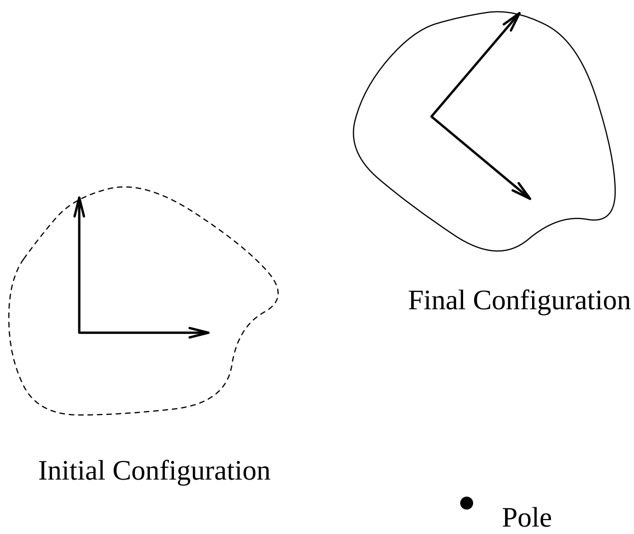
ME 115(a): Homework #1

(Due Tuesday October 12, 1999)

Problem 1: Every planar rigid body displacement is *equivalent* to a rotation about a unique point in the plane, known as the pole (see Figure).



Let $\vec{v}$ denote the location of the pole as seen by an observer in the reference frame that is coincident with the body before displacement. Let $(\vec{d}, R)$ denote the displacement of the body. Find the pole location, $\vec{v}$, as a function of $\vec{d}$ and R.

Problem 2: Let A be a fixed reference frame. A rigid body, L, which has local frame B attached to it, is located relative to reference frame A by $D_1 = (R_{01}, d_{01})$. Body L moves to position C, where the displacement to location C, as measured by an observer in frame B, is given by $D_2 = (R_{12}, d_{12})$. Where is the *pole* of the body displacement from position B to position C, as a function of R_{01}, R_{12}, d_{01}, and d_{12}?

a. As measured in Frame A

b. As measured in Frame B

c. As measured in Frame C

d. Suppose $D_1 = (x, y, \theta) = (1.0, 1.0, 45.0^o)$ and $D_2 = (x, y, \theta) = (3.0, 3.0, 30^o)$. Where is the pole of the displacement from B to C in this case?

Problem 3: Using the set up of Problem 2, pick a coordinate system whose origin is located at the pole of the displacement, and show that in this coordinate system, the displacement of the body from B to C is a pure rotation.

Problem 4: Do Problem 3(c) in Chapt. 2 of the MLS text.