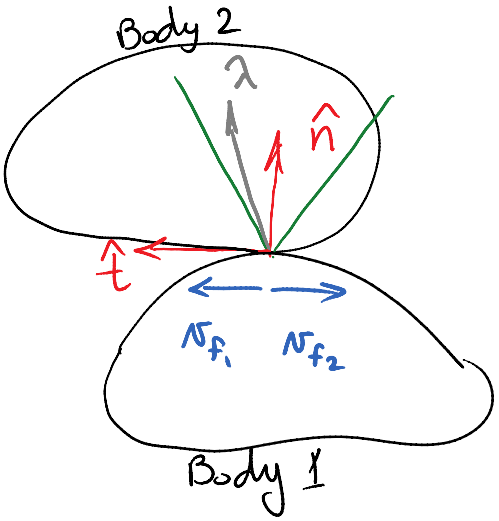
2012_mdtrm

Wednesday, March 07, 2012
8:36 AM



(1) Two bodies in the plane touch at a contact point with Coulomb friction.

Let $\lambda = \begin{bmatrix} \lambda_n \\ \lambda_t \end{bmatrix}$ be the contact force applied to body 2 by body 1.

The relative velocity of the contact point of body 2 wrt. body 1 is $\begin{bmatrix} v_n \\ v_t \end{bmatrix}$.

Assume $v_n = 0$, $\mu > 0$, $\lambda_n > 0$.

Let v_t be represented by the difference of its positive and negative parts, i.e.,

$$v_t = v_{f_1} - v_{f_2}, \quad v_{f_1} \geq 0, \quad v_{f_2} \geq 0$$

I claim that the following pair of linear complementarity conditions model planar Coulomb friction:

$$0 \leq \mu\lambda_n + \lambda_t \perp v_{f_1} \geq 0$$

$$0 \leq \mu\lambda_n - \lambda_t \perp v_{f_2} \geq 0$$

Demonstrate that I am right or wrong.

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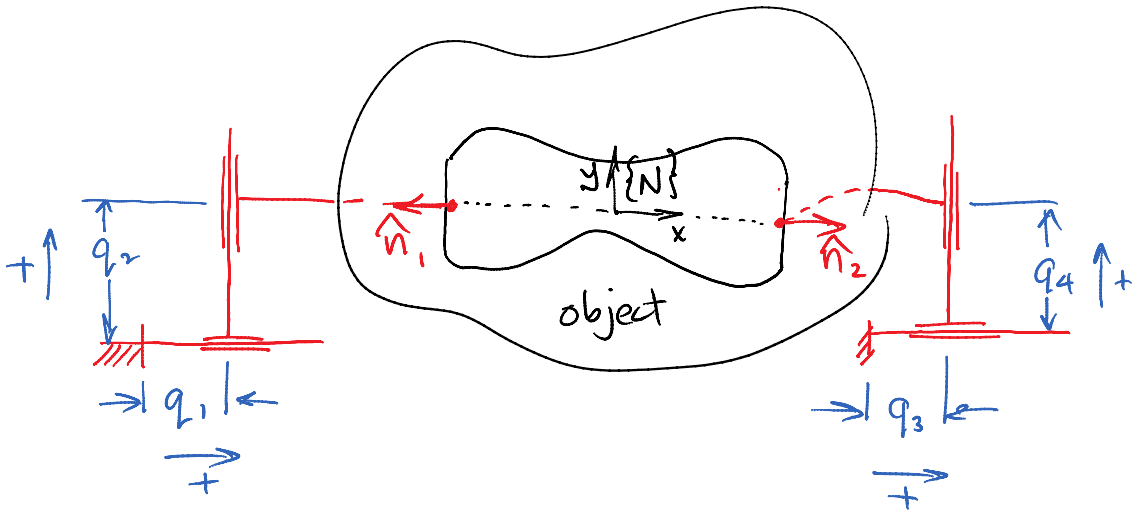
(2)



A hand with two fingers is grasping an object with contact points in a hole.

a. Construct G and J (If the assumed order of v_{cc} is $v_{cc} = [v_{1n}\ v_{1t}\ v_{2n}\ v_{2b}]^T$ then a possible basis of $\mathcal{N}(G)$ is $[1\ 0\ 1\ 0]^T$)

b. What are the dimensions of the four subspaces of

G and the four of J?

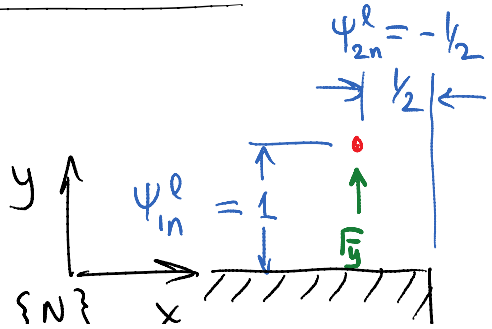
c. Show that the grasp has frictional form closure for any $\mu > 0$.

d. Show that the grasp has force closure.

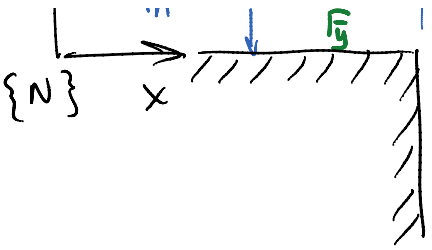
e. You may permanently lock a single joint. Can you choose one which will cause the grasp to lose force closure?

f. You may permanently lock two joints. Can you choose two which will cause the grasp to lose force closure?

(3.) A particle moving in the plane is near a corner



the plane is near a corner.



Assume mass = 1, $h = 1$,

$v_x^1 = 0$, $v_y^1 = -2$, $F_y = 1$

a. Set up the time-stepping LCP taking both edges into account.

b. Solve for v^{l+1}, u^{l+1}, p^{l+1}

c. If you did part b. correctly, then $v_x^{l+1} > 0$.

Since $g_{app} = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$ & $v_x^l = 0$,

what caused v_x^{l+1} to change?