Practical Lab: First-Order System Analysis

OS-Academy

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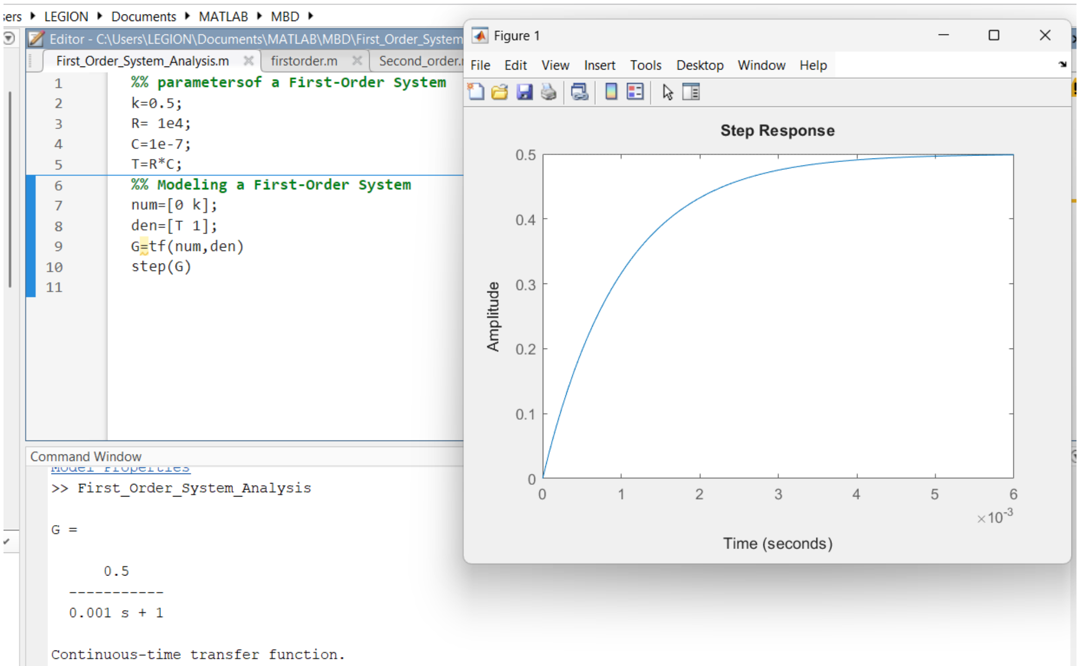
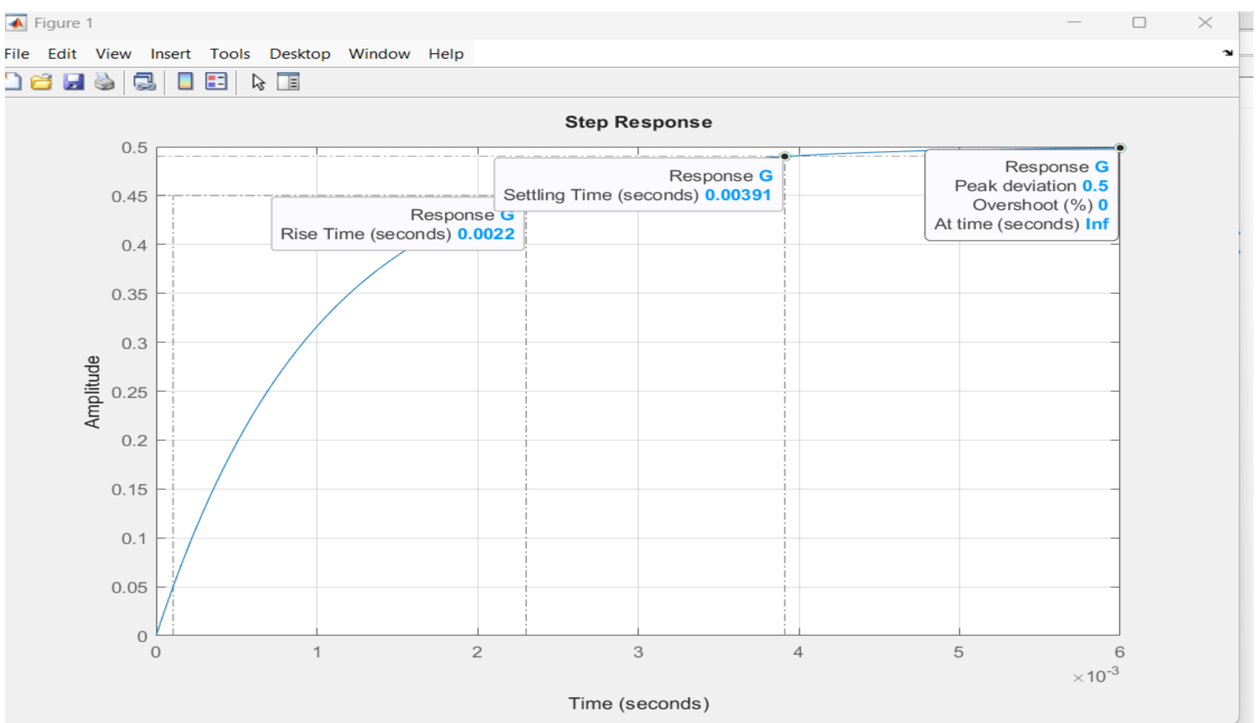
1. Modeling a First-Order System:



2. Analyzing the System Response:

- Observe the response characteristics, such as rise time, settling time, and overshoot, on the plot. (NO Overshoot for the 1st order system)



- Use the `stepinfo` function in MATLAB to obtain and display numerical values for these response characteristics.

```
%% Analyzing the System Response:
sys=stepinfo(G);
disp(sys)
```

Command Window

```
Continuous-time transfer function.
Model Properties
         RiseTime: 0.0022
    TransientTime: 0.0039
     SettlingTime: 0.0039
      SettlingMin: 0.4523
      SettlingMax: 0.4997
        Overshoot: 0
       Undershoot: 0
             Peak: 0.4997
         PeakTime: 0.0073
```

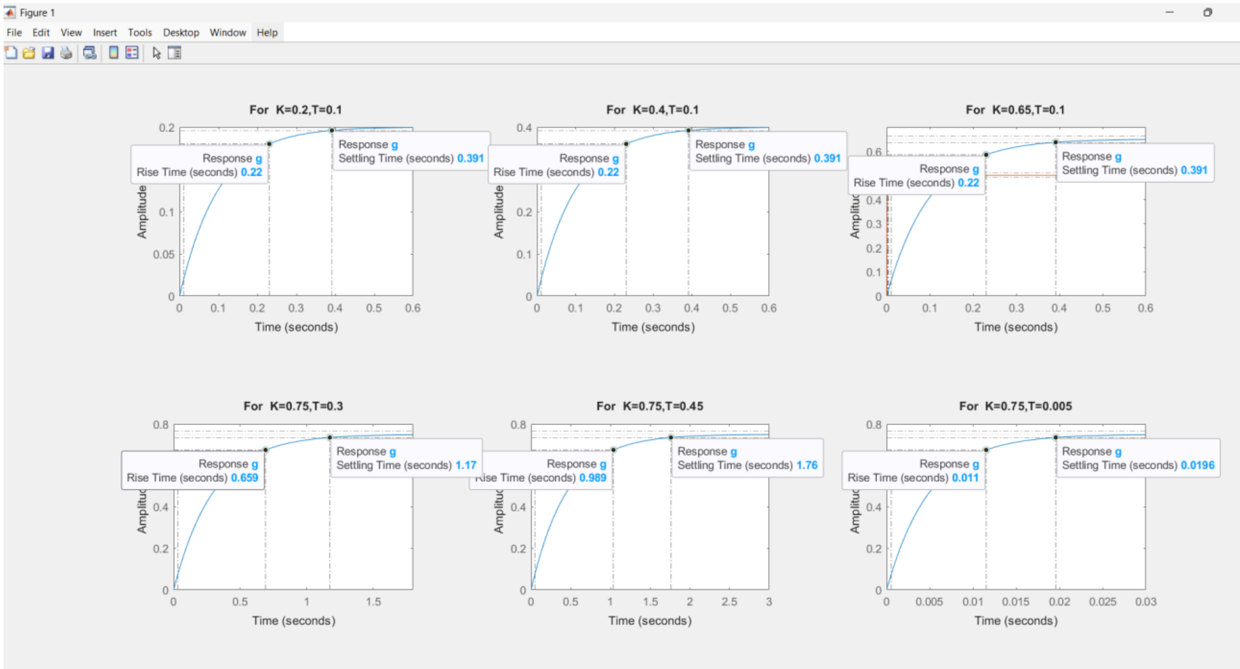
3. Exploring Different Scenarios:

- Change the values of the gain (k) and the time constant (T) and observe how it affects the system's time response.

```
%% Exploring Different Scenarios:
k=0.75;
t=0.005;
Num=[0 k];
Den=[t 1];
g=tf(Num,Den);
subplot(2,3,6)
step(g)
title(['For  ' 'K=' num2str(k) ',' 'T=' num2str(t)])
hold on
```

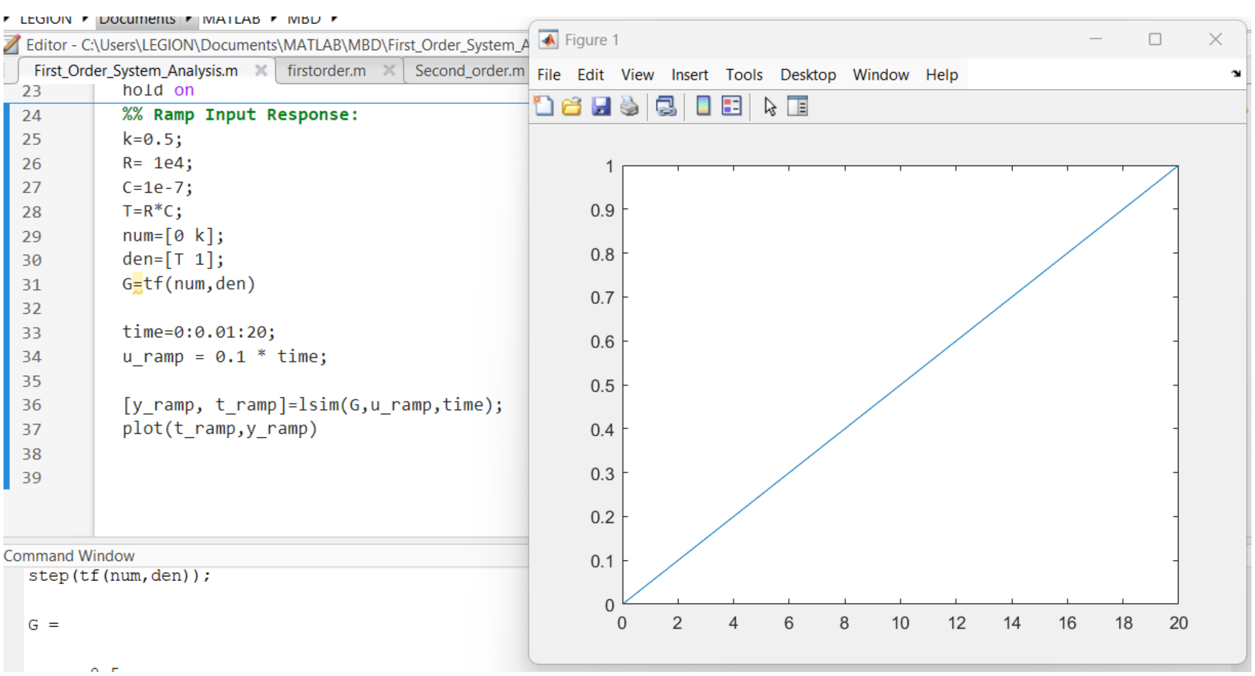
- Plot and analyze the step response for different combinations of gain and time constant values. As the time constant increases (constant gain), Ts increases & the response is slower.

As gain K increases (constant T), the output increases.



4. Ramp Input Response:

- Plot the system's response to the ramp input.



Let the system be a closed-loop system with unity feedback.

K_v = lim S * G = zero.   K_v: velocity constant & the steady state error = 1/K_v = ∞

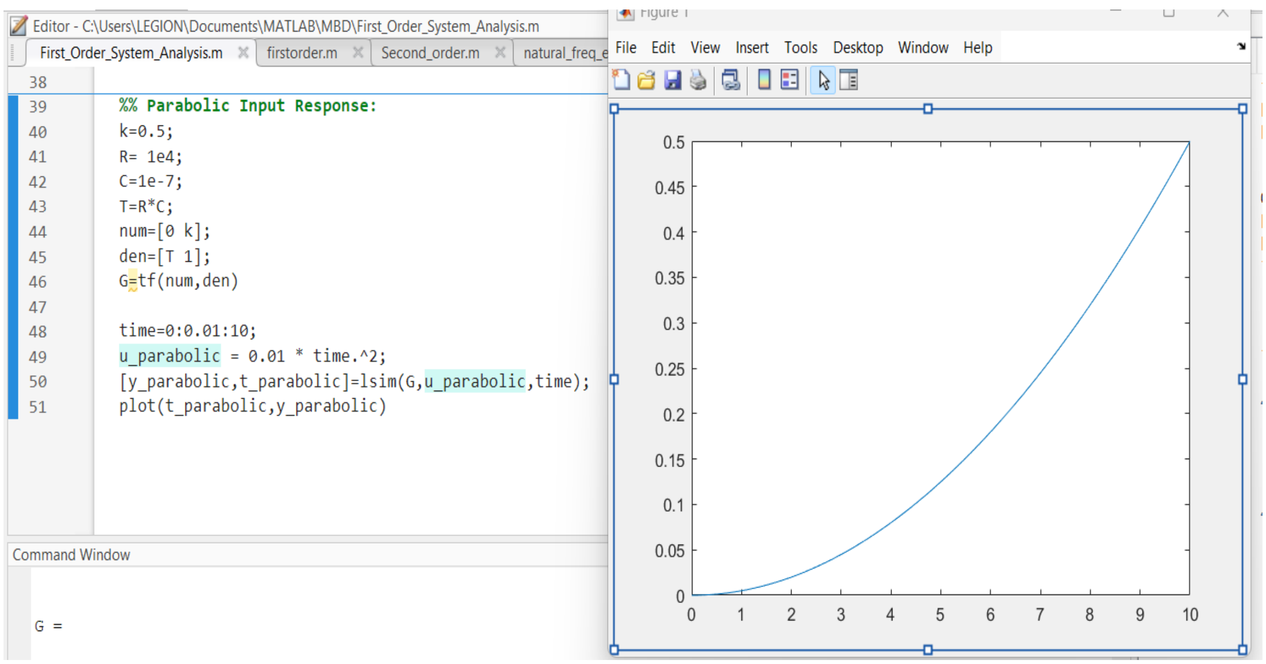
S~0

```
G =

      0.5
  -----------
  0.001 s + 1
```

5. Parabolic Input Response:

- Plot the system's response to the parabolic input.



- Analyze the response and observe how the system reacts to a changing rate of input.

<u>Increasing the rate of the input increases the error between the input and output, because the system cannot track the input fast enough.</u>