RO2102: Dynamics and Simulation

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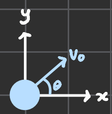
Homework-3

Problem 9 Due : 28 - Jan-2025 Time Spent : 2 Hours 30 Min

Sketch:

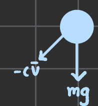



Given: $m, c, g, \theta_0, V_0$

To Find: EoM

Apply LMB,

FBD:




$$\sum \bar{F} = \dot{\bar{L}}$$

$$\Rightarrow \boxed{-c\bar{V} - mg\hat{j} = m\bar{a}}$$

(e) $$x = \frac{m}{c} V_{x0} \left(1 - e^{-\frac{c}{m}t}\right)$$

$$= \frac{m}{c} V_0 \cos\theta_0 \left(1 - e^{-c/m\, t}\right)$$

$$y = \frac{m}{c}\left(V_0 \sin\theta_0 + \frac{mg}{c}\right) * \left(1 - e^{-c/m\, t}\right) - \left(\frac{mgt}{c}\right)$$

At the cannon touching the surface, $y = 0$

$$\Rightarrow \frac{\cancel{m}gt}{\cancel{c}} \times \frac{1}{\left(1 - e^{-c/m\, t}\right)} = \frac{\cancel{m}}{\cancel{c}}\left(V_0 \sin\theta_0 + \frac{mg}{c}\right)$$

$$\Rightarrow \sin\theta_0 = \left(\frac{gt}{\left(1 - e^{-c/m\, t}\right)} - \frac{mg}{c}\right) V_0$$

Now solve this equation to find $t$ for a $\theta_0$ and $v_0$.

However, as the equation is highly non-linear it needs to be solved numerically.

Solve for a range of $theta_0$ and choose that which gives highest $x$.

Could do it in matlab but too tedious

For $v_0 \to \infty$, $\theta$ should tend to $0$