03OAIQW
Dynamic Design of Machines
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Mechanical Engineering
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Tutorial 4 – Controlled systems

Index

Exercise 1

In the linear system with a single degree of freedom in Figure 1, an active control action is provided by an actuator working on the spring with stiffness K1.

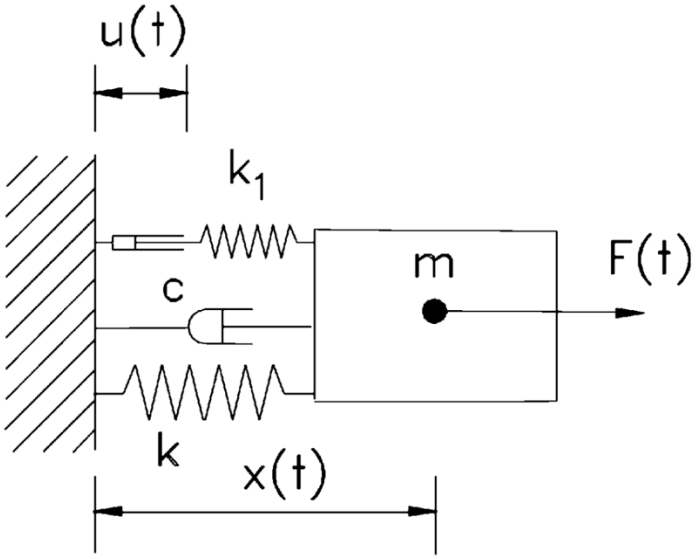

Figure 1 - Exercise 1.

It is requested to:

a) Compute the equation of motion of the system

b) Obtain the equivalent block diagram of the system

c) Considering that the controlled variable is the displacement of the mass m, write the closed loop transfer function G1(s) = x(s)/xref(s), considering a PID control action (GPID = KP+KDs + KI/s)

d) Write the closed loop transfer function G2(s) = x(s)/F(s), considering a PID control action (GPID = KP+KDs + KI/s)

e) Use the Matlab script and the Simulink model in the folder to design the PID control and evaluate the behaviour of the controlled system.

Exercise 2

In the linear system with a single degree of freedom in Figure 2, an active control action is provided by an actuator working on the dashpot with damping C1.

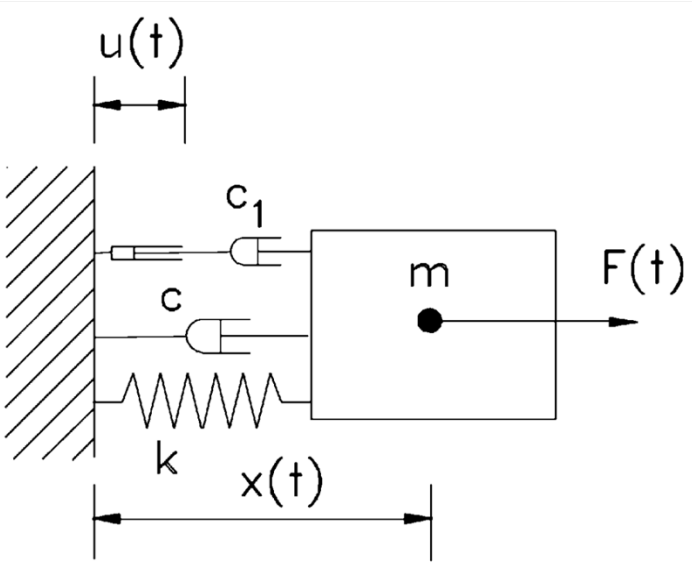

Figure 2 - Exercise 2.

It is requested to:

a) Compute the equation of motion of the system

b) Obtain the equivalent block diagram of the system

c) Considering that the controlled variable is the displacement of the mass m, write the closed loop transfer function G1(s) = x(s)/xref(s), considering a PID control action (GPID = KP+KDs + KI/s)

d) Write the closed loop transfer function G2(s) = x(s)/F(s), considering a PID control action (GPID = KP+KDs + KI/s)

e) Adapt the Matlab script and the Simulink model in the folder to design the PID control and evaluate the behaviour of the controlled system.

Exercise 3

In the linear system with a single degree of freedom in Figure 3, an active control action is provided by an actuator working on an auxiliary mass m1.

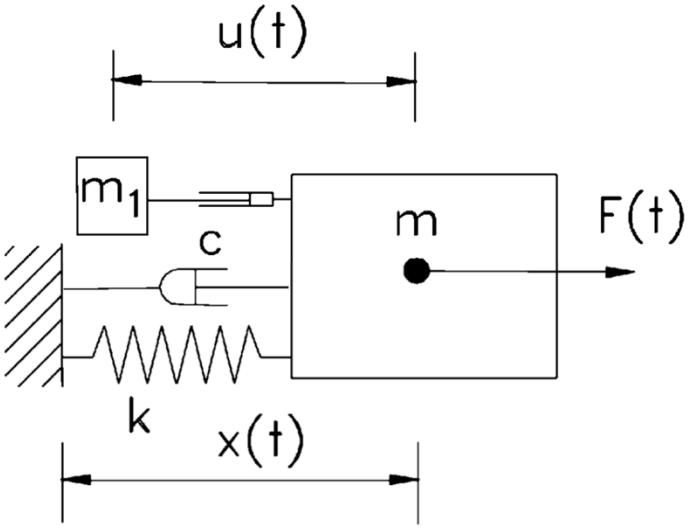

Figure 3 - Exercise 3.

It is requested to:

f) Compute the equation of motion of the system

g) Obtain the equivalent block diagram of the system

h) Considering that the controlled variable is the displacement of the mass m, write the closed loop transfer function G1(s) = x(s)/xref(s), considering a PID control action (GPID = KP+KDs + KI/s)

i) Write the closed loop transfer function G2(s) = x(s)/F(s), considering a PID control action (GPID = KP+KDs + KI/s)

j) Adapt the Matlab script and the Simulink model in the folder to design the PID control and evaluate the behaviour of the controlled system.