System Dynamics Homework 3

November 28, 2023

First Last

[1]:
```
import control as ct
import matplotlib.pyplot as plt
import numpy as np
import sympy as sp
import pandas as pd

# Use whichever pertains to your set-up
# plt.style.use('maroon_ipynb.mplstyle')
# plt.style.use('../maroon_ipynb.mplstyle')
```

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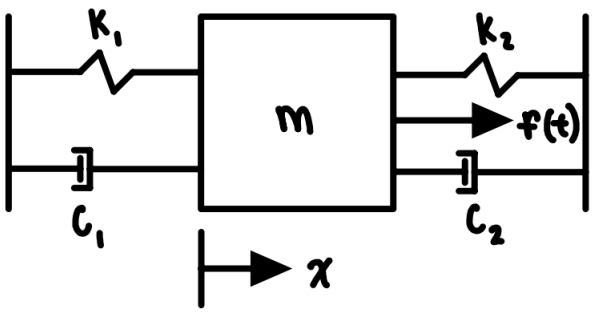
1 Problem 1

1.1 Given



$$m = 10\ kg$$

$$k_1 = 85\ N/m,\ k_2 = 30\ N/m$$

$$c_1 = 4\ N \cdot s/m,\ c_2 = 3\ N \cdot s/m$$

The input force $f(t)$ is in the `data.xlsx` file.

1.2 Find

Using the control package `tf()` function to get the forced response, find the following:

a. The equation of motion for the system.
b. The transfer function $X(s)/F(s)$.
c. The forced response for the no noise data. Plot the input force and the response on separate axes.
d. Repeat part c for the high frequency noise data.
e. Repeat part c for the low frequency noise data.

1.3 Solution

1.3.1 Part A

[ ]:

1.3.2 Part B

[ ]:

1.3.3 Part C

[ ]:

1.3.4 Part D

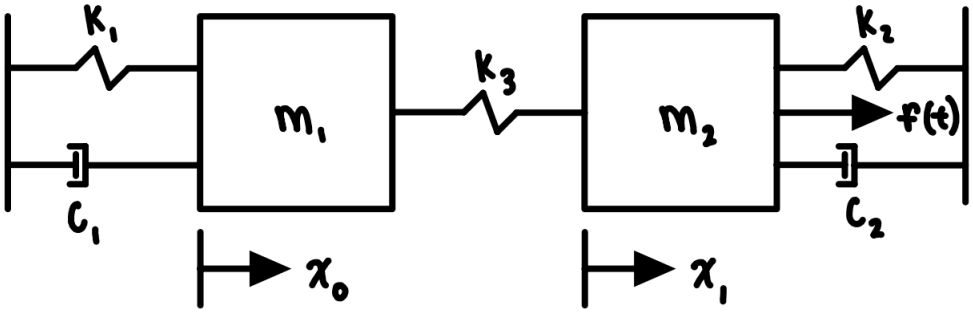
[ ]:

1.3.5 Part E

[ ]:

2 Problem 2

2.1 Given



$$m_1 = 5\ kg,\ m_2 = 10\ kg$$

$$k_1 = 85\ N/m,\ k_2 = 30\ N/m,\ k_3 = 500\ N/m$$

$$c_1 = 4\ N \cdot s/m,\ c_2 = 3\ N \cdot s/m$$

$$f(t) = 10^{-t}$$

The initial conditions are $x_0(0) = 0.5$, $\dot{x_0}(0) = 0$, $x_1(0) = 0$, $\dot{x_1}(0) = 0$.

2.2 Find

a. Determine the equations of motion.
b. Put the system in the state-variable form.
c. Define a state-space object using `ct.ss`.
d. Plot the response $x_0(t)$ and $x_1(t)$ (first 10 seconds) on the same plot using the `ct.forced_response` function. You may check the solution using the `odeint` function as well.

2.3 Solution

2.3.1 Part A

[ ]:

2.3.2 Part B

[ ]:

Note: The state variable model should have no derivatives on the right hand side of each equation.

2.3.3 Part C

[ ]:

2.3.4 Part D

[ ]: