

ME 115(b): Homework #2
(Due Wednesday, April 25, 2012)

Problem 1: Problem 20(a,b,c,e), Chapter 3 of MLS.

Note: Part (a) of the problem asks you to find the “degrees-of-freedom” (DOF) of the mechanism. In class, we used the word *mobility* instead of DOF.

Problem 2: (Special Configurations of a linkage). Consider the linkage shown Figure 1. This problem considers the stationary configurations of this mechanism.

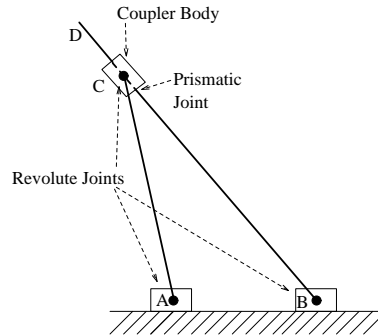


Figure 1: Mechanism

In this mechanism, let $|\overline{AB}| = 1$. The dimension $|\overline{AC}| = l_1$ is a parameter, and you will consider its value below.

- (a) derive the twist coordinates for the joint axis screws.
- (b) It was shown in class that the special (or stationary) configurations for the j^{th} joint occur when the determinant of the cofactor of the jj element of the grammian matrix:

$$\begin{bmatrix} \xi_1 \cdot \xi_1 & \xi_1 \cdot \xi_2 & \xi_1 \cdot \xi_3 & \xi_1 \cdot \xi_4 \\ \xi_2 \cdot \xi_1 & \xi_2 \cdot \xi_2 & \xi_2 \cdot \xi_3 & \xi_2 \cdot \xi_4 \\ \xi_3 \cdot \xi_1 & \xi_3 \cdot \xi_2 & \xi_3 \cdot \xi_3 & \xi_3 \cdot \xi_4 \\ \xi_4 \cdot \xi_1 & \xi_4 \cdot \xi_2 & \xi_4 \cdot \xi_3 & \xi_4 \cdot \xi_4 \end{bmatrix}$$

becomes zero (where ξ_j denotes the twist for joint axis j).

Develop an expression for the stationary configurations of the joint B. What are the necessary conditions (in terms of link lengths, etc.) for joint B to have a stationary configuration?

- (c) Do any other joints have stationary configurations?