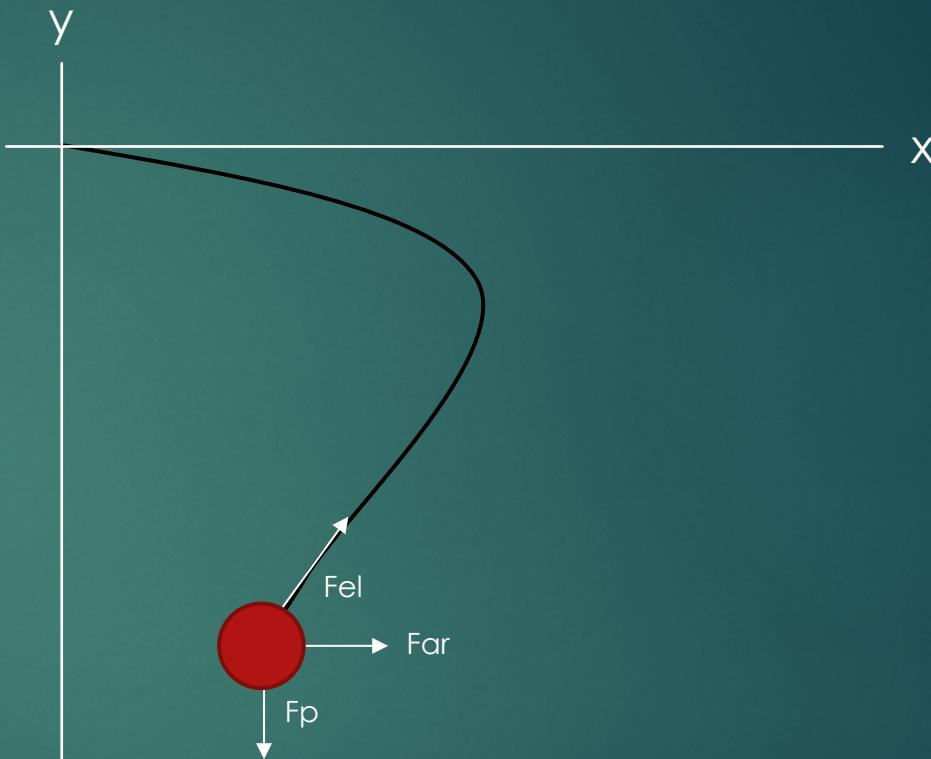
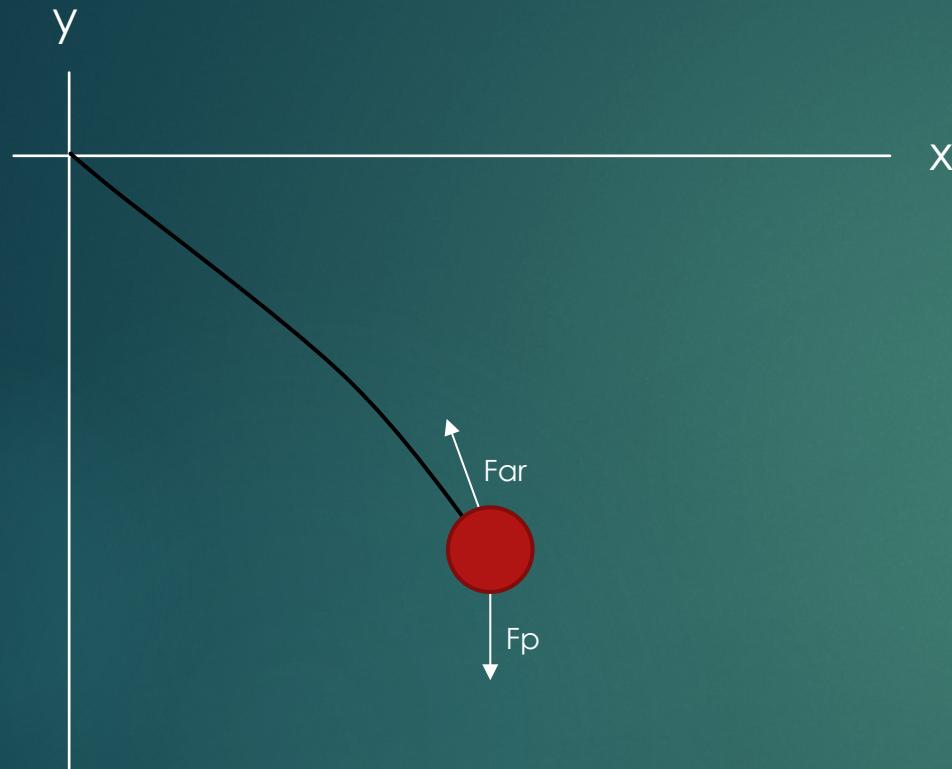


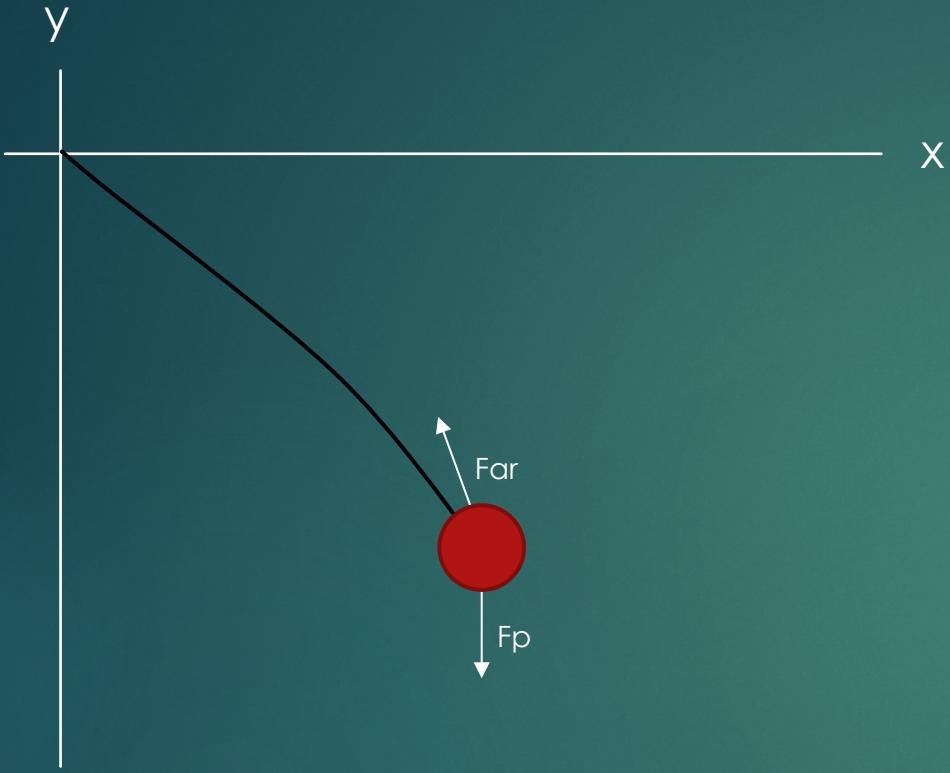
Modelagem e Simulação: Bungee Jump

EDUARDO VAZ

REBECCA COHEN

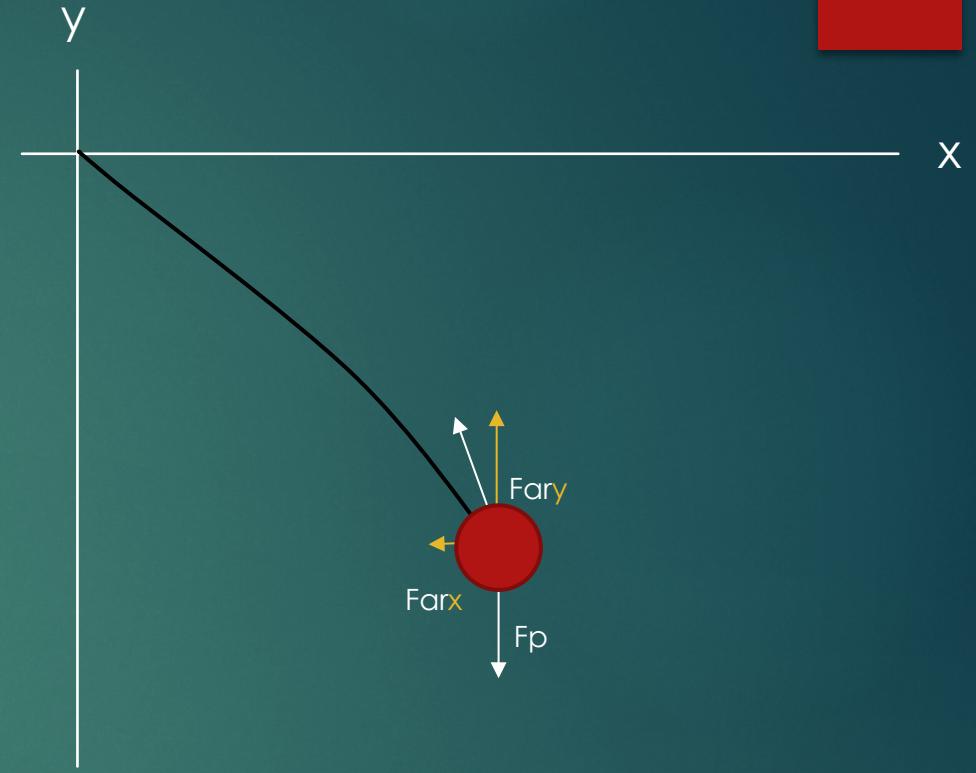
Bungee Jump





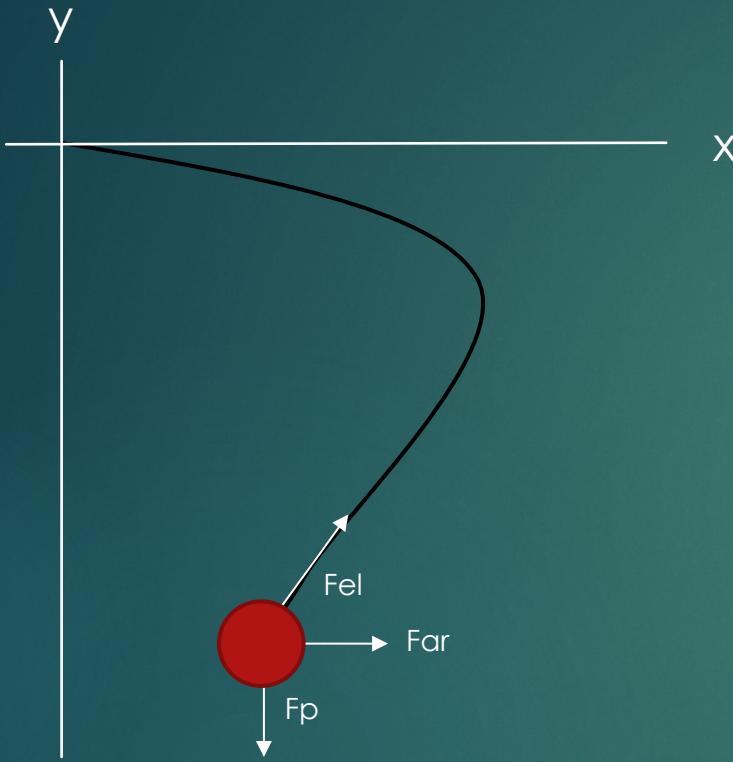
$$\frac{dx}{dt} = Vx$$

$$\frac{dy}{dt} = Vy$$



$$\frac{dVx}{dt} = -Ax$$

$$\frac{dVy}{dt} = -Ay + P$$

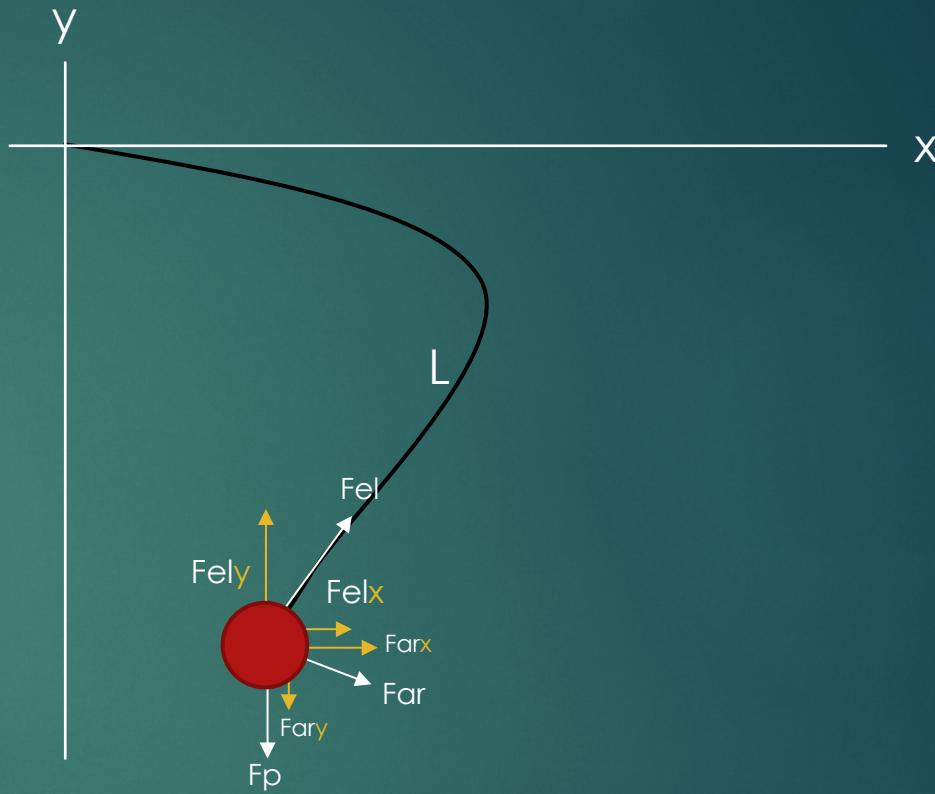


$$\frac{dx}{dt} = V_x$$

$$\frac{dy}{dt} = V_y$$

$$\frac{dVx}{dt} = -Ax - F_{elx}$$

$$\frac{dVy}{dt} = -Ay - F_{ely} + P$$



Equações

$$\frac{d^2x}{dt^2} = -Ax - Felx$$

$$\frac{d^2x}{dt^2} = -Ay - Fely + P$$

$$\frac{dx}{dt} = Vx$$

$$\frac{dy}{dt} = Vy$$

$$\frac{dVx}{dt} = -Ax - Felx$$

$$\frac{dVy}{dt} = -Ay - Fely + P$$

$$P = m \cdot g \quad \text{sen}\alpha = \frac{y}{L} \quad \text{cos}\alpha = \frac{x}{L}$$

$$V = \sqrt{Vx^2 + Vy^2} \quad \text{sen}\Theta = \frac{Vy}{V} \quad \text{cos}\Theta = \frac{Vx}{V} \quad L = \sqrt{x^2 + y^2}$$

$$Ax = \frac{C \cdot p \cdot A \cdot (Vx^2 + Vy^2)}{2} \cdot \frac{Vx}{\sqrt{Vx^2 + Vy^2}} \quad Felx = k \cdot (\sqrt{x^2 + y^2} - l_0) \cdot \frac{x}{\sqrt{x^2 + y^2}}$$

$$Ay = \frac{C \cdot p \cdot A \cdot (Vx^2 + Vy^2)}{2} \cdot \frac{Vy}{\sqrt{Vx^2 + Vy^2}} \quad Fely = k \cdot (\sqrt{x^2 + y^2} - l_0) \cdot \frac{y}{\sqrt{x^2 + y^2}}$$

$$\frac{d^2x}{dt^2} = -\frac{C \cdot p \cdot A \cdot (Vx^2 + Vy^2)}{2} \cdot \frac{Vx}{\sqrt{Vx^2 + Vy^2}} - k \cdot (\sqrt{x^2 + y^2} - l_0) \cdot \frac{x}{\sqrt{x^2 + y^2}}$$

$$\frac{d^2y}{dt^2} = -\frac{C \cdot p \cdot A \cdot (Vx^2 + Vy^2)}{2} \cdot \frac{Vy}{\sqrt{Vx^2 + Vy^2}} - k \cdot (\sqrt{x^2 + y^2} - l_0) \cdot \frac{y}{\sqrt{x^2 + y^2}} + m \cdot g$$

Parâmetros

$$m = 70 \text{ kg}$$

$$g = 9.8 \frac{\text{m}}{\text{s}^2}$$

$$A = 0.5 \text{ m}^2$$

$$C = 0.47$$

$$p = 1.2 \frac{\text{kg}}{\text{m}^3}$$

$$\alpha = 15^\circ$$

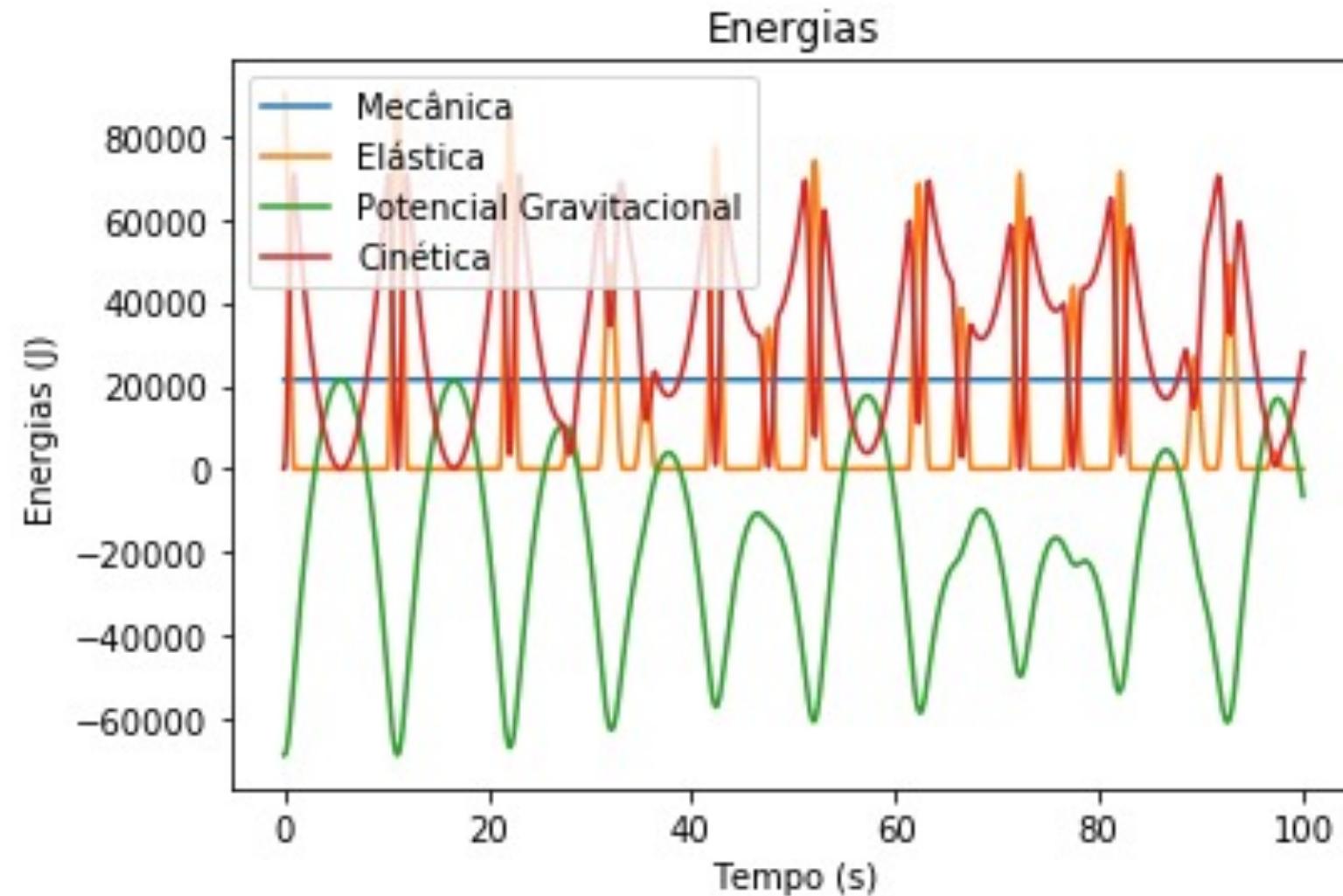
$$V_0 = \frac{5}{3.6} \frac{\text{m}}{\text{s}}$$

$$l_0 = 70 \text{ m}$$

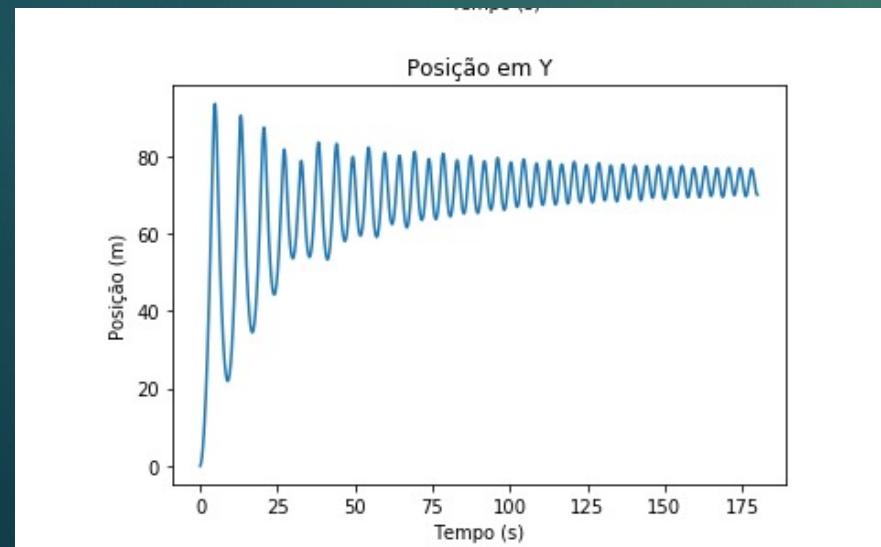
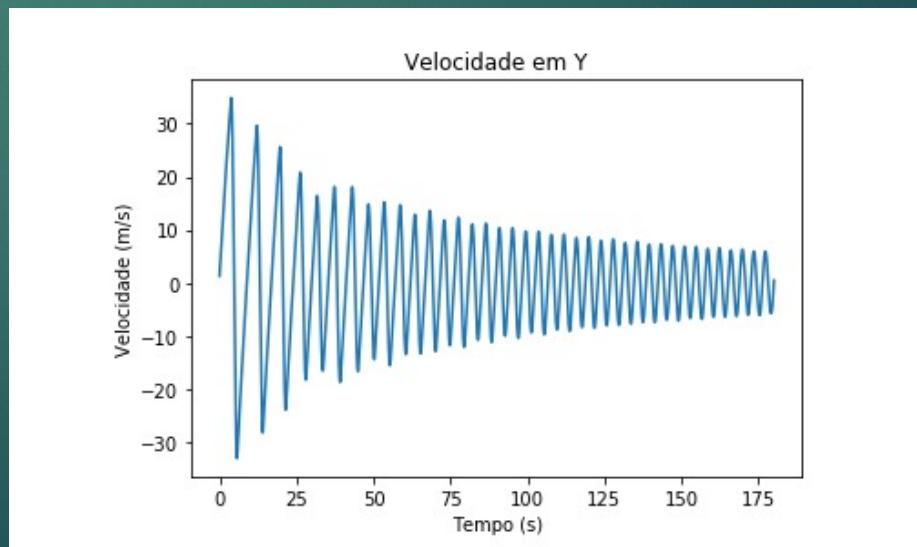
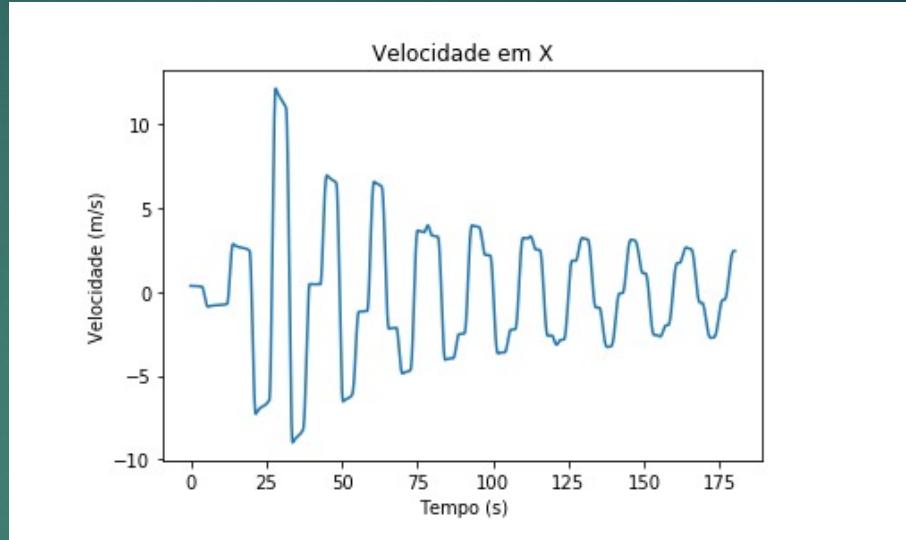
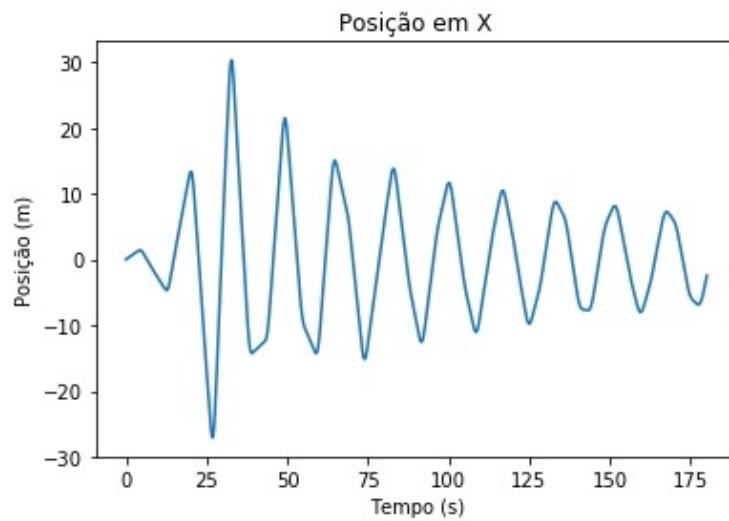
$$k = 200 \frac{n}{m}$$

$$t = 180 \text{ s}$$

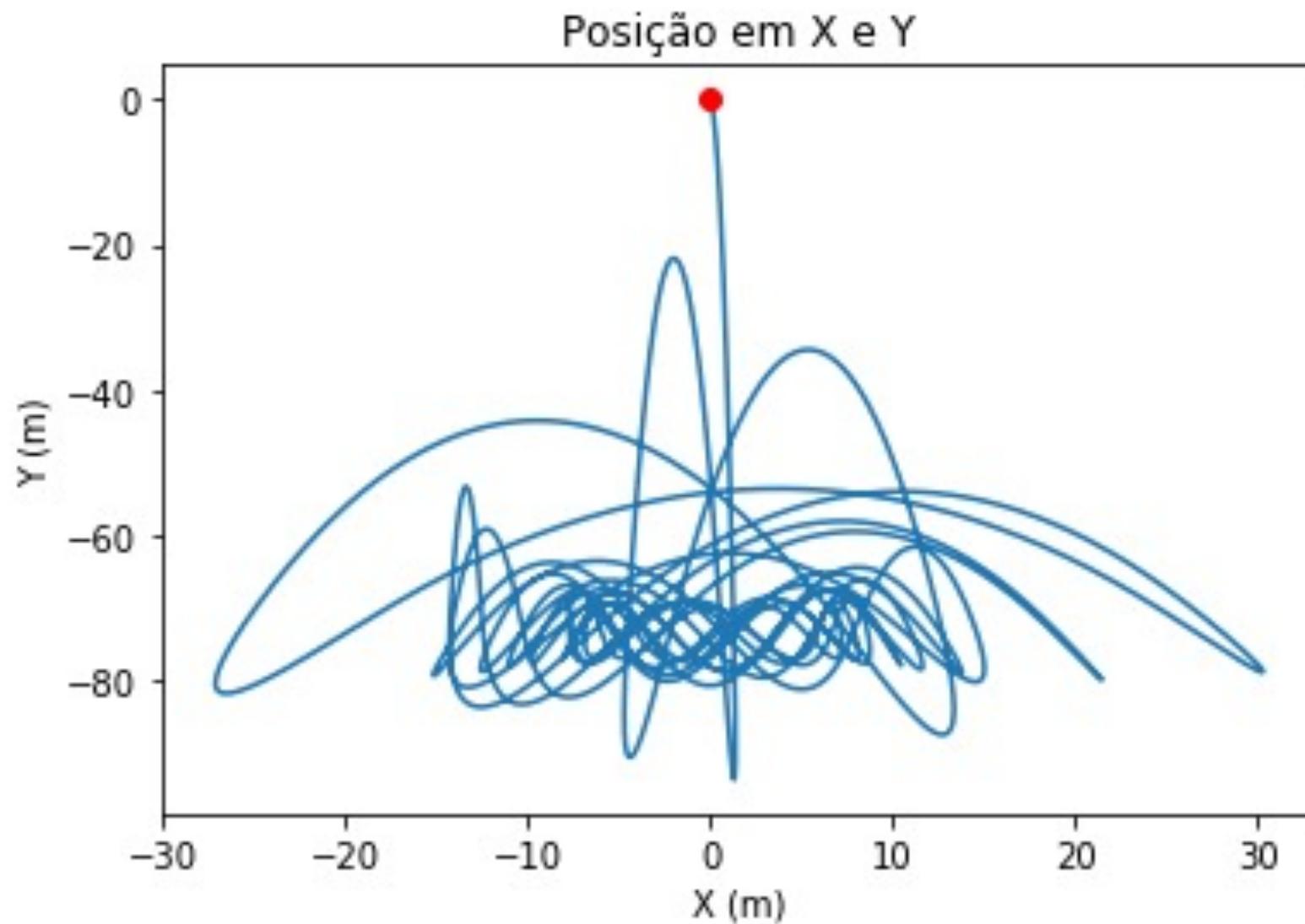
Validação



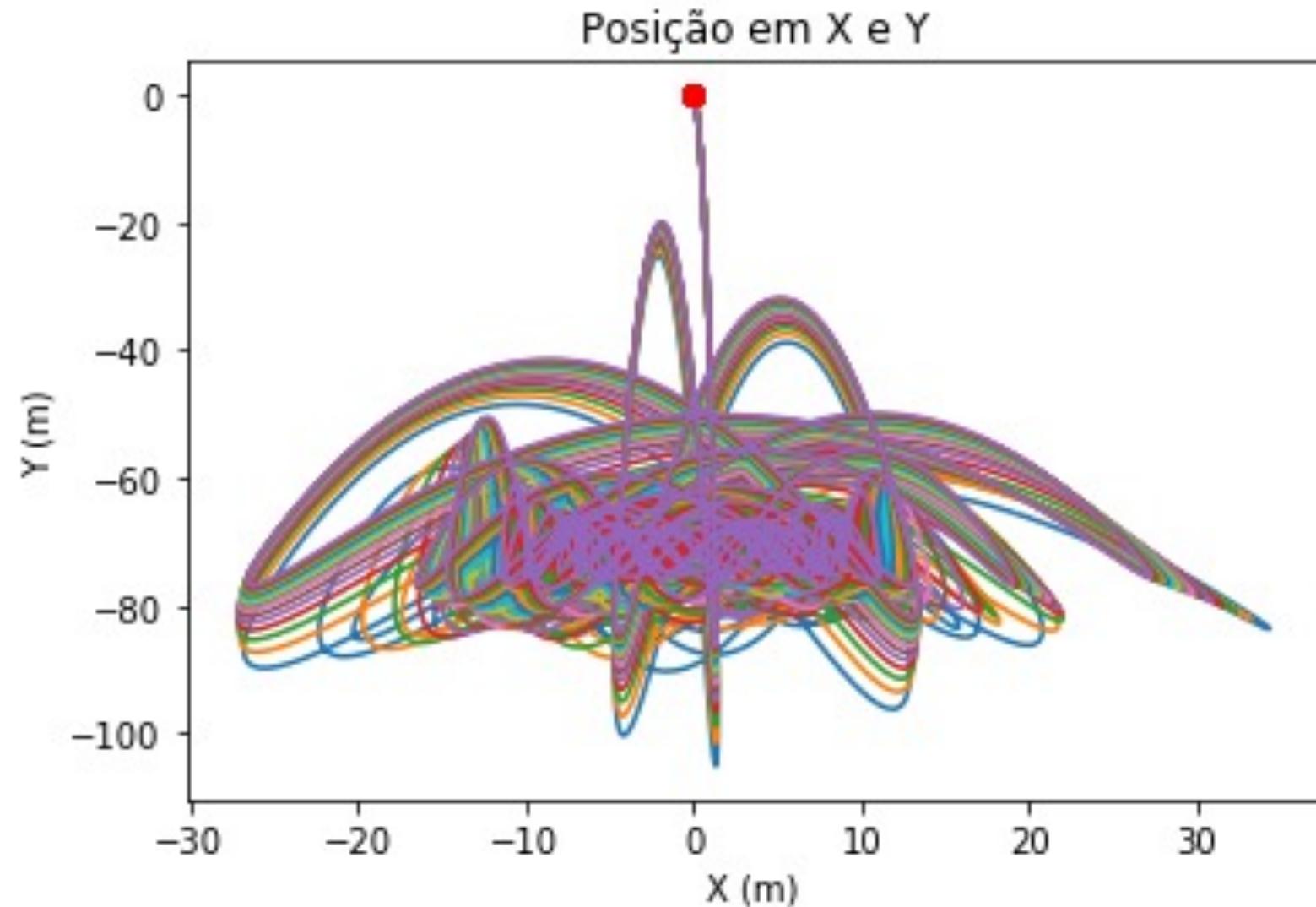
Resultados



Resultados



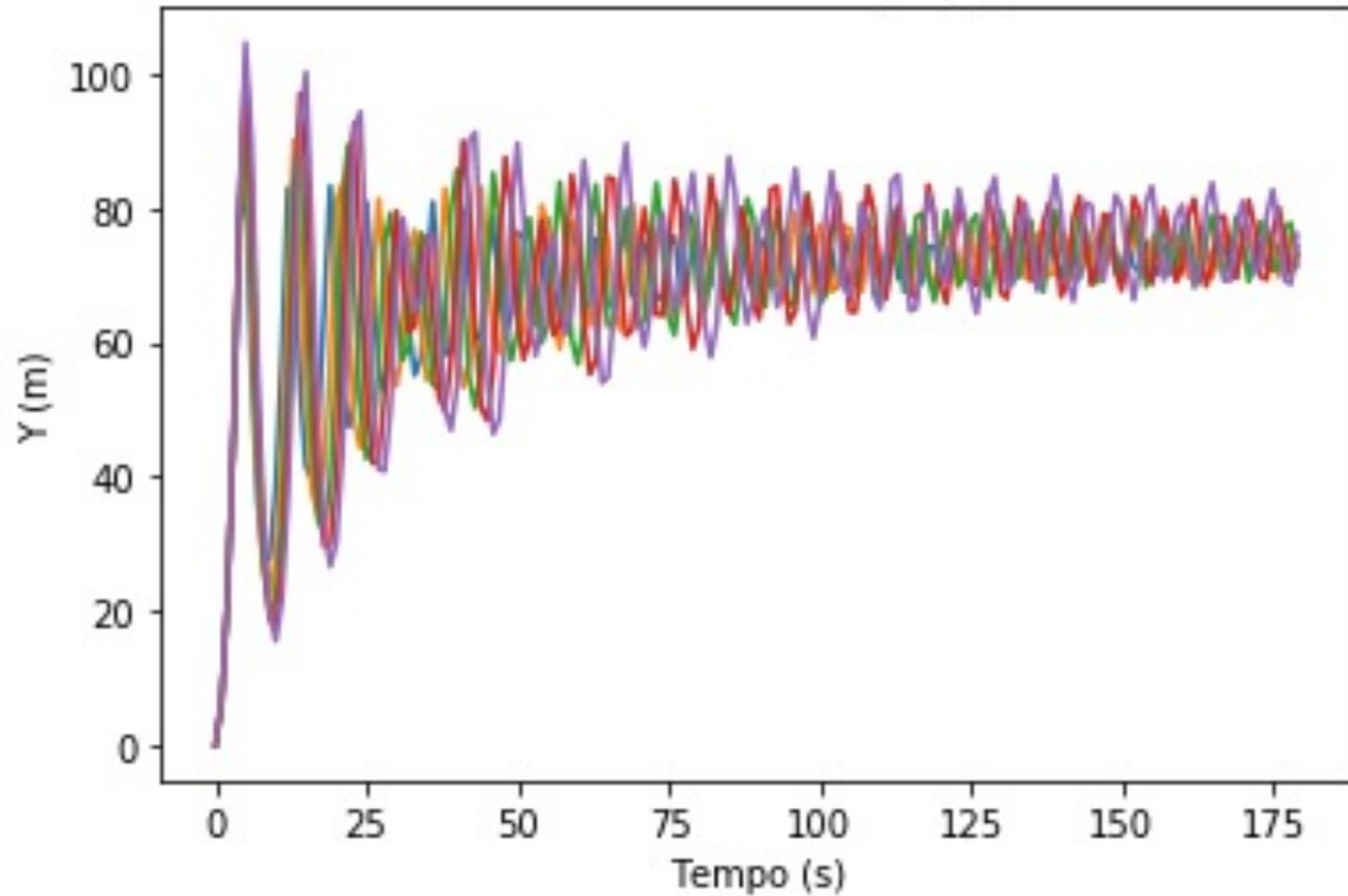
Análise de Sensibilidade



Constante elástica variando de 100 à 400 N/m

Análise de Sensibilidade

Velocidade em Y (m/s)



Massa
variando de
50 à 150 kg

Referências

- ▶ https://en.wikipedia.org/wiki/Drag_coefficient
- ▶ <http://ofantasticodafisica.blogspot.com.br/2012/08/bungee-jumping.html>
- ▶ <http://www.tutorbrasil.com.br/forum/viewtopic.php?t=13400>
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- ▶ <https://www.terra.com.br/vida-e-estilo/turismo/confira-20-lugares-no-mundo-para-fazer-bungee-jumping,e0aa392625237310VgnCLD100000bbcceb0aRCRD.html>