2(e) Roots of the Standard Equation

Table of Contents

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code

```
clc;
zeta=1;
TF=tf([1],[1,(2*zeta),1])
sys = tf([1],[1,(2*zeta),1])
figure
subplot(2,3,1)
S = stepinfo(sys)
[z,p,k]= tf2zp([1],[1,(2*zeta),1])
zplane(z,p)

zeta=0.7 ;
TF=tf([1],[1,(2*zeta),1])
sys = tf([1],[1,(2*zeta),1])
subplot(2,3,2)
S = stepinfo(sys)
[z,p,k]= tf2zp([1],[1,(2*zeta),1])
zplane(z,p)

zeta=2;
TF=tf([1],[1,(2*zeta),1])
sys = tf([1],[1,(2*zeta),1])
subplot(2,3,3)
S = stepinfo(sys)
[z,p,k]= tf2zp([1],[1,(2*zeta),1])
zplane(z,p)

zeta=-1.85;
TF=tf([1],[1,(2*zeta),1])
sys = tf([1],[1,(2*zeta),1])
subplot(2,3,4)
S = stepinfo(sys)
[z,p,k]= tf2zp([1],[1,(2*zeta),1])
zplane(z,p)

zeta=-0.4;
TF=tf([1],[1,(2*zeta),1])
sys = tf([1],[1,(2*zeta),1])
subplot(2,3,5)
S = stepinfo(sys)
[z,p,k]= tf2zp([1],[1,(2*zeta),1])
```

```
zplane(z,p)

zeta=-2.45;
TF=tf([1],[1,(2*zeta),1])
sys = tf([1],[1,(2*zeta),1])
subplot(2,3,6)
S = stepinfo(sys)
[z,p,k]= tf2zp([1],[1,(2*zeta),1])
zplane(z,p)


TF =

        1
  -------------
  s^2 + 2 s + 1

Continuous-time transfer function.


sys =

        1
  -------------
  s^2 + 2 s + 1

Continuous-time transfer function.


S =

  struct with fields:

        RiseTime: 3.3579
    SettlingTime: 5.8339
     SettlingMin: 0.9000
     SettlingMax: 0.9994
       Overshoot: 0
      Undershoot: 0
            Peak: 0.9994
        PeakTime: 9.7900


z =

  0×1 empty double column vector


p =

    -1
    -1
```

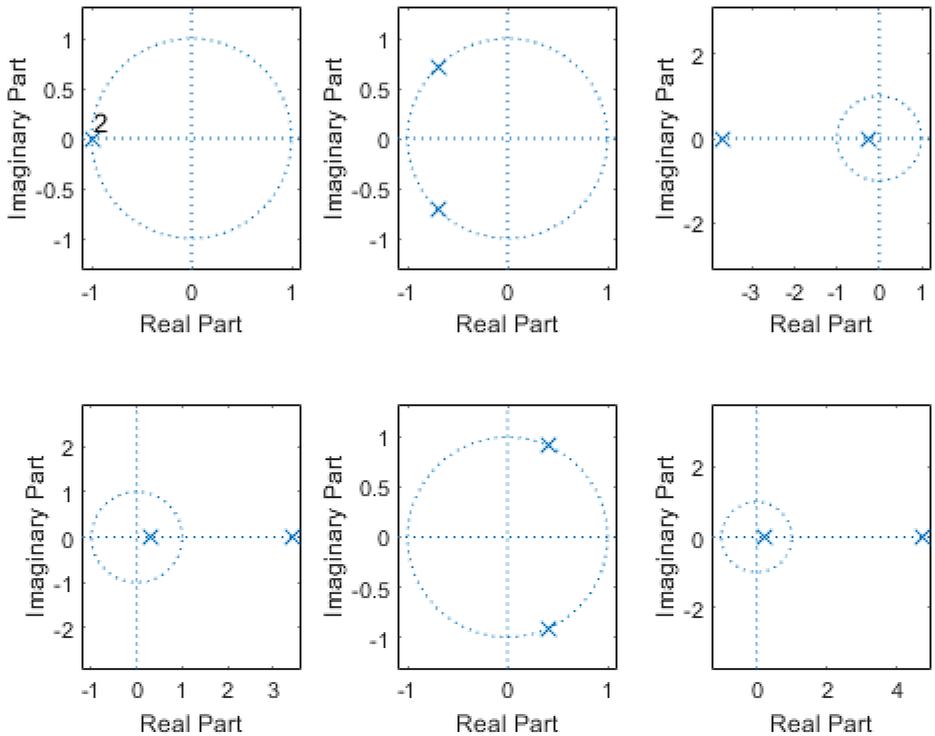
```
k =

     1


TF =

         1
  ---------------
  s^2 + 1.4 s + 1

Continuous-time transfer function.


sys =

         1
  ---------------
  s^2 + 1.4 s + 1

Continuous-time transfer function.


S =

  struct with fields:

        RiseTime: 2.1268
    SettlingTime: 5.9789
     SettlingMin: 0.9001
     SettlingMax: 1.0460
       Overshoot: 4.5986
      Undershoot: 0
            Peak: 1.0460
        PeakTime: 4.4078


z =

  0×1 empty double column vector


p =

  -0.7000 + 0.7141i
  -0.7000 - 0.7141i


k =

     1


TF =
```

```
        1
  -------------
  s^2 + 4 s + 1

Continuous-time transfer function.


sys =

        1
  -------------
  s^2 + 4 s + 1

Continuous-time transfer function.


S =

  struct with fields:

        RiseTime: 8.2308
    SettlingTime: 14.8789
     SettlingMin: 0.9017
     SettlingMax: 0.9993
       Overshoot: 0
      Undershoot: 0
            Peak: 0.9993
        PeakTime: 27.3269


z =

  0×1 empty double column vector


p =

   -3.7321
   -0.2679


k =

     1


TF =

         1
  ---------------
  s^2 - 3.7 s + 1

Continuous-time transfer function.
```

```
sys =

         1
  ---------------
  s^2 - 3.7 s + 1

Continuous-time transfer function.


S =

  struct with fields:

        RiseTime: NaN
    SettlingTime: NaN
     SettlingMin: NaN
     SettlingMax: NaN
       Overshoot: NaN
      Undershoot: NaN
            Peak: Inf
        PeakTime: Inf


z =

  0×1 empty double column vector


p =

    3.4064
    0.2936


k =

     1


TF =

         1
  ---------------
  s^2 - 0.8 s + 1

Continuous-time transfer function.


sys =

         1
  ---------------
```

```
  s^2 - 0.8 s + 1

Continuous-time transfer function.


S =

  struct with fields:

        RiseTime: NaN
    SettlingTime: NaN
     SettlingMin: NaN
     SettlingMax: NaN
       Overshoot: NaN
      Undershoot: NaN
            Peak: Inf
        PeakTime: Inf


z =

  0×1 empty double column vector


p =

   0.4000 + 0.9165i
   0.4000 - 0.9165i


k =

     1


TF =

         1
  ---------------
  s^2 - 4.9 s + 1

Continuous-time transfer function.


sys =

         1
  ---------------
  s^2 - 4.9 s + 1

Continuous-time transfer function.


S =
```

```
  struct with fields:

        RiseTime: NaN
    SettlingTime: NaN
     SettlingMin: NaN
     SettlingMax: NaN
       Overshoot: NaN
      Undershoot: NaN
            Peak: Inf
        PeakTime: Inf


z =

  0×1 empty double column vector


p =

    4.6866
    0.2134


k =

     1
```



Comparison Analysis:

1st value lise on negative x axis means: Critically-damped case & stable 2nd value lise in 2nd & 3rd quadrant means: Under-damp case & stable 3rd value lise on negative x axis means: Overdamped case & stable 4th value lise on positive x axis means: unstable 5th value lise on 1st & 4th quadrant means: unstable 6th value lise on positive x axis means: unstable

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