ME 115(a): Homework #5

(Due Monday, March 5, 2012)

Problem #1: Consider the two screws, S_1 and S_2, shown in Figure 1. S_1 is perpendicular to the plane, P, and has zero pitch: $h_1 = 0$. The screw axis of S_2 lies in P, and S_2 some non-zero pitch, h_2. The distance between S_1 and S_2, as measured along a mutually perpendicular line, is denoted a. Describe the set of all screws whose axes lie in P and that are reciprocal to both S_1 and S_2.

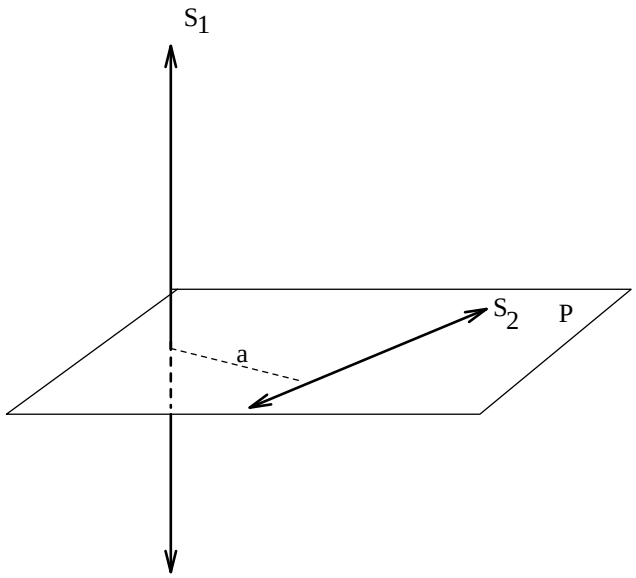

Figure 1: Two Screws.

Problem #2: Consider the simple manipulators that are associated with Prob.3 in Chapter 3 of the MLS text. Determine the Denavit-Hartenberg parameters for manipulators (i) and (ii).

Problem #3: Consider the simple manipulator (iii) associated with Prob.4 in Chapter 3 of the MLS text.

- Determine the Denavit-Hartenberg parameters of this manipulator
- Find the forward kinematics using the Denavit-Hartenberg approach.
- Find the forward kinematics using the Product-of-Exponentials approach.

Problem #4: Figure 2(b) shows a schematic of an 3-jointed "cylindrical" robot manipulator. This manipulator consists of two revolute joints (joints #1 and #2) and one prismatic joint (the third joint). All three joint axes are vertical and parallel to each other.

- Derive the Denavit-Hartenberg parameters.

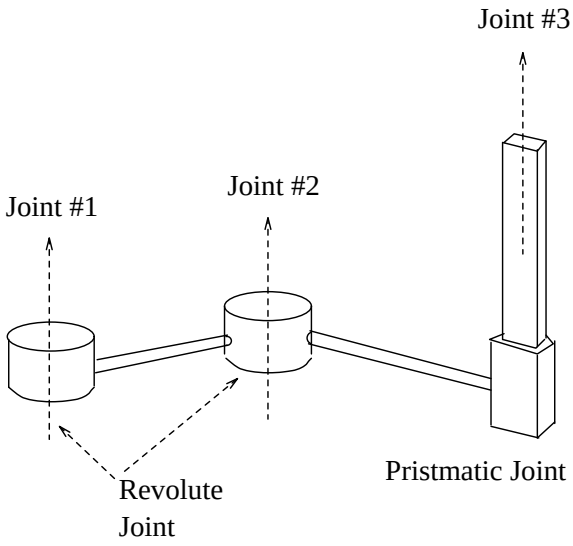

Figure 2: Schematic of a "Cylindrical Manipulator"

- Derive the inverse kinematic solution, assuming that the goal is to position the tool frame origin at some desired position, (x_T, y_T, z_T).