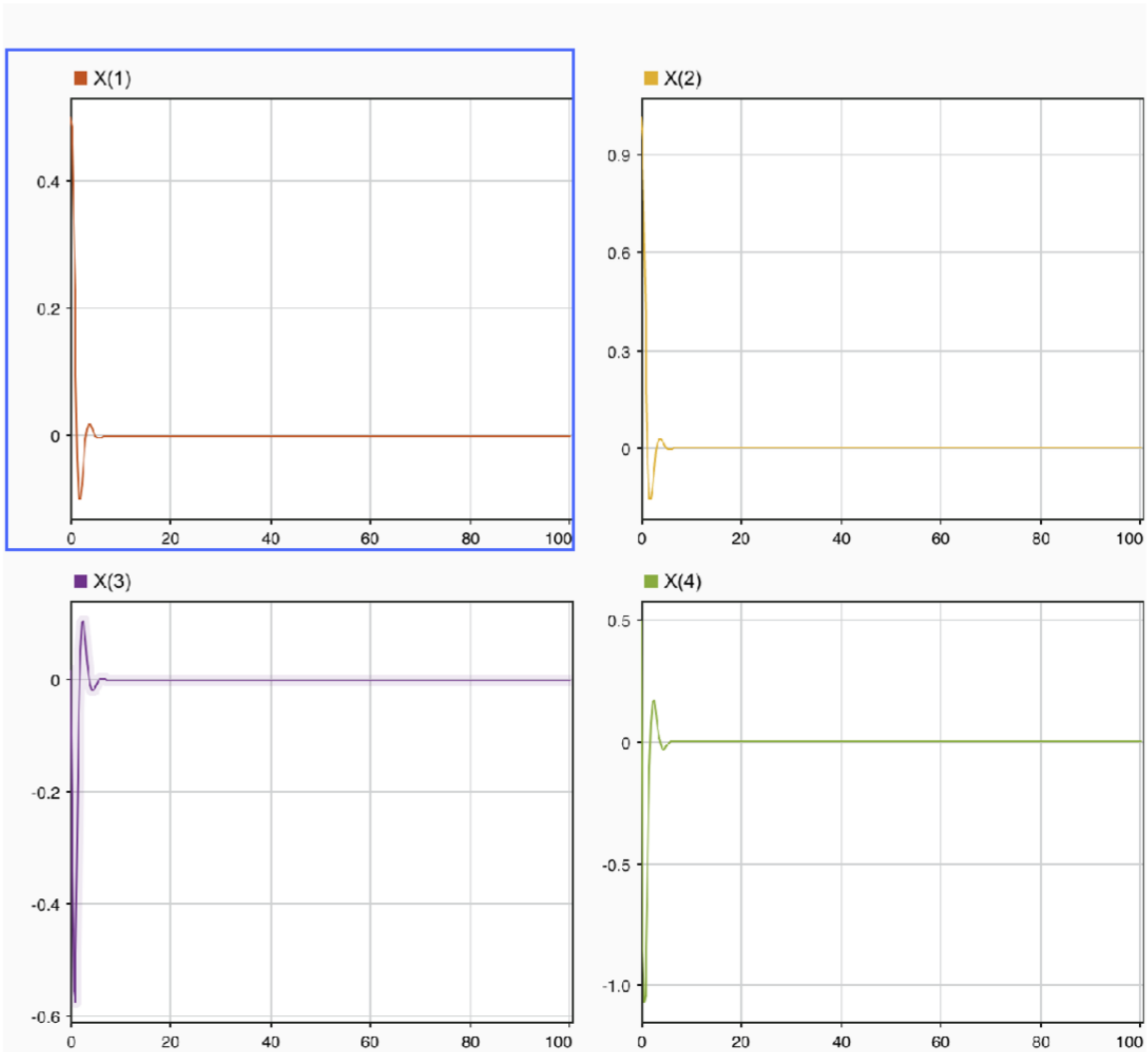
CONTROL SYSTEMS ENGINEERING

Volansi

Ashok Sarath Chandra Reddy Irigireddy

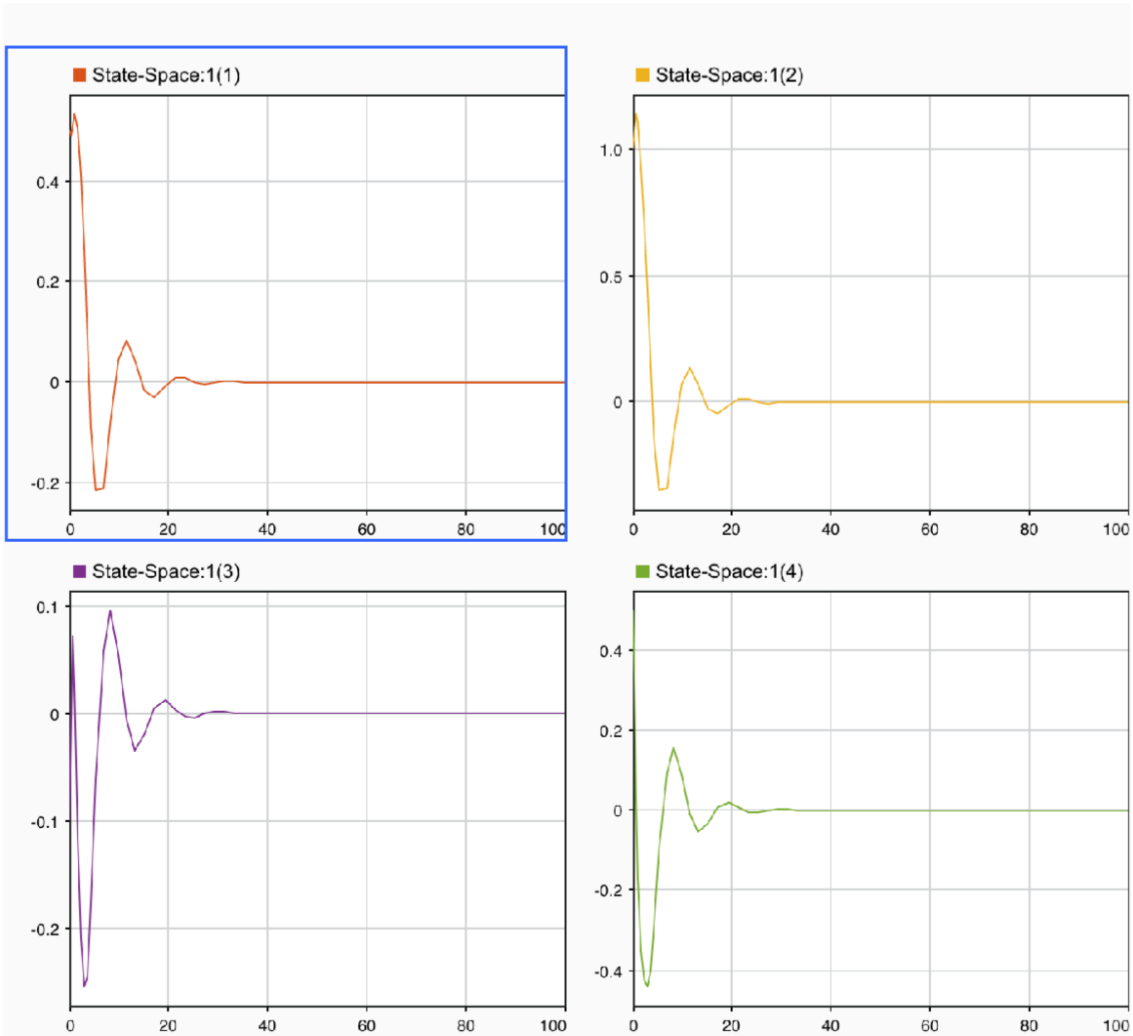
P1. Let $m_1 = m_2 = 1$ kg , $k_1 = k_2 = 10$N/m and $c_1 = c_2 = 5$ kg/s. Simulate the state space system for an initial condition : $[x_1\ x_2\ x_3\ x_4] = [0.5\ 1\ -0.1\ 0.5\ ]$ and $u = 0$. Plot the time-evolution of all the four states.



P2. Assume that $m_1 = m_2 = 1$ kg. Analyze open loop stability for the following cases

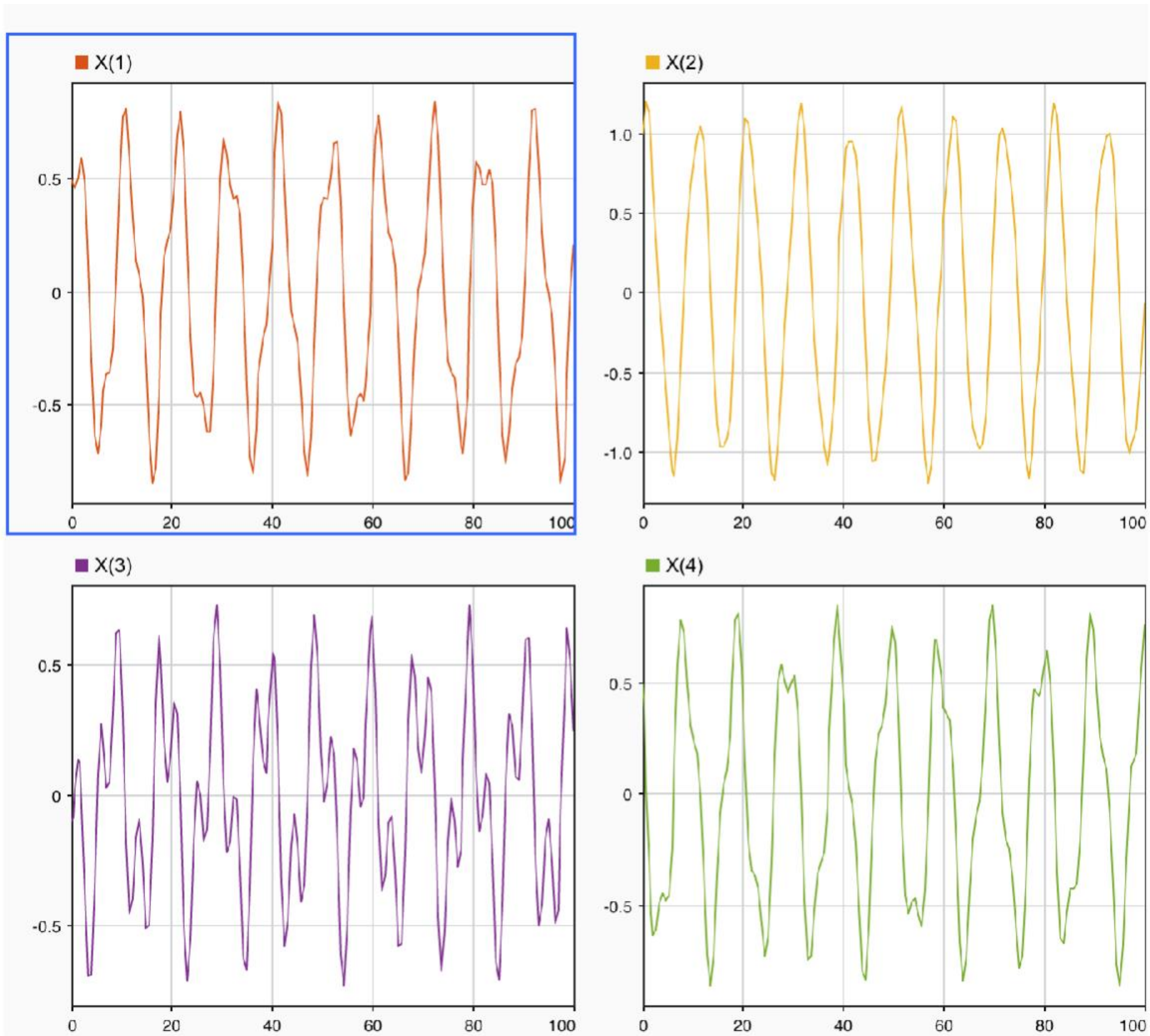
1. $k_1 = k_2 = 1$N/m and $c_1 = c_2 = 1$ kg/s
2. $k_1 = k_2 = 1$N/m and $c_1 = c_2 = 0$ kg/s
3. $k_1 = k_2 = 0$N/m and $c_1 = c_2 = 0$ kg/s.

1) $k_1 = k_2 = 1N/m$ and $c_1 = c_2 = 1$ kg/s



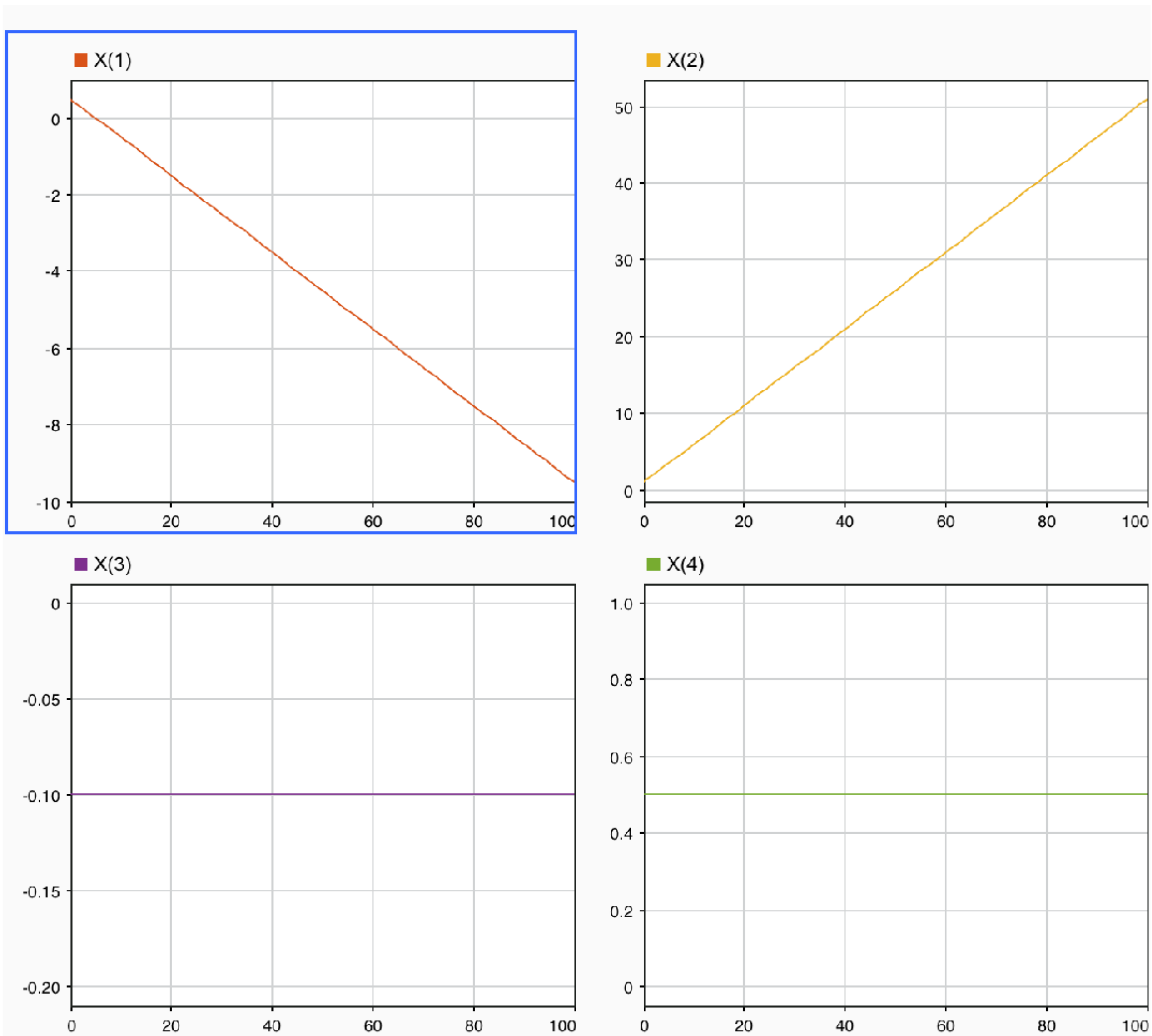
When the spring constants and damping constants are constant and equal the system will become stable after certain period of time. This can be seen with the eigen values of the system too.

2. $k_1 = k_2 = 1 N/m$ and $c_1 = c_2 = 0$ kg/s



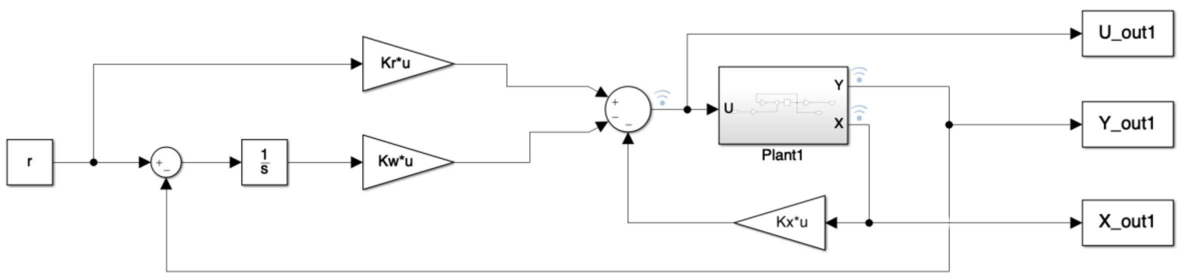
As there is no damping in this condition the system is not stable and continuously moving.

3. $k_1 = k_2 = 0$N/m and $c_1 = c_2 = 0$ kg/s.



In this condition, the spring constant and damping is zero.

P3. Let $m_1 = m_2 = 1$ kg , $k_1 = k_2 = 10$N/m and $c_1 = c_2 = 0.1$ kg/s. Assume that full state feedback is available. Design a feedback law to command position of m_1. Simulate your controller and track $x_1 = 10$m. Plot the tracking performance of your designed controller. (You may choose any controls technique to design your feedback law).



- For this problem LQR was designed. LQR is implemented with integral action to reduce the constant error between the desired and system output. The tracking error between system output and reference output is computed.