ME 115(a): Homework #5

(Due Tuesday, Nov. 28, 2000)

Problem #1: Complete Prob #5 from homework #4, which was postponed to this homework set.

Problem #2: 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.

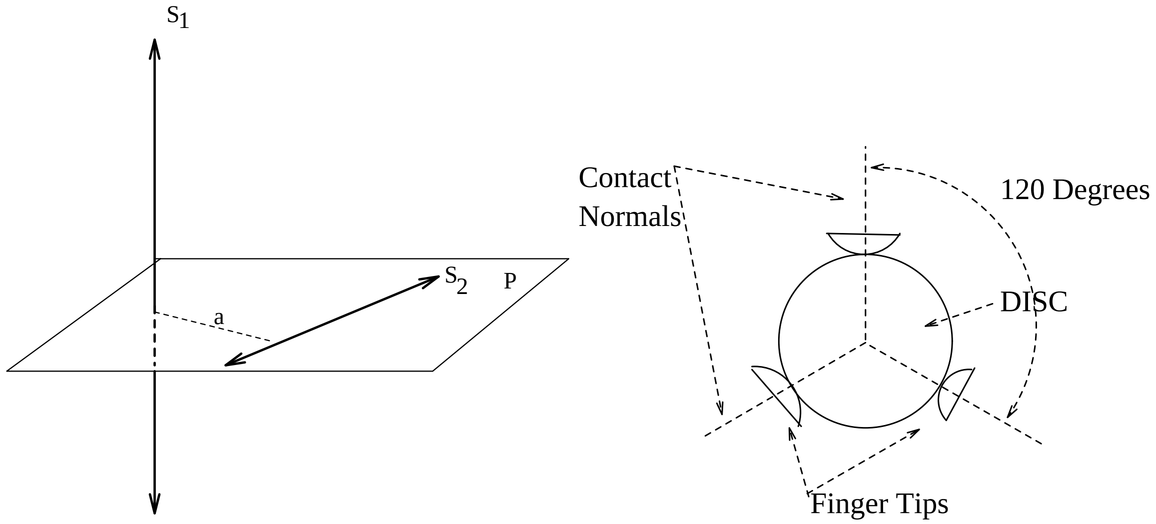

Figure 1: (a) Two Screws; (b) grasp of a disc

Problem #3: Next quarter we will extensively study the problem of grasping–i.e., how one can grab an object with fingers in such as way as to prevent the grasped object from slipping out of the grasp. Consider the arrangement in Figure 1(b) where a planar disc is touched by 3 "planar" fingers. Assume that each finger touches the disc with *frictionless* point contact. Also assume that each finger can apply any possible force to the object.

Question: Is the disc immobilized? That is, are there any free motions of the disc that can not be prevented by the fingers? In addition to an intuitive discussion of this question, you must back up your answer with some analysis.

Problem #4: 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.