ME 115(a): Homework #4

(Due Friday February 26, 2016)

Problem 1: (5 Points) Problem 11(e) in Chapter 2 of MLS.

Problem 2: (10 Points) Problem 14 in Chapter 2 of MLS.

Problem 3: (25 Points) Problem 18(a,b,c,d,e) in Chapter 2 of MLS.

Problem 4: (10 Points) Problem 16(a,b) in Chapter 2 of MLS.

Problem 5: (15 points) 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(a) 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.

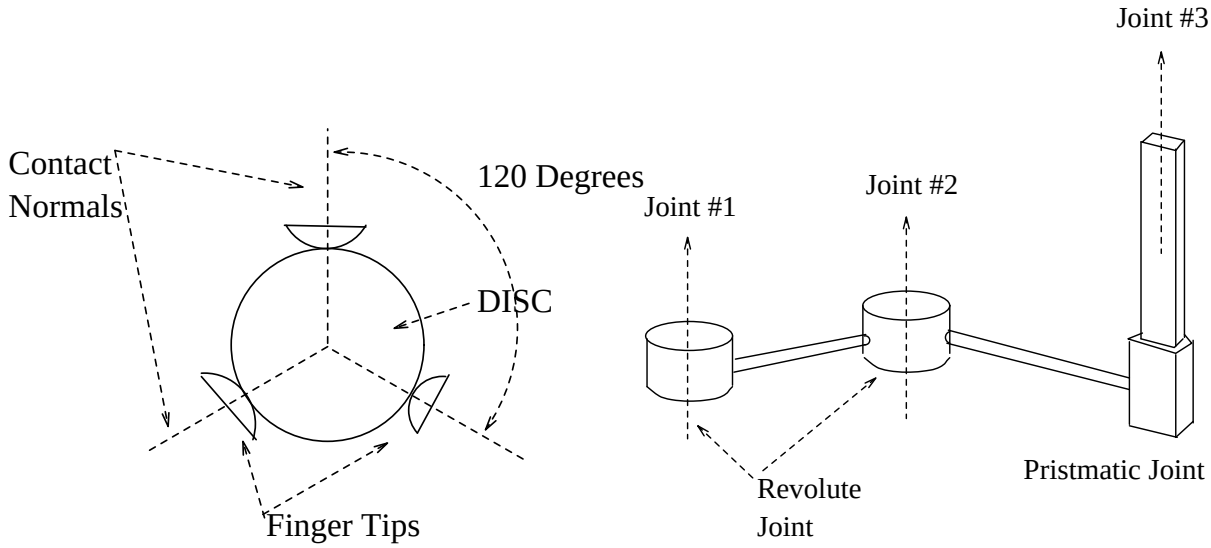

Figure 1: (a) Grasp of a disc by frictionless fingers (b) Schematic of a "Cylindrical Manipulator"

Problem 6: (15 points) Figure 1(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.
- 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).