Dynamics

a made up expression

$$\mathcal{L} = \frac{1}{2} m c_2 \dot{\theta}_1^* \dot{L}_2^* + \frac{1}{2} I_{zz} \dot{\theta}_1^{2*} + m g L_1$$

$$\frac{\partial}{\partial \dot{\theta}_1^*} = \frac{1}{2} m c_2 \cdot 1 \cdot \dot{L}_2^* + I_{zz} \dot{\theta}_1^*$$

$$\frac{d}{dt} \frac{\partial}{\partial \dot{\theta}_1^*} = -\frac{1}{2} m s_2 \dot{L}_2^* \dot{\theta}_1^* + \frac{1}{2} c_2 m \ddot{L}_2^* + I_{zz} \ddot{\theta}_1^*$$

$$\frac{\partial}{\partial \theta_1} = -\frac{1}{2} m s_2 \dot{\theta}_1^* \dot{L}_2^*$$

$$\frac{\partial}{\partial \dot{L}_2^*} = \frac{1}{2} m c_2 \dot{\theta}_1^* \cdot 1$$

$$\frac{d}{dt} \frac{\partial}{\partial \dot{L}_2^*} = -\frac{1}{2} m s_2 \dot{\theta}_1^{2*} + \frac{1}{2} m c_2 \ddot{\theta}_1^*$$

$$\frac{\partial}{\partial L_2^*} = 0$$

$$\tau = \begin{bmatrix} \frac{d}{dt}\frac{\partial \mathcal{L}}{\partial \dot{q}_1} - \frac{\partial \mathcal{L}}{\partial q_1} \\ \frac{d}{dt}\frac{\partial \mathcal{L}}{\partial \dot{q}_2} - \frac{\partial \mathcal{L}}{\partial q_2} \end{bmatrix}$$

$$\tau = \begin{bmatrix} -\frac{1}{2}m\cancel{s_2 L_2^*}\dot{\theta}_1^* + \frac{1}{2}c_2 m \ddot{L}_2^* + I_{zz}\ddot{\theta}_1^* + \cancel{\frac{1}{2}m s_2 \dot{\theta}_1^* \dot{L}_2^*} \\ -\frac{1}{2}m s_2 \dot{\theta}_1^{2*} + \frac{1}{2}m c_2 \ddot{\theta}_1^* \end{bmatrix}$$

$$= \begin{bmatrix} \frac{1}{2}c_2 m \ddot{L}_2^* + I_{zz}\ddot{\theta}_1^* \\ -\frac{1}{2}m s_2 \dot{\theta}_1^{2*} + \frac{1}{2}m c_2 \ddot{\theta}_1^* \end{bmatrix}$$

$$\tau = \begin{bmatrix} I_{zz} & \frac{1}{2}m c_2 \\ \frac{1}{2}m c_2 & 0 \end{bmatrix} \begin{Bmatrix} \ddot{\theta}_1^* \\ \ddot{L}_2^* \end{Bmatrix} \begin{bmatrix} 0 & 0 \\ -\frac{1}{2}m s_2 \dot{\theta}^* & 0 \end{bmatrix} \begin{bmatrix} \dot{\theta}_1^* \\ \dot{L}_2 \end{bmatrix} + \begin{bmatrix} 0 \\ g \end{bmatrix}$$

D C g