# Mass Spring Response

## Table of Contents



An example of obtaining the response of a double mass-spring system.

# Define Symbolic Variables

Define the state variables, input variables, and any constants.

```
syms M1 B B1 K K1 M2 B2 K2 t positive
syms u1(t) u2(t)
syms y1(t) y2(t)
```

# Define the State Space Model

The system is defined by the equations of motion:

$$M_1\ddot{y}_1 + (B + B_1)\dot{y}_1 + (K + K_1)y_1 - B\dot{y}_2 - Ky_2 = u_1$$

$$M_2\ddot{y}_2 + (B + B_2)\dot{y}_2 + (K + K_2)y_2 - B_1\dot{y}_1 - Ky_1 = u_2$$

```
f1 = M1*diff(y1, t, t) + (B + B1)*diff(y1, t) + (K + K1)*y1 -
 B*diff(y2, t) - K*y2 == u1;
f2 = M2*diff(y2, t, t) + (B + B2)*diff(y2, t) + (K + K2)*y2 -
 B1*diff(y1, t) - K*y1 == -u2;
```

Convert the equations of motion to state space form. The state variables are defined as $y_1$, $\dot{y}_1$, $y_2$, $\dot{y}_2$.

```
sys = eom2symss([f1, f2], [y1, diff(y1, t), y2, diff(y2, t)]);
```

Specify the inputs as $u_1$ and $u_2$.

```
sys.inputs = [u1 u2];
```

Define the output equations.

```
sys.g(1) = y1;
sys.g(2) = y2;
```

# Specify Initial Conditions

Specify constant values and initial conditions.

```
cons = {M1==0.1, B==1, B1==1, K==1, K1==1, M2==2, B2==1, K2==1};
ic = [1 0 0 0];
```

Obtain the symbolic system response.

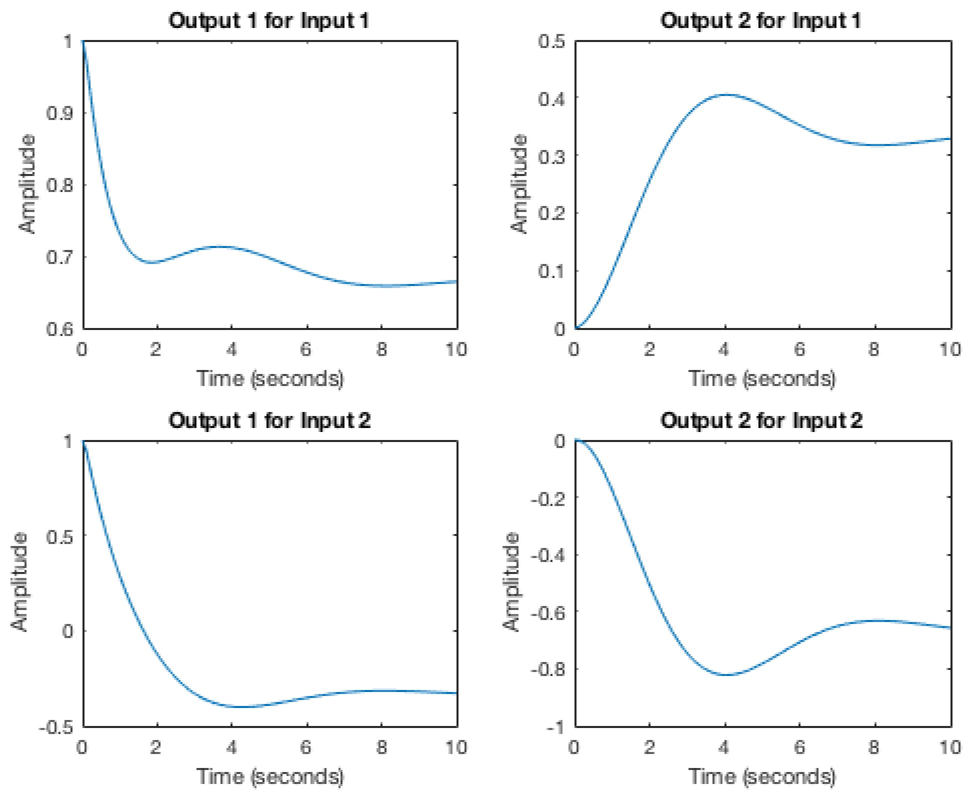
```
y = step(sys|cons, ic);
```

Define the time interval to plot over and get the time-series data for the system response.

```
T = 0:0.1:10;
ts = gettsdata(y, T);
```

Plot the system response for the time series data obtained.

```
plottsdata(ts, T);
```

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