Simulation of Mechatronic Systems

Exercise 3 protocol

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Exercise 3a): Simulating the step response of a transfer function

In the first sub task of this exercise, we want to simulate the step response of the transfer-function **PT1** which can be defined as follows:

$$G(s) = \frac{K}{1 + T * s} \tag{1}$$

Hereby, variables K and T are to be defined as $K = 5$ and $T = 4$. Furthermore, the differential equation of **PT1** is given as follows:

$$\dot{x} = \frac{1}{T}(K * u - x) \tag{2}$$

Now that this has been established, we can build equation 2 within Simulink which yields the following model:

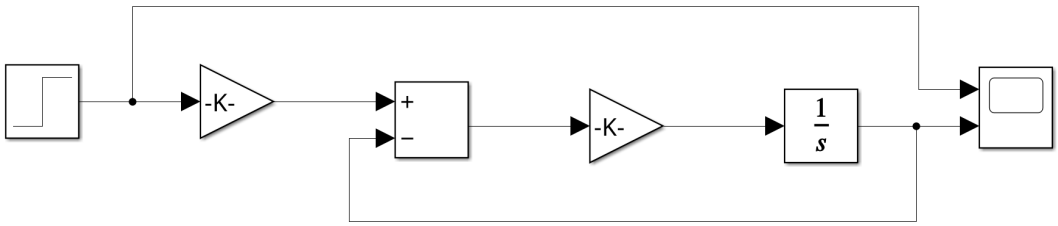

Figure 1: Differential equation of **PT1** conveyed as Simulink model.

As shown in the figure above, the value of u gets simulated by a step block. Both simulated values of u and x get forwarded to the scope block, which lets us examine their values within a Matlab script. Something that is not directly apparent from the graphic is the simulation run time, which has been set to 50 seconds.
Within our Matlab code, we can set and access the Simulink simulation as demonstrated in the code snippet below:

Matlab Code Snippet:

```
clear; clf; clc;
% PARAMETERS EXERCISE 1
par1.K = 5;              % Gain
par1.T = 4;              % Time constant
par1.u = 1;              % step value
par1.t.start = 0;        % start simulation time
par1.t.stop = 50;        % stop simulation time

out1 = sim('exercise3_SIM');                              % simulate the system with
    simulink and get the scope datas

figure()
plot(out1.plotG1_De.time,out1.plotG1_De.signals(1).values,...       % Plot the result of
    the simulation in simulink (differential equation)
     out1.plotG1_De.time,out1.plotG1_De.signals(2).values)
grid on, xlabel('Time [sec]');legend('step','out'); title('step response differential
    equation SIMULINK');
```

Hereby, we can access concrete scope variables using `plotG1_De`, a logging value which has been defined within our Simulink model and is not directly apparent from any graphic.
The plot code of the step response yields the following graphic 2:

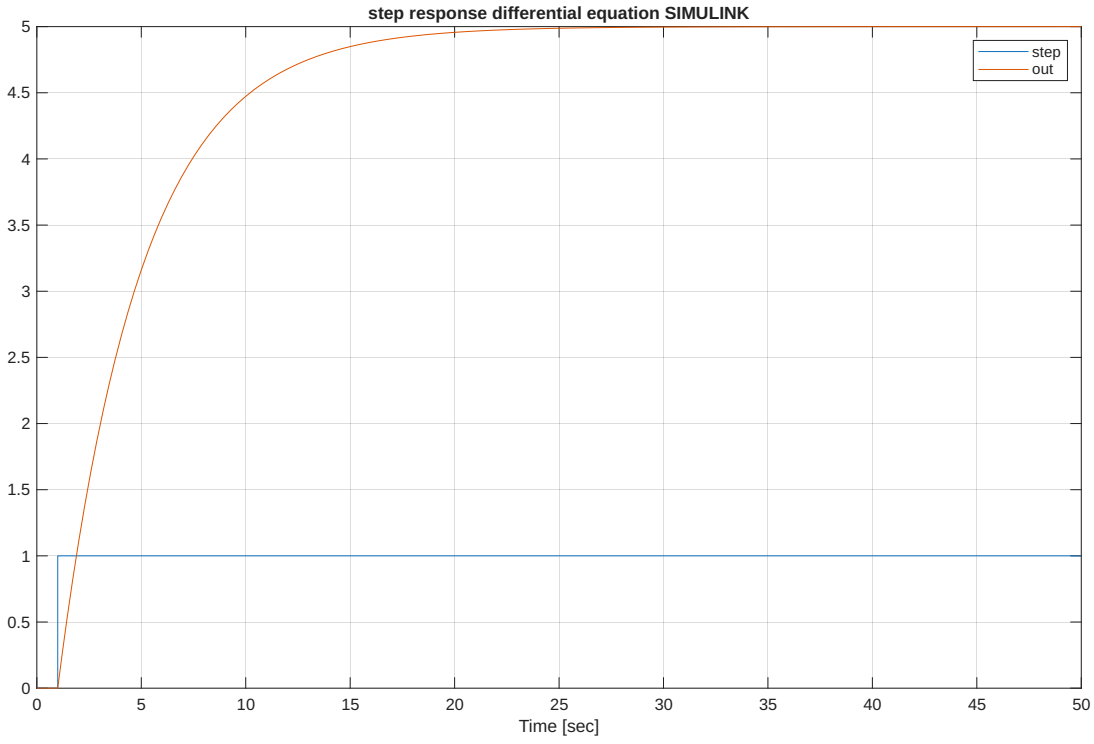

Figure 2: Step response of our Simulink model plotted within Matlab.

As expected, the output `out` of the step function **PT1** converges at a value of 5, which corresponds to the value of parameter K.

Exercise 3b): Building a one-mass system in Simulink

Exercise 3c): Building and optimizing a two-mass system in Simulink