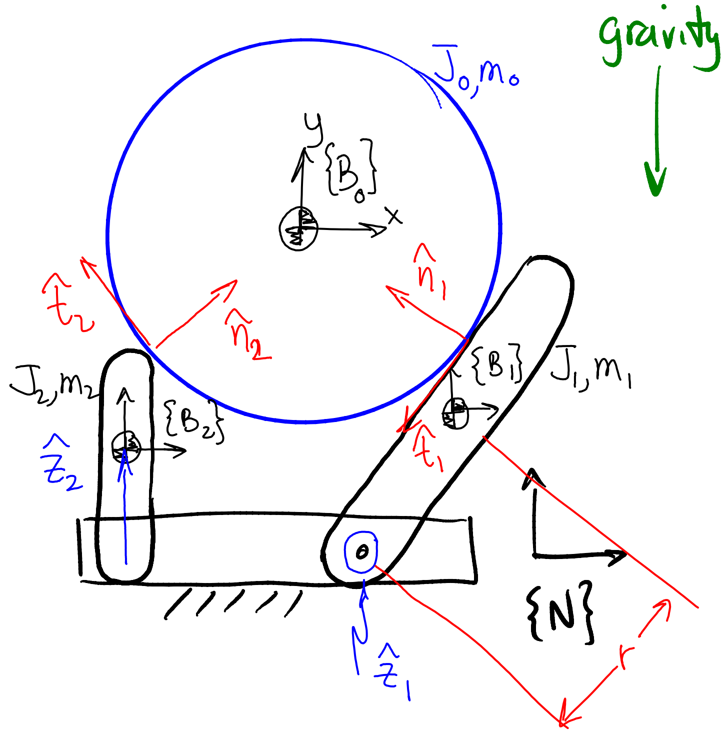
In-class: Dynamics

Monday, February 09, 2009
12:28 PM

Define the quantities need to take a step in the simulation of this system.



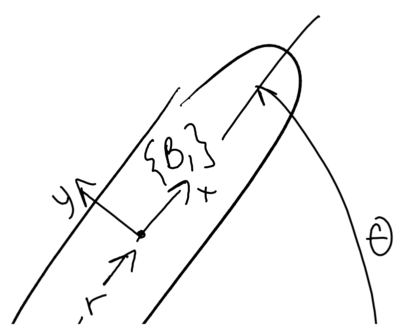
$$u = \begin{bmatrix} x_1 \\ y_1 \\ \theta_1 \\ x_2 \\ y_2 \\ \theta_2 \\ x_3 \\ y_3 \\ \theta_3 \end{bmatrix} \qquad \nu = V\dot{u}$$

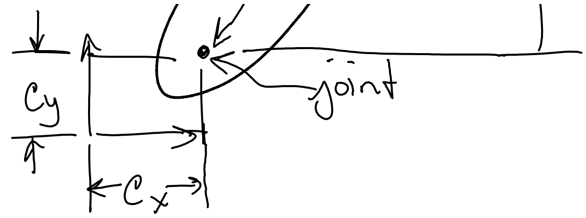
$$V = I_{(9\times 9)}$$

$$M = \mathrm{diag}(m_0, m_0, J_0, m_1, m_1, J_1, m_2, m_2, J_2)$$

$$\Psi_B = \begin{bmatrix} x_1 - rc_1 - c_x \\ y_1 - rs_1 - c_y \\ x_2 - \text{constant} \\ \theta_2 - \text{constant} \end{bmatrix}$$

constants





$$\frac{\partial \Psi_B}{\partial t} = 0_{(4\times1)}$$

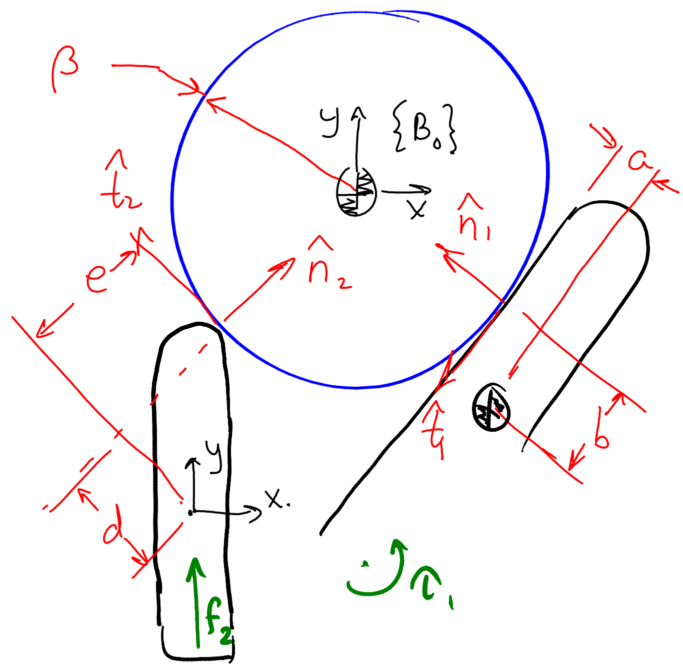
$$\frac{\partial \Psi_B}{\partial u} = \left[\begin{array}{c|ccc|ccc} & 1 & 0 & rs_1 & & & \\ 0_{(4\times3)} & 0 & 1 & -rc_1 & & 0_{2\times3} & \\ \cline{2-7} & & & & 1 & 0 & 0 \\ & & 0_{2\times3} & & 0 & 0 & 1 \end{array}\right]$$

$$G_B^T = \frac{\partial \Psi_B}{\partial u} V = \frac{\partial \Psi_B}{\partial u}$$

Hard to write Ψ_n in closed form. Assume collision detection gives distances. At the moment, $\Psi_n^{l} = 0_{(2\times1)}$

$\frac{\partial \Psi_n}{\partial t} = 0$, since Ψ_n not explicit fcn of time.

$\frac{\partial \Psi_f}{\partial t} = 0$, since no treadmill-effect on surfaces.



$$G_n = \begin{bmatrix} 0.6 & \sqrt{2}/2 \\ 0.8 & -\sqrt{2}/2 \\ 0 & 0 \\ -0.6 & 0 \\ -0.8 & 0 \\ -b & 0 \\ 0 & -\sqrt{2}/2 \\ 0 & -\sqrt{2}/2 \\ 0 & d \end{bmatrix} \quad (9\times2)$$

$$G_f = \left[\begin{array}{cc|cc} -0.8 & 0.8 & \sqrt{2}/2 & -\sqrt{2}/2 \\ -0.6 & 0.6 & \sqrt{2}/2 & -\sqrt{2}/2 \\ -\beta & \beta & -\beta & \beta \\ \hline -0.8 & 0.8 & & \\ -0.6 & 0.6 & \multicolumn{2}{c}{\bigcirc\ (3\times2)} \\ a & -a & & \\ \hline & & -\sqrt{2}/2 & \sqrt{2}/2 \\ \multicolumn{2}{c|}{\bigcirc\ (3\times2)} & -\sqrt{2}/2 & \sqrt{2}/2 \\ & & e & -e \end{array}\right] \quad (9\times4)$$

$$U = \begin{bmatrix} \mu_1 & 0 \\ 0 & \mu_2 \end{bmatrix}$$

$$E = \begin{bmatrix} 1 & 0 \\ 1 & 0 \\ 0 & 1 \\ 0 & 1 \end{bmatrix}$$

$$F_{ext} = \left[\begin{array}{ccc:ccc:ccc} 0 & -m_0 g & 0 & 0 & -m_1 g & 0 & 0 & -m_2 g & 0 \end{array}\right]^T h$$

$$T = \left[\begin{array}{ccc:ccc:ccc} 0 & 0 & 0 & 0 & 0 & \tau_1 & 0 & f_2 & 0 \end{array}\right]^T h$$