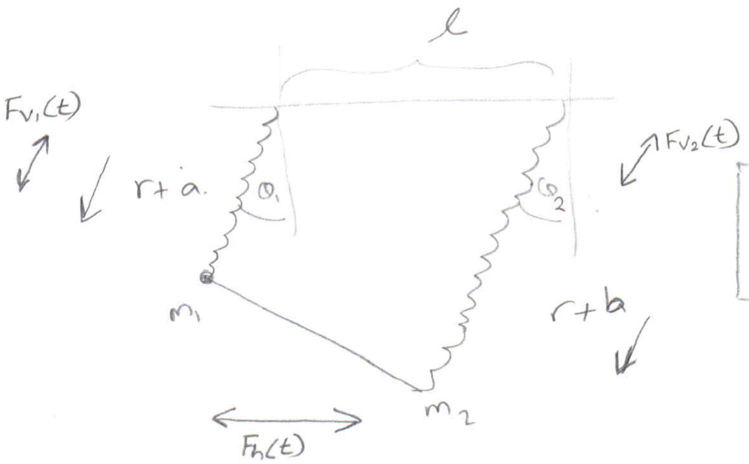


Spring stiffness = k
unstretched length = r

Damping

Spring $\Rightarrow C_s \dot{a}$ and or $C_s \dot{b}$

Pendulum $\Rightarrow C_p \dot{\theta}_1$ & $C_p \dot{\theta}_2$

$$T = \frac{1}{2} m_1 \dot{a}^2 + \frac{1}{2} m_2 \dot{b}^2 + \frac{1}{2} m_1 (r+a)^2 \dot{\theta}_1^2 + \frac{1}{2} m_2 (r+b)^2 \dot{\theta}_2^2$$

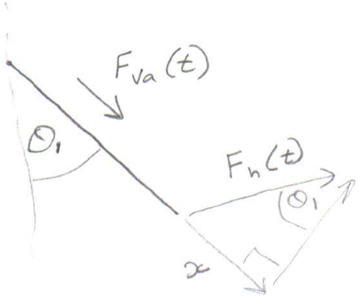
$$V = \frac{1}{2} k a^2 + \frac{1}{2} k b^2 - m_1 g (r+a) \cos\theta_1 - m_2 g (r+b) \cos\theta_2$$

a. <u>coordinate</u>

$$\frac{d}{dt}\left(\frac{\partial \mathcal{L}}{\partial \dot a}\right) = m_1 \ddot a \qquad \frac{\partial \mathcal{L}}{\partial a} = \frac{m_1(2a+2r)\dot\theta_1^2}{2} - ka + gm_1\cos\theta_1$$

$$\frac{\partial D}{\partial \dot a} = C_s \dot a$$

$$m_1\ddot a - \overbrace{\frac{m_1(2a+2r)\dot\theta_1^2}{2}}^{m_1\dot\theta_1^2(a+r)} + ka - gm_1\cos\theta_1 + C_s\dot a = Q_a$$



$$\sin\theta_1 = \frac{x}{F_h(t)}$$

$$x = F_h(t)\sin\theta_1$$

$$(\delta_1+\delta_2)Q_x = F_h(t)\left[\sin\theta_1\hat i + \cos\theta_1\hat j\right]\cdot\delta_1 + F_v(t)\delta_2 \uparrow$$

Similarly for b
* only 16,67Hz for b.

$$\Rightarrow F_h(t)\sin\theta + F_v(t)$$

↳ occurs twice
@ parametric frequency
& 16,67Hz

$$m_1\ddot a = Q_a - m_1\dot\theta_1^2(a+r) + ka - gm_1\cos\theta_1 - C_s\dot a$$

$$\ddot a = \frac{Q + m_1\dot\theta_1^2(a+r) - ka + gm_1\cos\theta_1 - C_s\dot a}{m_1}$$

b coordinate

$$\frac{d}{dt}\left(\frac{\partial \mathcal{L}}{\partial \dot{b}}\right) = m_2 \ddot{b} \qquad \frac{\partial \mathcal{L}}{\partial b} = \frac{m_2 (2b+2r)\dot{\theta}_2^2}{2} - kb + g m_2 \cos\theta_2$$

$$\frac{\partial D}{\partial \dot{b}} = C_s \dot{b}$$

$$m_2 \ddot{b} + \overbrace{\frac{m_2 (2b+2r)\dot{\theta}_2^2}{2}}^{m_2 \dot{\theta}_2^2 (r+b)} + kb - g m_2 \cos\theta_2 + C_s \dot{b} = Q_b$$

$$m_2 \ddot{b} = Q_b - m_2 \dot{\theta}_2^2 (r+b) + kb - g m_2 \cos\theta_2 - C_s \dot{b}$$

$$\ddot{b} = \frac{Q_b + m_2 \dot{\theta}_2^2 (r+b) - kb + g m_2 \cos\theta_2 - C_s \dot{b}}{m_2}$$

θ_1 Coordinate

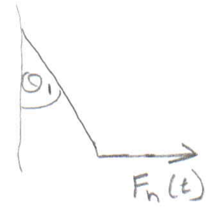
$$\frac{\partial \mathcal{L}}{\partial \dot{\theta}_1} = m_1 \dot{\theta}_1 (r+a)^2$$

$$\frac{d}{dt}\left(\frac{\partial \mathcal{L}}{\partial \dot{\theta}_1}\right) = m_1 \ddot{\theta}_1 (a+r)^2 + 2 m_1 \dot{\theta}_1 \dot{a} (r+a)$$

$$\frac{\partial \mathcal{L}}{\partial \theta_1} = -g m_1 \sin\theta_1 (a+r)$$

$$\frac{\partial D}{\partial \dot{\theta}_1} = C_p \dot{\theta}_1$$

$$m_1 \ddot{\theta}_1 (r+a)^2 + 2 m_1 \dot{\theta}_1 \dot{a} (r+a) + g m_1 \sin\theta_1 (a+r) + C_p \dot{\theta}_1 = Q_{\theta_1}$$



$$\delta_{q_1} Q_{\theta_1} = F_n(t)\left[\sin\theta\, \hat{i} + \cos \hat{j}\right](a+r)\delta\theta_1$$

$$\Rightarrow (a+r) F_n(t) \cos\theta_1$$

Similarly for θ_2.

$$m_1 \ddot{\theta}_1 (r+a)^2 = Q_q - 2 m_1 \dot{\theta}_1 \dot{a} (r+a) + g m_1 \sin\theta_1 (a+r) - C_p \dot{\theta}_1$$

$$\ddot{\theta}_1 = \frac{Q_{\theta_1} - 2 m_1 \dot{\theta}_1 \dot{a} (r+a) - g m_1 \sin\theta_1 (a+r) - C_p \dot{\theta}_1}{m_1 (r+a)^2}$$

θ_2 coordinate

$$\frac{\partial \mathcal{L}}{\partial \dot{\theta}_2} = m_2 \dot{\theta}_2 (r+b)^2 \qquad \frac{d}{dt}\left(\frac{\partial \mathcal{L}}{\partial \dot{\theta}_2}\right) = m_2 \ddot{\theta}_2 (r+b)^2 + 2 m_2 \dot{\theta}_2 \dot{b} (r+b)$$

$$\frac{\partial \mathcal{L}}{\theta_2} = -g m_2 \sin\theta_2 (r+b)$$

$$\frac{\partial D}{\partial \dot{\theta}_2} = C_p \dot{\theta}_2$$

$$m_2 \ddot{\theta}_2 (r+b)^2 + 2 m_2 \dot{\theta}_2 \dot{b} (r+b) + g m_2 \sin\theta_2 (r+b) + C_p \dot{\theta}_2 = Q_{\theta_2}$$

$$m_2 \ddot{\theta}_2 (r+b)^2 = Q_{\theta_2} - 2 m_2 \dot{\theta}_2 \dot{b} (r+b) + g m_2 \sin\theta_2 (r+b) - C_p \dot{\theta}_2$$

$$\ddot{\theta}_2 = \frac{Q_{\theta_2} - 2 m_2 \dot{\theta}_2 \dot{b} (r+b) - g m_2 \sin\theta_2 (r+b) - C_p \dot{\theta}_2}{m_2 (r+b)^2}$$

where $(b+r)$ & $\dot{b}$ are replaced with the holonomic constraint