$$\left[-lcq_1\dot{q}_1^2 - lsq_1\ddot{q}_1 + \frac{1}{2}Ssq_1\ddot{q}_1 + \frac{1}{2}Scq_1\dot{q}_1^2 - \frac{1}{2}Ss(q_1+q_2)(\ddot{q}_1 \ldots\right.$$

$\downarrow$ found velocity & acceleration

The reaction force is $F = M\ddot{X}_G - M\bar{g}$

$$F = 2m\ddot{X}_g - 2m \ldots$$

$$\bar{g} = [\,g\sin\theta \quad -g\cos\theta\,]$$

FUNCTION IMPACT

$A_1 \quad J_R$ = function IMPACT.

$$\begin{bmatrix} A_1 & -J_{R2}^T \\ J_{R2} & O_{2\times 2} \end{bmatrix} \cdot \begin{bmatrix} \dot{x}^+ \\ \dot{y}^+ \\ \dot{\rho}_1^+ \\ \dot{\rho}_2^+ \\ I_{R2X} \\ I_{R2Y} \end{bmatrix} = \begin{bmatrix} A_1 \\ O_{2\times 4} \end{bmatrix} \begin{bmatrix} \dot{x}^- \\ \dot{y}^- \\ \dot{\rho}_1^- \\ \dot{\rho}_2^- \end{bmatrix}$$

A_1 directly [illegible]

$$\bar{B} = \bar{B}_{C_1} + \bar{B}_{C_2} = \frac{1}{2}[\dot{x}\ \dot{y}\ \dot{q}_1\ \dot{q}_2][A_1]\begin{bmatrix}\dot{x}\\ \dot{y}\\ \dot{q}_1\\ \dot{q}_2\end{bmatrix}$$

Known tip position (X, Y) $\qquad \dot{x}_f = J_R \dot{q}_e$

$X = l \sin q_1$

$Y = l \cos q_1$

now X and Y are known

$$G_1 = \begin{bmatrix} x - S \sin q_1 \\ y - S \cos q_1 \end{bmatrix} \qquad \dot{G}_1 = \begin{bmatrix} \dot{x} - S \cos q_1 \dot{q}_1 \\ \dot{y} + S \sin q_1 \dot{q}_1 \end{bmatrix}$$

$$G_2 = \begin{bmatrix} x - S \sin(q_1 + q_2) \\ y + S \cos(q_1 + q_2) \end{bmatrix} \quad \dot{G}_2 = \begin{bmatrix} \dot{x} - S\cos(q_1 + q_2)(\dot{q}_1 + \dot{q}_2) \\ \dot{y} \mp S \sin(q_1 + q_2)(\dot{q}_1 + \dot{q}_2) \end{bmatrix}$$

$\omega_1 = \dot{q}_1 \qquad \omega_2 = (\dot{q}_1 + \dot{q}_2)$

$$\bar{B}_1 = \frac{1}{2} m \underbrace{[\dot{x} - S c q_1 \dot{q}_1 \quad \dot{y} + S \sin q_1 \dot{q}_1]}_{1 \times 2} \underbrace{\begin{bmatrix} \dot{x} - S c q_1 \dot{q}_1 \\ \dot{y} + S \sin q_1 \dot{q}_1 \end{bmatrix}}_{2 \times 1} + \frac{1}{2} I$$

$\cancel{\frac{1}{2} m [\dot{x}^2}$

$$= \frac{1}{2} m [\dot{x}^2 - 2\dot{x} S c q_1 \dot{q}_1 + S^2 c^2 q_1 \dot{q}_1^2 + \dot{y}^2 + 2\dot{y} S \sin q_1 \dot{q}_1 + S^2 \sin^2 q_1 \dot{q}_1^2$$

$= 1$

$$= \frac{1}{2} m [\dot{x}^2 + \dot{y}^2 + 2 S \dot{q}_1 (-\dot{x} c q_1 + \dot{y} \sin q_1) + S^2 \dot{q}_1^2]$$

$$\mathcal{T}_2 = m\frac{1}{2}\left[\dot{x} - Sc(q_1+q_2)(\dot{q}_1+\dot{q}_2) \quad \dot{y} - Ss(q_1+q_2)(\dot{q}_1+\dot{q}_2)\right]\begin{bmatrix}\dot{x} - Sc(q_1+q_2)(\dot{q}_1+\dot{q}_2) \\ \dot{y} - Ss(q_1+q_2)(\dot{q}_1+\dot{q}_2)\end{bmatrix}$$

$$= \frac{1}{2}m\Big[\dot{x}^2 - 2Sc(q_1+q_2)(\dot{q}_1+\dot{q}_2)\dot{x} + Sc^2(q_1+q_2)(\dot{q}_1+\dot{q}_2)^2$$

$$+ \dot{y} - 2Ss(q_1+q_2)(\dot{q}_1+\dot{q}_2)\dot{y} + Ss^2(q_1+q_2)(\dot{q}_1+\dot{q}_2)^2\Big] + \frac{1}{2}I(\dot{q}_1+\dot{q}_2)^2$$

$$= \frac{1}{2}m\left[\dot{x}^2+\dot{y}^2 - 2S(\dot{q}_1+\dot{q}_2)\left(\dot{x}c(q_1+q_2) + \dot{y}s(q_1+q_2)\right) + S(\dot{q}_1+\dot{q}_2)^2\right] + \frac{1}{2}I(\dot{q}_1+\dot{q}_2)^2$$

mapping torus

=> from this, we can extrapolate

careful

the A matrix

$$\boxed{\mathcal{T}_{TOT} = \mathcal{T}_1 + \mathcal{T}_2}$$

$$\begin{array}{c|c} \begin{matrix}\dot{x}\\ \dot{y}\\ \dot{q}_1\\ \dot{q}_2\end{matrix} & \begin{bmatrix} 2m & 0 & mSc q_1 - mSc(q_1+q_2) & -mSc(q_1+q_2) \\ 0 & 2m & mSc q_1 - sSsin(q_1+q_2) & -mSs(q_1+q_2) \\ mSc(q_1) - mSc(q_1+q_2) & mSs(q_1) - mSs(q_1+q_2) & +2mS^2 + 2I & mS^2 + I \\ -mSc(q_1+q_2) & -mSs(q_1+q_2) & mS^2 + I & mS^2 + I \end{bmatrix} \end{array}$$

$2m$ as $\frac{1}{2}m\dot{x}^2 + \frac{1}{2}m\dot{x}$

A found.

I also apply here

$$\dot{x} = J_R\,\dot{q}_e \qquad J_R = \begin{bmatrix} 1 & 0 & -lcq_1 & -lc(q_1+q_2) \\ 0 & 1 & -lsq_1 & -ls(q_1+q_2)\end{bmatrix}$$