Table of Contents

Title: 2ND ORDER SYSTEM CONTROL

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Reference: [1] MATLAB and Simulink crash course for engineers (Eklas Hossain, 2022) [Ch.9]

```
close all; clearvars; clc
```

PARAMETERS

```
Num = [0 1 10];
  % Transfer function numerator : s +10
Den = [1 2 6];
  % Transfer function denumerator : s^2 +2s +6
```

PARTIAL FRACTION EXPANSION

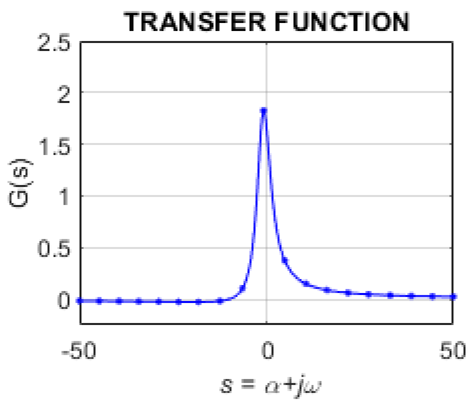
```
[r,p,k] = residue(Num,Den)
  % re-arrange transfer function as H(s) = k +Epsilon rj/(s-pj)
```

```
r =

   0.5000 - 2.0125i
   0.5000 + 2.0125i


p =
```

```
  -1.0000 + 2.2361i
  -1.0000 - 2.2361i


k =

     []
```

SYMBOLIC

```
syms s t
H1 = (Num(1)*s^2+Num(2)*s^1+Num(3)) / (Den(1)*s^2+Den(2)*s^1+Den(3));
  % Symbolic reprentation of transfer function H(s)

figure
subplot(2,2,1)
fplot(H1,'b.-')
xlim(50*[-1 1])
ylim(2.5e0*[-.1 1])
xlabel('{\it s = \alpha+j\omega}')
ylabel('G(s)')
title('TRANSFER FUNCTION')
grid on
```



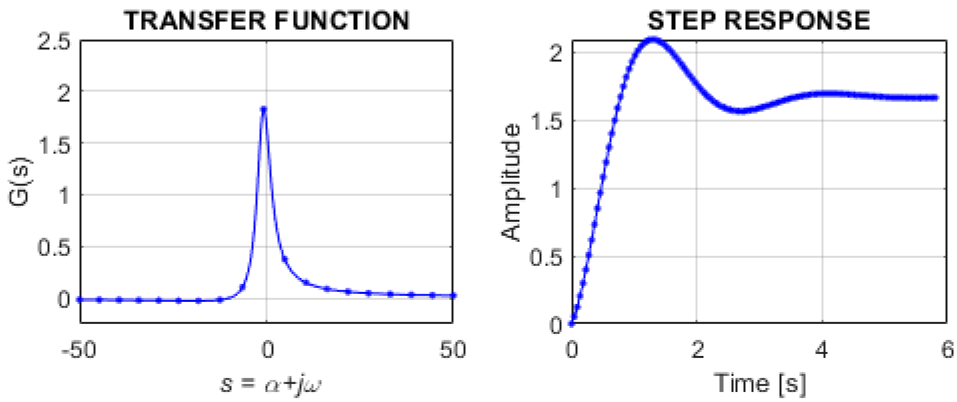
TRANSFER FUNCTION

```
H2 = tf(Num,Den)
  % MATLAB built-in reprentation of transfer function H(s)
zeros = zero(H2)
  % Estimate transfer function zeros
poles = pole(H2)
  % Estimate transfer function poles
```

```
H2 =

     s + 10
  -------------
  s^2 + 2 s + 6

Continuous-time transfer function.


zeros =

   -10


poles =

  -1.0000 + 2.2361i
  -1.0000 - 2.2361i
```

STEP RESPONSE

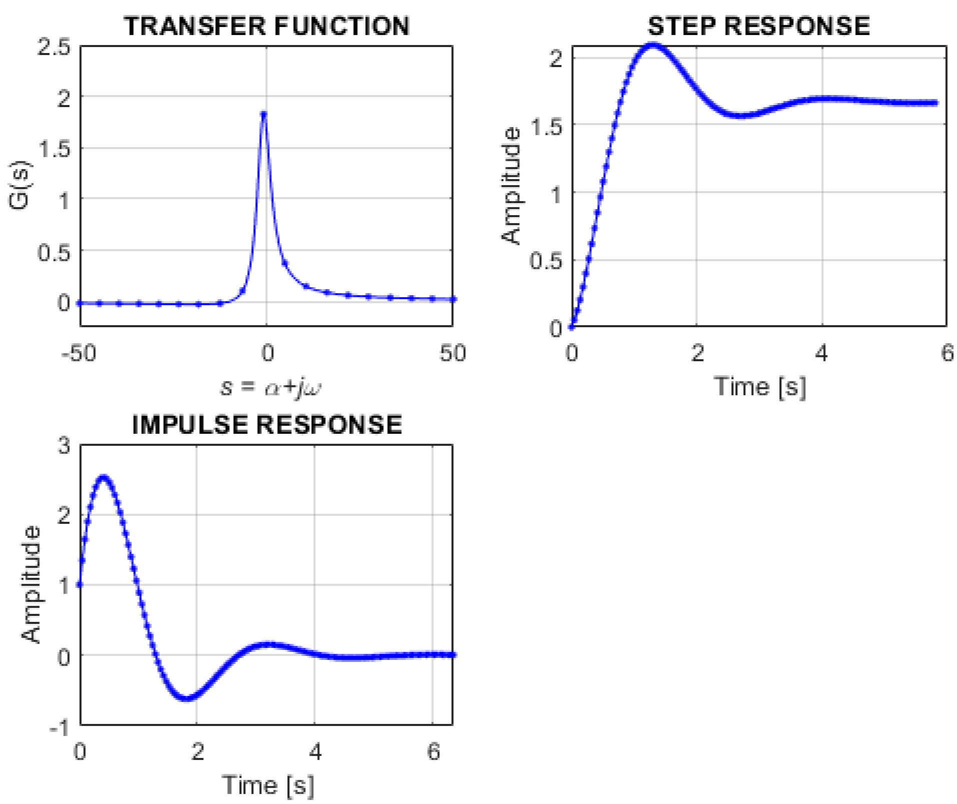
```
[Ystep,Xstep] = step(H2);
  % Estimate step response

subplot(2,2,2)
plot(Xstep,Ystep,'b.-')
xlabel('Time [s]')
ylabel('Amplitude')
title('STEP RESPONSE')
grid on
```



IMPULSE RESPONSE

```
[Yimp,Ximp] = impulse(H2);
  % Estimate impulse response
subplot(2,2,3)
plot(Ximp,Yimp,'b.-')
xlabel('Time [s]')
ylabel('Amplitude')
title('IMPULSE RESPONSE')
grid on

h(t) = ilaplace(H1)
  % Calculate impulse response formula

dc_gain = limit(H1,s,0)
   % Calculate DC gain of transfer function (NB: shall match H(s) in 1st graph
 for s=0)

lim0 = limit(s*H1,s,Inf)
   % Calculate transfer function initial value through limit in Laplace domain
 (NB: shall match h(t) forumla for t=0)

limInf = limit(s*H1,s,0)
    % Calculate transfer function final value through limit in Laplace domain
 (NB: shall match h(t) forumla for t=Inf)
```

```
h(t) =

exp(-t)*(cos(5^(1/2)*t) + (9*5^(1/2)*sin(5^(1/2)*t))/5)


dc_gain =

5/3


lim0 =

1


limInf =

0
```



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