure. The non-zero link parameters are $a_1 = 1$, $\alpha_2 = 45^o$, $d_3 = \sqrt{2}$, and $a_3 = \sqrt{2}$, and the mechanism is pictured in the configuration corresponding to $\Theta = [0, 90^o, -90^o, 0]^T$. Each joint has a $\pm 180^o$ as limits. Find all values of θ_3 such that ${}^0P_{4ORG} = [1.1, 1.5, 1.707]^T$.



4 Write a MATLAB script file using the Robotics Toolbox that solves the inverse kinematics problem of the PUMA560. Use the following values of the joint variables to find the desired end-effector location, then find all other possible solutions $q = [30900 - 3000]^T$. Plot all different solutions.