

Lab4 DOF Pendulum

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Case 1. 2-DOF Pendulum

There is a pendulum with two degrees of freedom with rigid links. Angles θ_1 and θ_2 are measured from the x-axis and the axis of the first link, respectively, as shown in the figure 1.

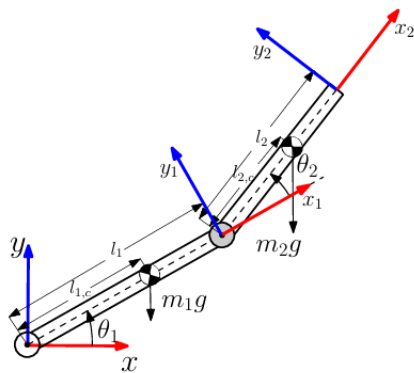


Figure 1: 2-DOF pendulum scheme

System description:

- Acceleration of gravity: g
- Joint angles: θ_1, θ_2
- Link masses: m_1, m_2
- Link lengths: l_1, l_2
- a_1, a_2 and b_1, b_2 – rectangular links width and height respectively.

Initial Data

ans = 包含以下字段的 struct:

```
a1: 0.1695
a2: 0.0862
b1: 0.0623
b2: 0.0647
g: [0;-9.82000;0];
initialTheta: [-0.804197861029562;-0.226490079971473]
l1: 1.3453
l2: 2.5323
m1: 3.4819
m2: 4.3600
```

Calculation

$$x_1 = \frac{l_1}{2} \sin(\theta_1)$$

$$y_1 = -\frac{l_1}{2} \cos(\theta_1)$$

$$x_2 = l_1 \sin(\theta_1) + \frac{l_2}{2} \sin(\theta_2)$$

$$y_2 = -l_1 \cos(\theta_1) + \frac{l_2}{2} \cos(\theta_2)$$

$$\dot{x}_1 = \frac{l_1}{2} \cos(\theta_1) \cdot \dot{\theta}_1$$

$$\dot{y}_1 = \frac{l_1}{2} \sin(\theta_1) \cdot \dot{\theta}_1$$

$$\dot{x}_2 = l_1 \cos(\theta_1) \cdot \dot{\theta}_1 + \frac{l_2}{2} \cos(\theta_2) \cdot \dot{\theta}_2$$

$$\dot{y}_2 = l_1 \sin(\theta_1) \cdot \dot{\theta}_1 - \frac{l_2}{2} \sin(\theta_2) \cdot \dot{\theta}_2$$

$$I_1 = \frac{1}{12} m_1 (a_1^2 + l_1^2)$$

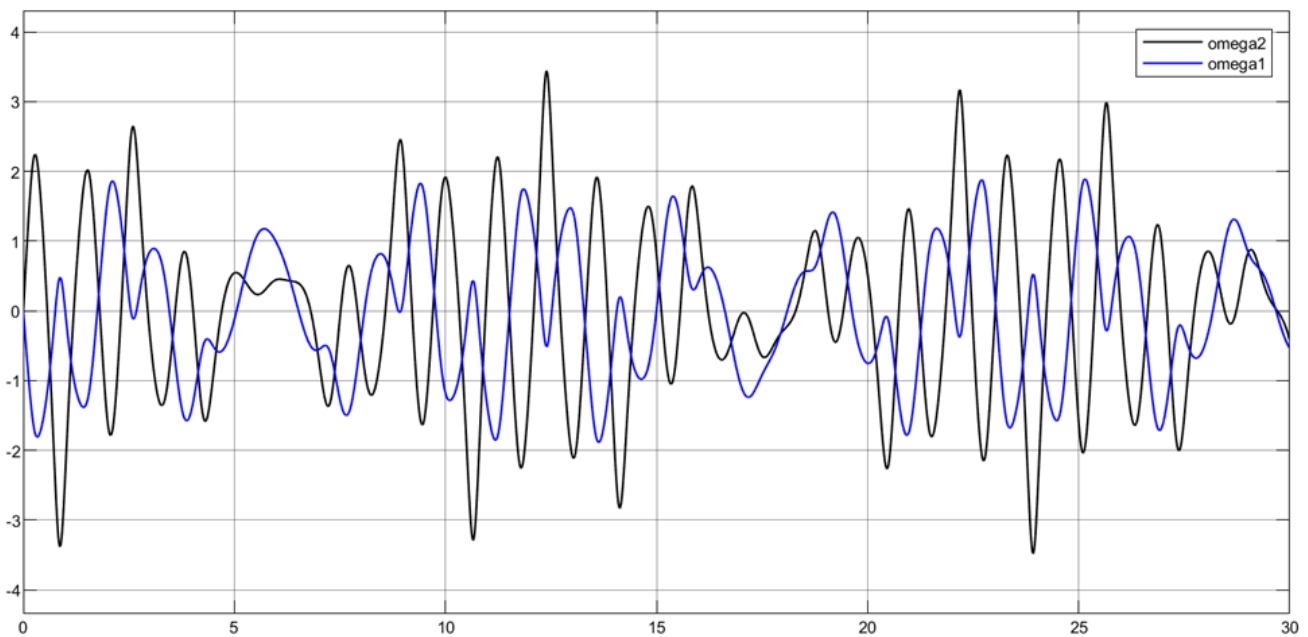
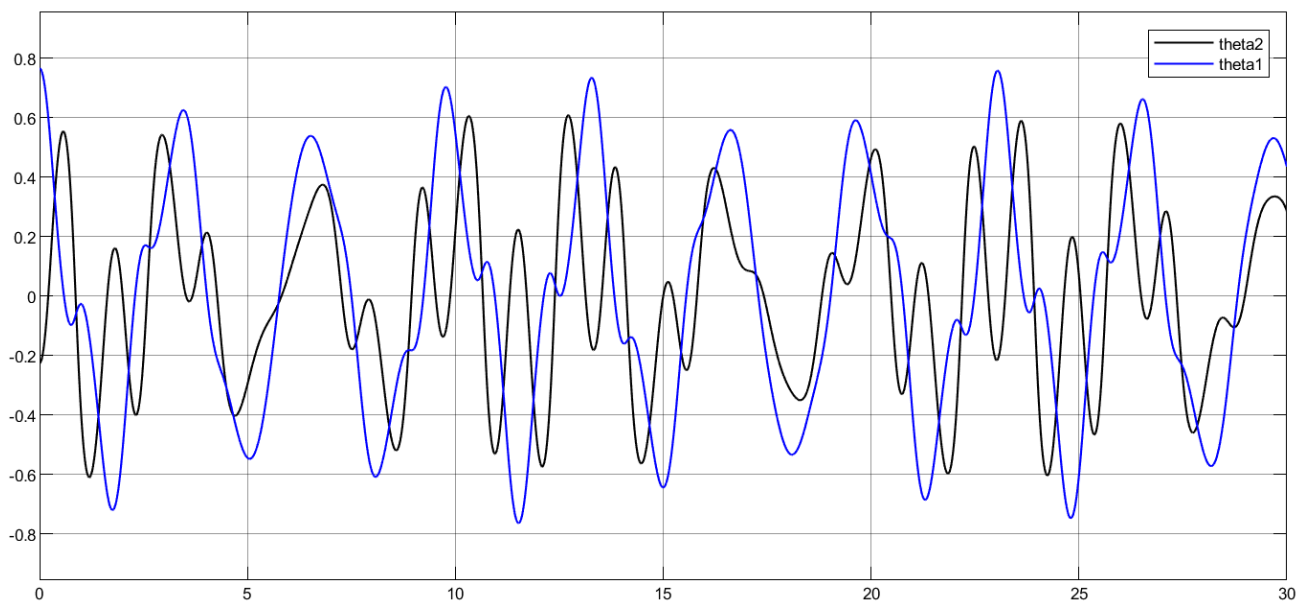
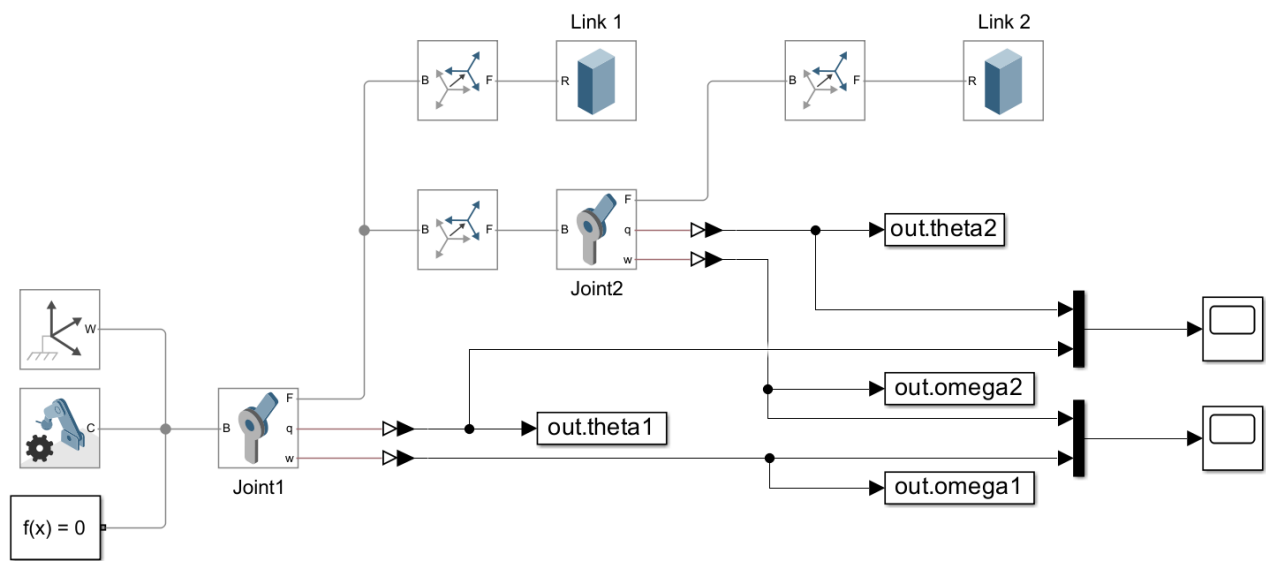
$$I_2 = \frac{1}{12} m_2 (a_2^2 + l_2^2)$$

$$K_1 = \frac{1}{2} \left(m_1 \left(\frac{l_1}{2} \right)^2 + I_1 \right) \dot{\theta}_1^2$$

$$K_2 = \frac{1}{2} m_2 \left[\left(l_1^2 + \left(\frac{l_2}{2} \right)^2 + l_1 l_2 \cos(\theta_2) \right) \dot{\theta}_1^2 + 2 \left(\left(\frac{l_2}{2} \right)^2 + \frac{l_1 l_2}{2} \cos(\theta_2) \right) \dot{\theta}_1 \dot{\theta}_2 + \left(\frac{l_2}{2} \right)^2 \dot{\theta}_2^2 \right] + \frac{1}{2} I_2 (\dot{\theta}_1 + \dot{\theta}_2)^2$$

$$K_{\text{total}} = K_1 + K_2$$

Simulation



Answers

ans = 包含以下字段的 struct:

```
maxK: 30.2573
maxTheta: [-0.8042 0.6095]
maxdTheta: [1.8926 3.4427]
```

You have 38 attempts left

ans = 包含以下字段的 struct:

```
maxK: 2
maxTheta: 1
maxdTheta: 1
total_score: 4
```