MECH 573 Mechanics of Robotic Systems

Notes: Exercise numbers in all assignments correspond to the *Exercises* at the end of the text. Assignments are due on the date indicated, at the beginning of the lecture. Since solutions are handed out during the lecture time, **late submissions will not be accepted**.

Assignment 1

Assigned: January 6th, 2004 **Due: February 5th, 2004**

1.1 (15%) Shown in Fig. 1 is the seven-dof Canadarm2, mounted on the International Space Station (ISS). The kinematic chain of this robot is symmetric with respect to the mid revolute axis and all angles between neighbouring joint axes are multiples of 90°. The foregoing symmetry allows the base and the EE of this manipulator to exchange roles, a feature that enables the robot to move along the ISS. The kinematic chain of the Canadarm2 is sketched in Fig. 2, whereby the EE is not shown for simplicity. Under these conditions, the OP is taken as the origin of $\mathcal{F}_8$. Find the Jacobian matrix of this robot in base-frame coordinates at the posture shown in Fig. 2.

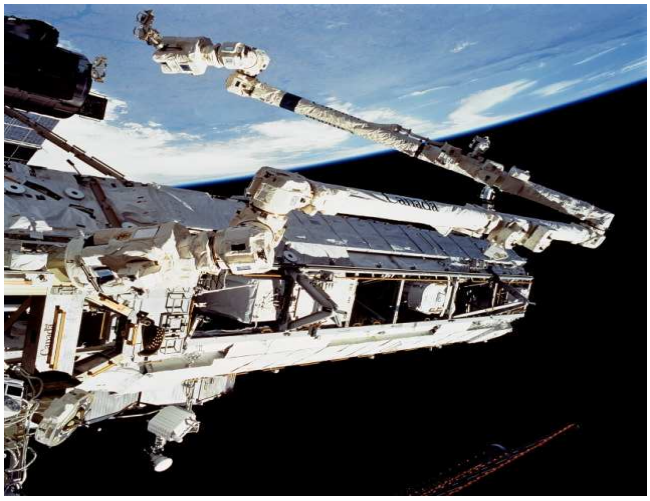

Figure 1: The Canadarm2

1.2 (55%) Using the methodology outlined in (Angeles, 2004), find the characteristic length and the KCI of the Fanuc Arc Mate, whose DH parameters are displayed in Table 4.2 of the text. *Hint: The use of MATLAB's Optimization Toolbox is strongly recommended here.*

1.3 (15%) Exercise 4.19.

1.4 (15%) Exercise 4.20.

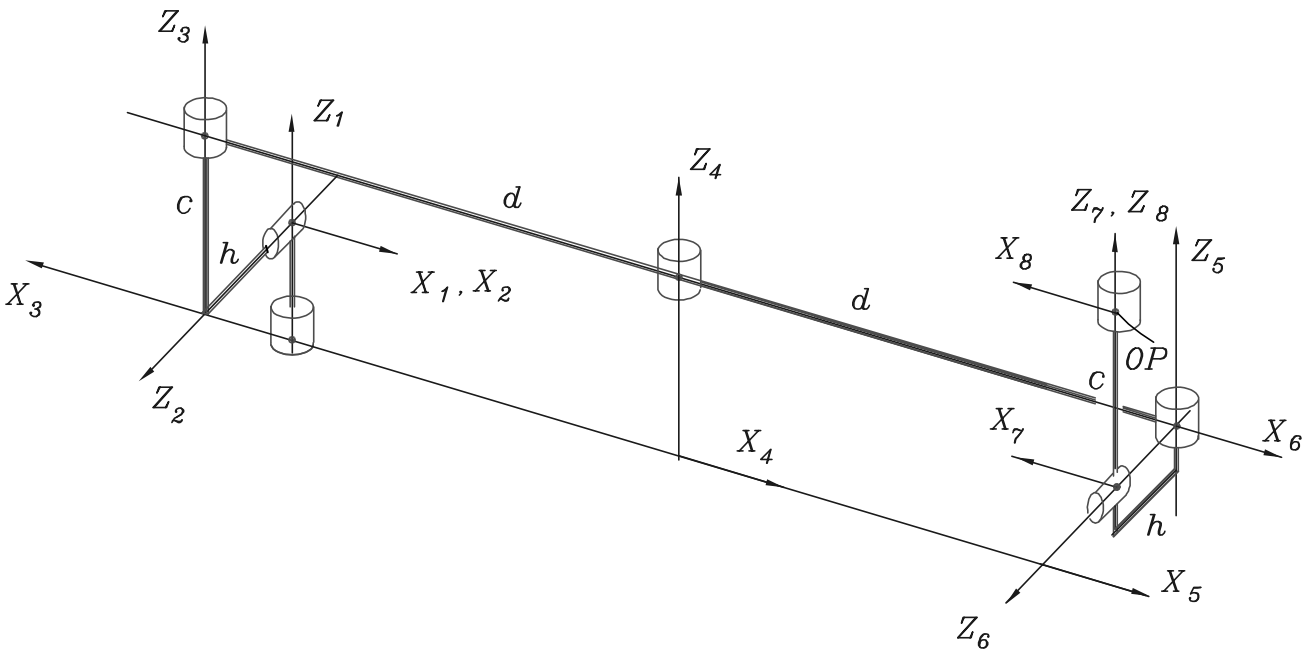

Figure 2: The kinematic chain of Canadarm2

Reference:

Angeles, J., 2004, *On the Optimum Dimensioning of Robotic Manipulators*, Department of Mechanical Engineering and Centre for Intelligent Machines Technical Report, McGill University, Montreal.