801400805441 Kendinden Ayarlamalı Kontrol Sistemleri [1-5]

Kesikli zaman modellerinin geliştirilmesi, blok diyagramlar ile uygulamalar,

Matlab uygulamaları [1-5]

Kaynaklar

[1] Wellstead P. E., Zarrop M.B., 1991, Self-Tuning Systems, Control and Signal Processing, John-Wiley and Sons.

[2] Coughanowr D., LeBlanc S., 2009, Process Systems Analysis and Control, McGraw-Hill

[3] Bequette B.W., 2008, Process Control Modelling; Design and Simulation, Prentice-Hall

[4] Seborg D.E., Mellichamp D. A., Edgar T.F, Doyle F.J., 2011, Process Dynamics and Control , John Wiley and Sons

[5] Stephanopoulos G., 1984, Chemical Process Control : an introduction to theory and practice, Prentice-Hall

Aşağıda verilen sistem modeline birim basamak etki verildiğinde ayrık veya kesikli y cevabını bulmak için Matlab ortamında filter komutu uygulanır

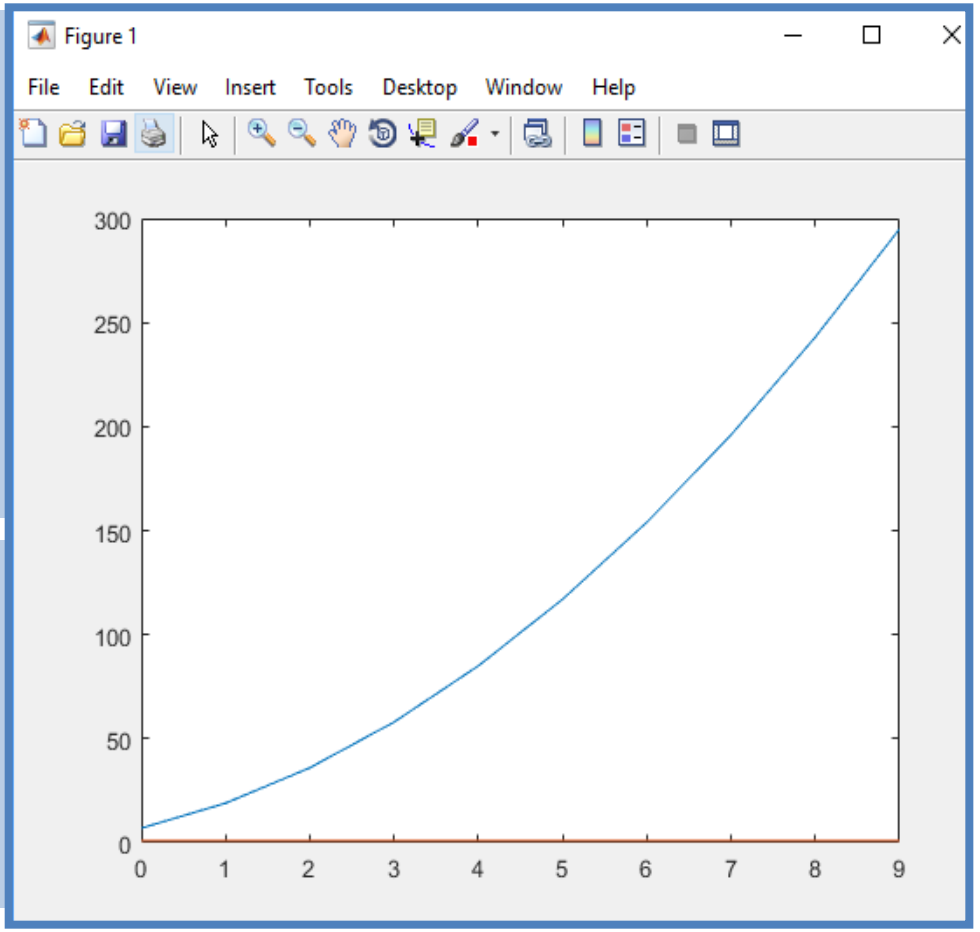
$$\frac{y(z)}{u(z)} = \frac{-2z^{-1}+7}{(1-z^{-1})^2} = \frac{7-2z^{-1}}{1-2z^{-1}+z^{-2}}$$

```
>> U=ones(1,10)

U =

     1     1     1     1     1     1     1     1     1     1
```

```
>> pay=[7 -2]

pay =

     7    -2

>> payda=[1 -2 1];
```

```
>> y=filter(pay,payda,U)

y =

    7    19    36    58    85   117   154   196   243   295

>> k=0:1:9

k =

 0    1    2    3    4    5    6    7    8    9
```

```
>> plot(k,y)

>> hold on

>> plot(k,U)

>> hold off
```



Aynı sistem modeline U=10*k formunda ramp etki verildiğinde ayrık veya kesikli y cevabını bulmak için Matlab ortamında filter komutu aşağıdaki şekilde uygulanır.

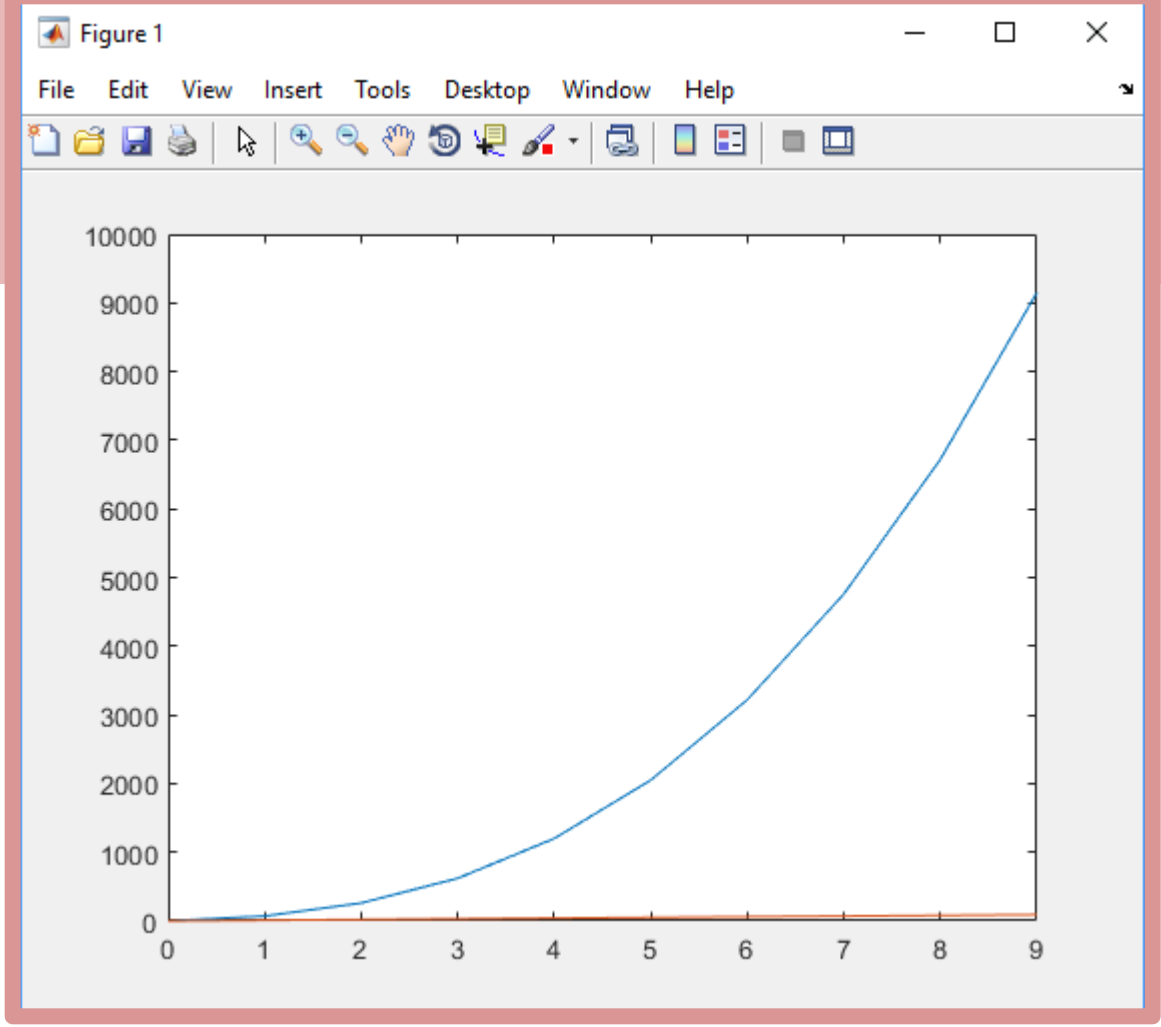
```
>> T=10;

>> k=0:1:9;

>> U=k*T;
```

⇨

```
>> pay=[7 -2];

>> payda=[1 -2 1];

>> y=filter(pay,payda,U)
```

⇨

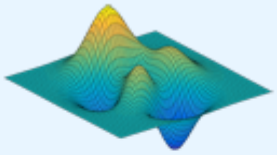
```
y =

     0     70    260    620   1200   2050   3220   4760   6720   9150

>> plot(k,y)

>> hold on

>> plot(k,U)

>> hold off
```



Aynı sistem modeline "impulse"(Kronecker delta) etki verildiğinde ayrık veya kesikli y cevabını bulmak için Matlab ortamında filter komutu aşağıdaki şekilde uygulanır.

Command Window

New to MATLAB? See resources for Getting Started.

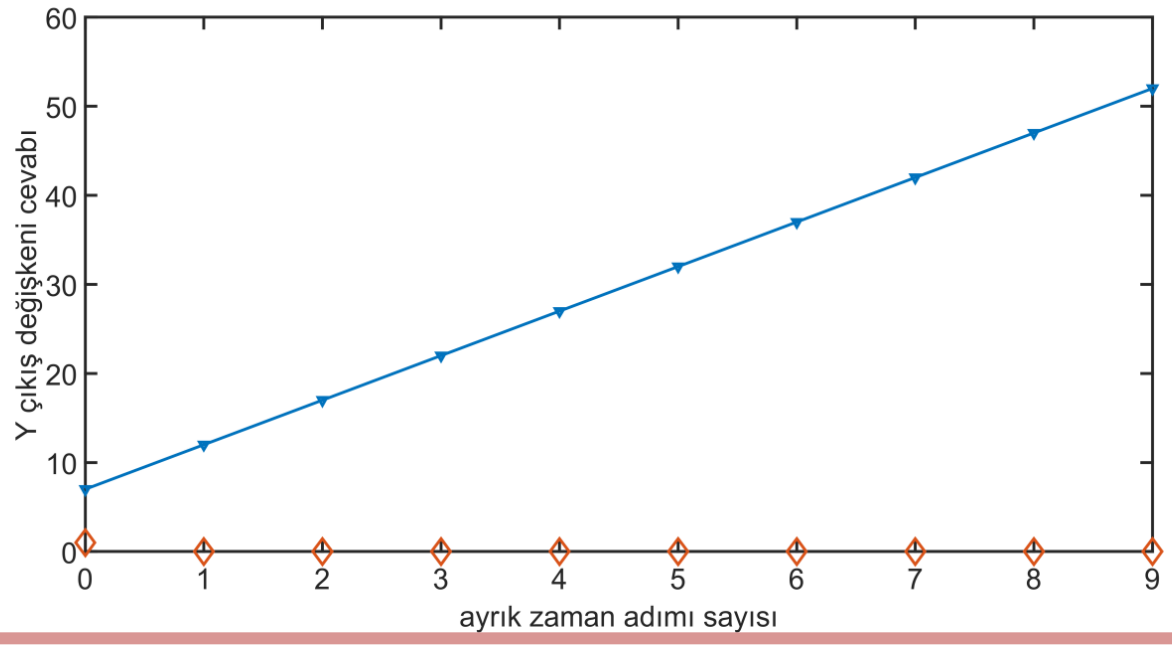


New MATLAB Graphics System

MATLAB R2014b introduces a new MATLAB graphics system, with new
many new features. Some existing code may need to be revised to work

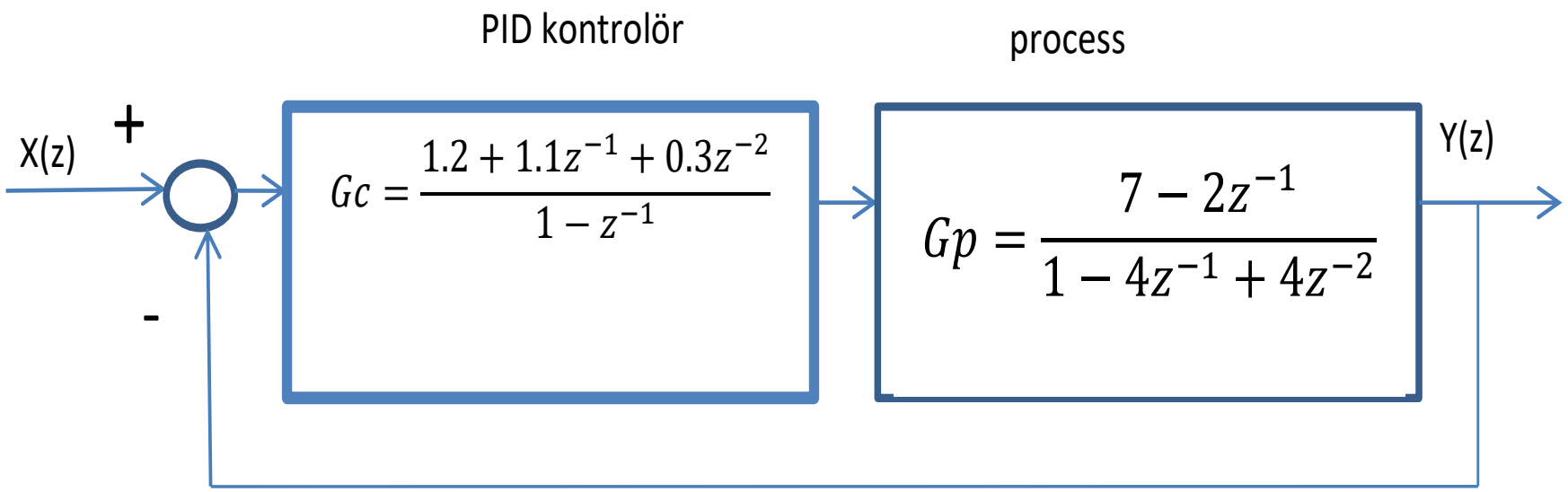
Learn more

```
>> k=0:1:9;
>> U=[1 zeros(1,9)];
>> pay=[7 -2];
>> payda=[1 -2 1];
>> y=filter(pay,payda,U)

y =

     7    12    17    22    27    32    37    42    47    52

>> plot(k,y)
>> hold on
>> plot(k,U)
>> hold off
>>
```



Aşağıda kesikli zaman transfer fonksiyonu verilen sistemin geri beslemeli kontrolü

$$\frac{y(z)}{u(z)} = \frac{-2z^{-1}+7}{(1-2z^{-1})^2} = \frac{7-2z^{-1}}{1-4z^{-1}+4z^{-2}}$$



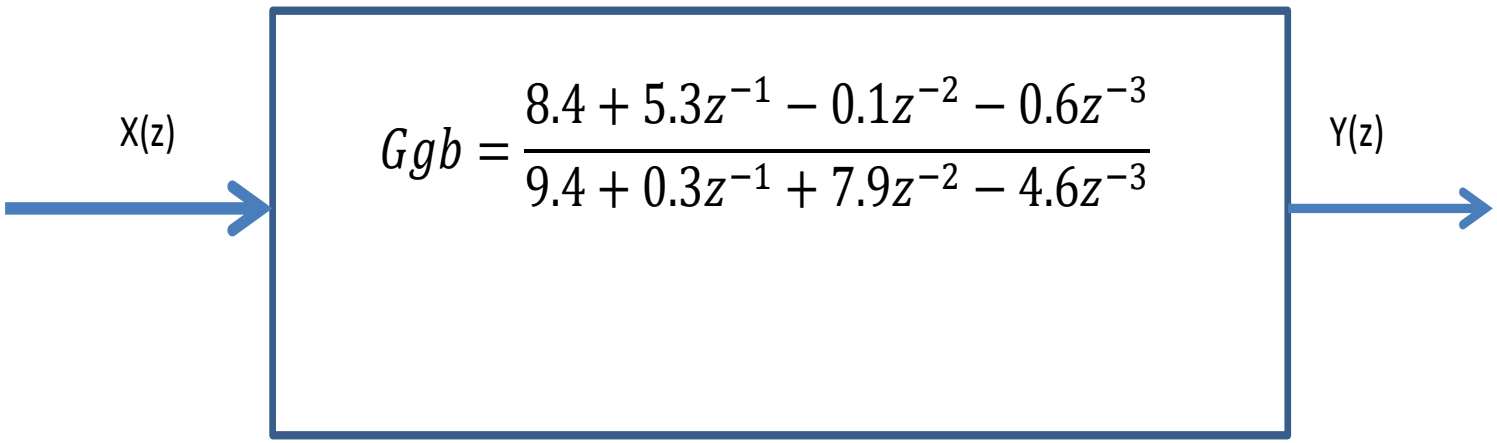

```
>> Ts=1

>>Ts =

    1

>> Gc=tf([1.2 1.1 0.3],[1 -1],Ts)
```

```
Gc =

  1.2 z^2 + 1.1 z + 0.3
  ---------------------
        z - 1

Sample time: 1 seconds

Discrete-time transfer function.
```

```
>> Gp=tf([7 -2],[1 -4 4],Ts)

Gp =

    7 z - 2
  ------------
  z^2 - 4 z + 4

Sample time: 1 seconds

Discrete-time transfer function.
```

```
>> Gol=series(Gc,Gp)

Gol =

  8.4 z^3 + 5.3 z^2 - 0.1 z - 0.6
  -------------------------------
      z^3 - 5 z^2 + 8 z - 4

Sample time: 1 seconds

Discrete-time transfer function.
```

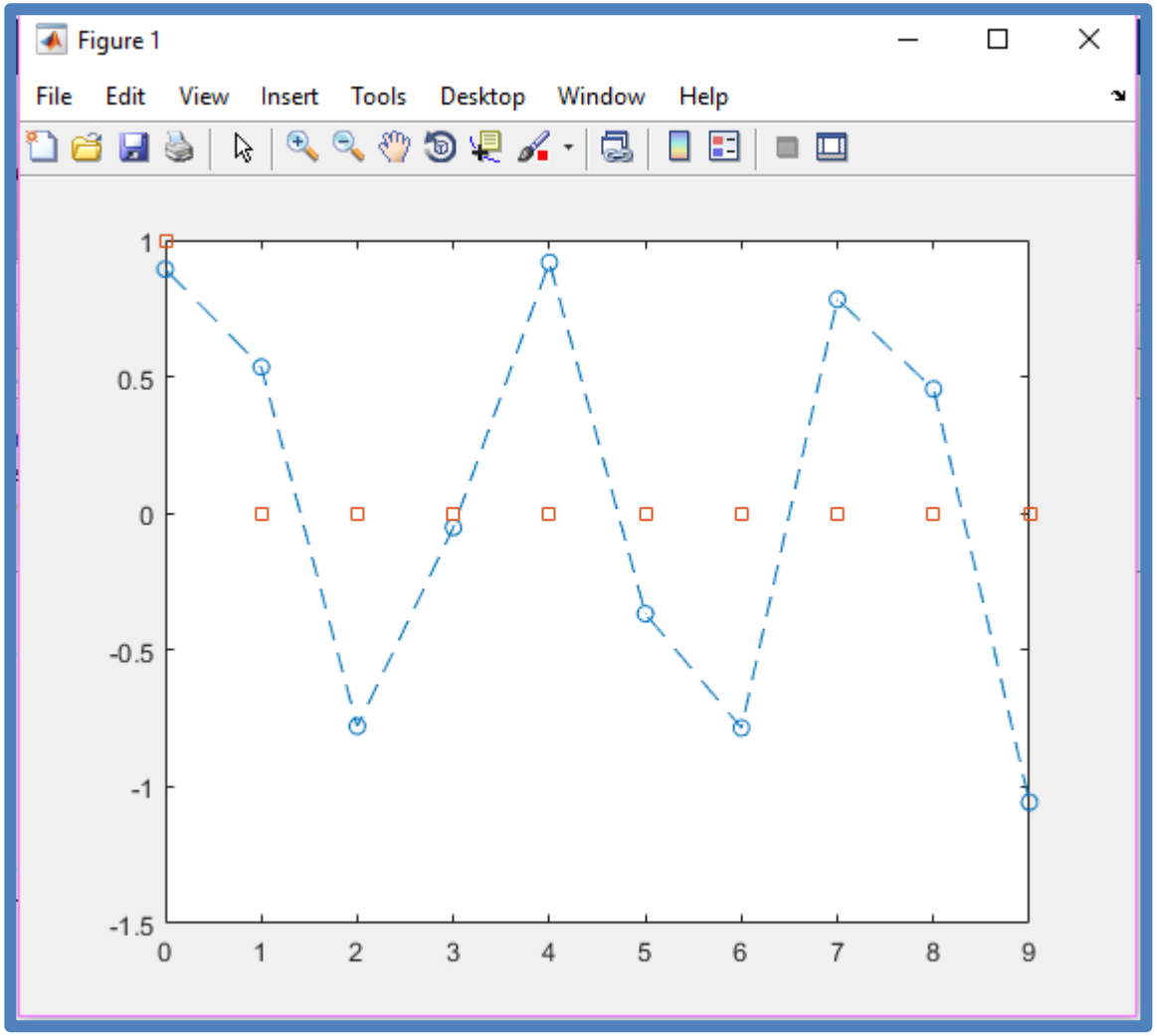
```
>> Ggb=feedback(Gol, tf([1],[1]), -1)

Ggb =

  8.4 z^3 + 5.3 z^2 - 0.1 z - 0.6
  -------------------------------
  9.4 z^3 + 0.3 z^2 + 7.9 z - 4.6

Sample time: 1 seconds

Discrete-time transfer function.
```



Negatif geri besleme ile oluşturulan kapalı hat transfer fonksiyonu blok diyagramında verildiği şekilde elde edilmiştir.

Bu geri beslemeli proses kontrol sistemine birim “impulse” (Kronecker delta) giriş değişkeni etkisi vererek sistem çıkış değişkeni cevabını kesikli zaman adımı sayısına göre elde edelim.

```
>> x=[1 zeros(1,9)];
>> pay=[8.4 5.3 -0.1 -0.6];
>> payda=[9.4 0.3 7.9 -4.6];
>> y=filter(pay,payda,x);
>> k=0:9;
>> plot(k,y,'o--')
>> hold on
>> plot(k,x,'square')
>> hold off
>> clear all
>> clc
```



Bu geri beslemeli proses kontrol sistemine cevap kararsız gibi görünüyor geri beslemeli sistemin kararlılığını inceleyelim.

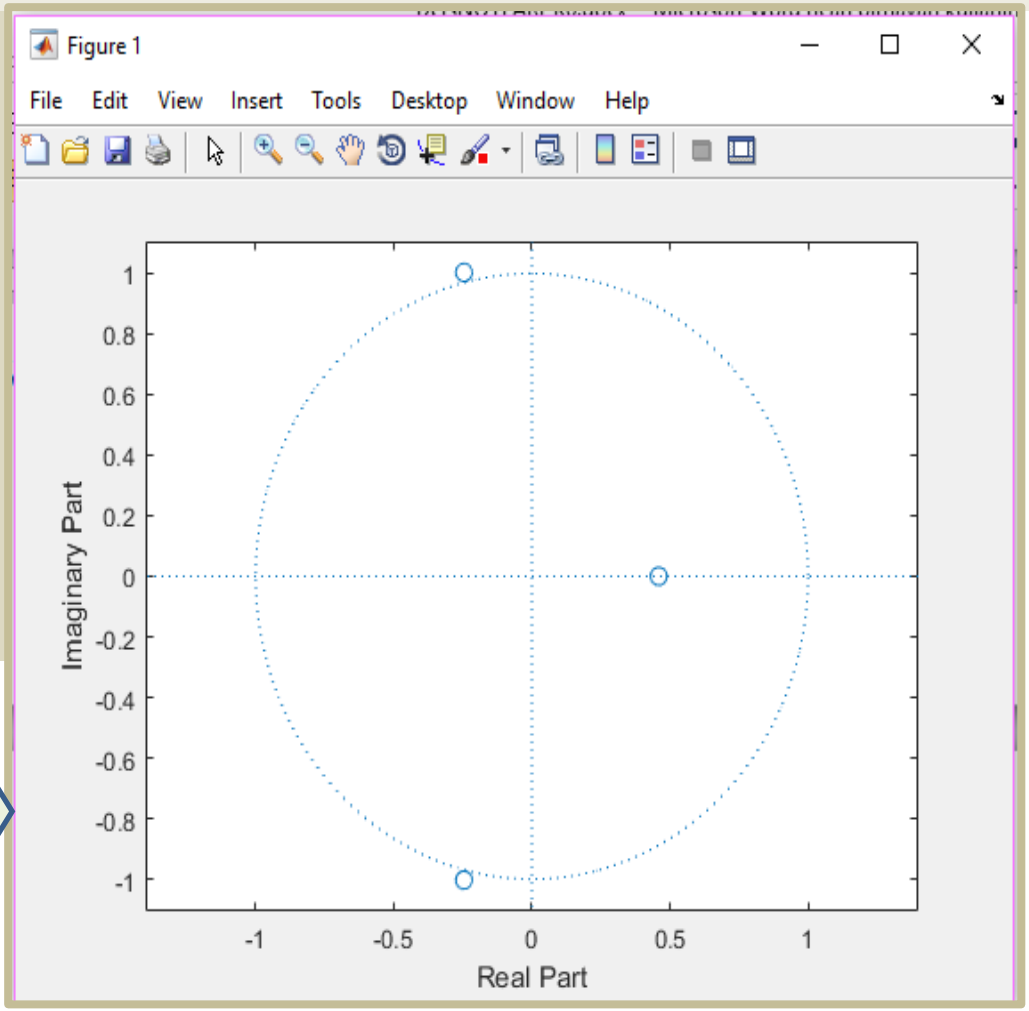
$$Ggb = \frac{y(z)}{x(z)} = \frac{8.4 + 5.3z^{-1} - 0.1z^{-2} - 0.6z^{-3}}{9.4 + 0.3z^{-1} + 7.9z^{-2} - 4.6z^{-3}}$$

Önce kararlılık incelemesi yapalım:

```
>> pd=[9.4 0.3 7.9 -4.6];

>> roots(pd)

ans =

  -0.2455 + 1.0028i

  -0.2455 - 1.0028i

   0.4591 + 0.0000i
```

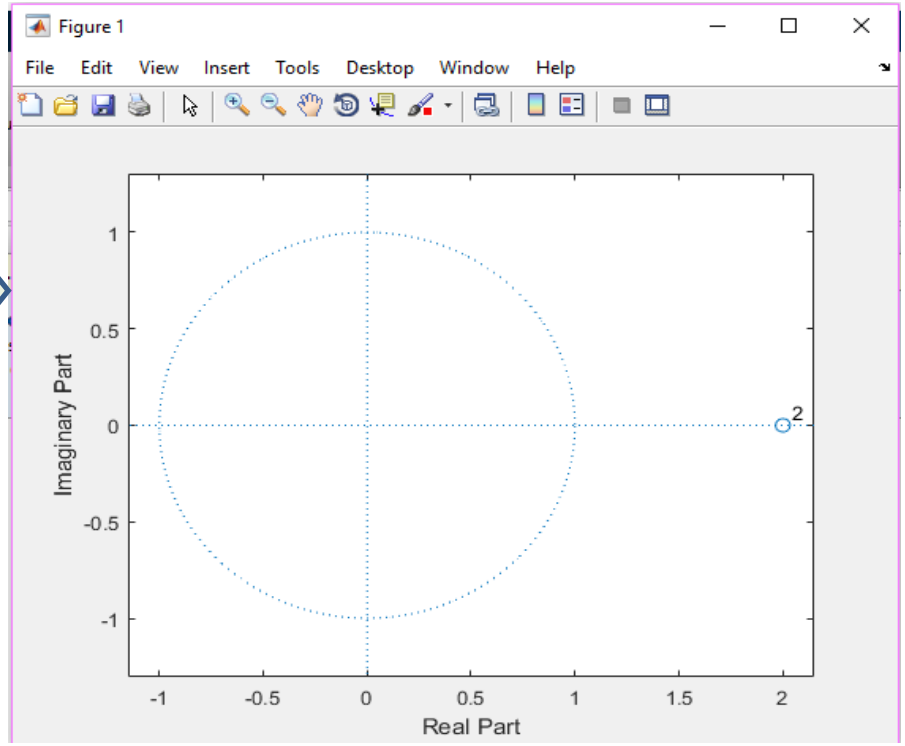
```
>> zplane(ans)
```

Karar: geri beslemeli sistem kararsız yapıda kontrol ayar parametreleri değiştirilmelidir.

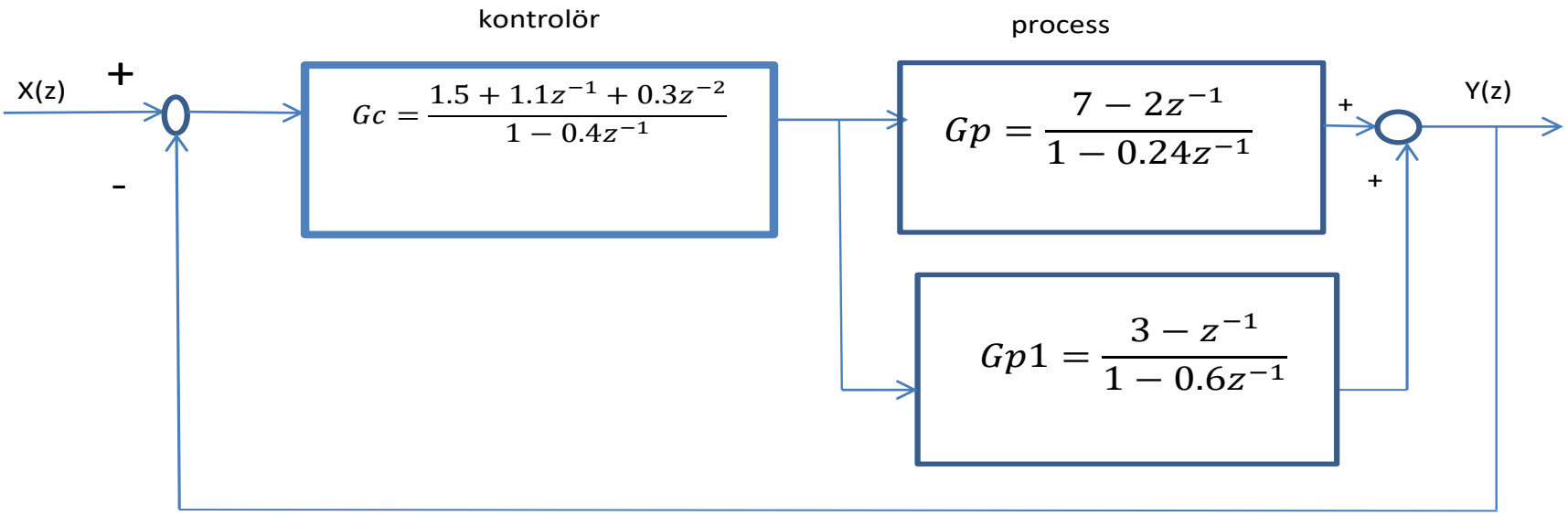


```
>> p=[1 -4 4];

>> roots(p)

ans =

    2

    2
```

Proses kontrolörsüz olarak kararsız.



blok diyagramı verilen geri beslemeli proses kontrol sisteminin transfer fonksiyonu :



```
>> Ts=1

Ts =

     1

>> Gc=tf([1.5 1.1 0.3],[1 -0.4],Ts)

Gc =

  1.5 z^2 + 1.1 z + 0.3
  ---------------------
        z - 0.4

Sample time: 1 seconds

Discrete-time transfer function.
```

```
>> Gp=tf([7 -2],[1 -0.24],Ts)

Gp =

  7 z - 2
  -------
  z - 0.24

Sample time: 1 seconds

Discrete-time transfer function.
```

```
>> Gp1=tf([3 -1],[1 -0.6],Ts)

Gp1 =

  3 z - 1
  -------
  z - 0.6

Sample time: 1 seconds

Discrete-time transfer function.
```

```
>> t=[1 -0.84 0.144];

>> roots(t)

ans =

    0.6000

    0.2400

(Gpall

Kararlı

yapıdadır)
```

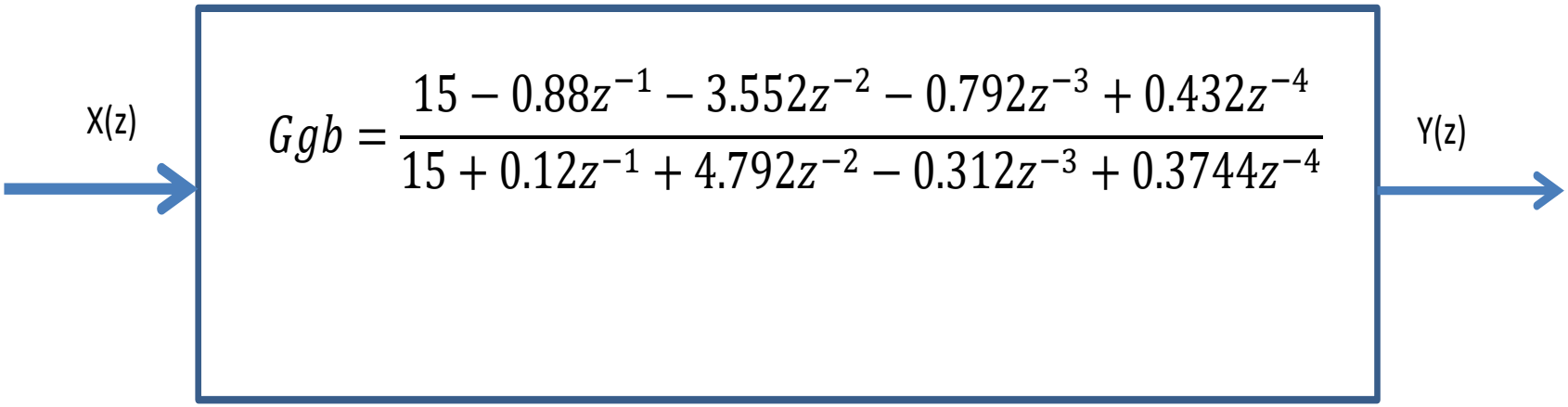
```
>> Gpall=parallel(Gp,Gp1)

Gpall =

  10 z^2 - 7.92 z + 1.44
  ----------------------
   z^2 - 0.84 z + 0.144

Sample time: 1 seconds

Discrete-time transfer function.
```

```
>> Gol=series(Gc,Gpall)

Gol =

  15 z^4 - 0.88 z^3 - 3.552 z^2 - 0.792 z + 0.432
  -----------------------------------------------
       z^3 - 1.24 z^2 + 0.48 z - 0.0576

Sample time: 1 seconds

Discrete-time transfer function.
```

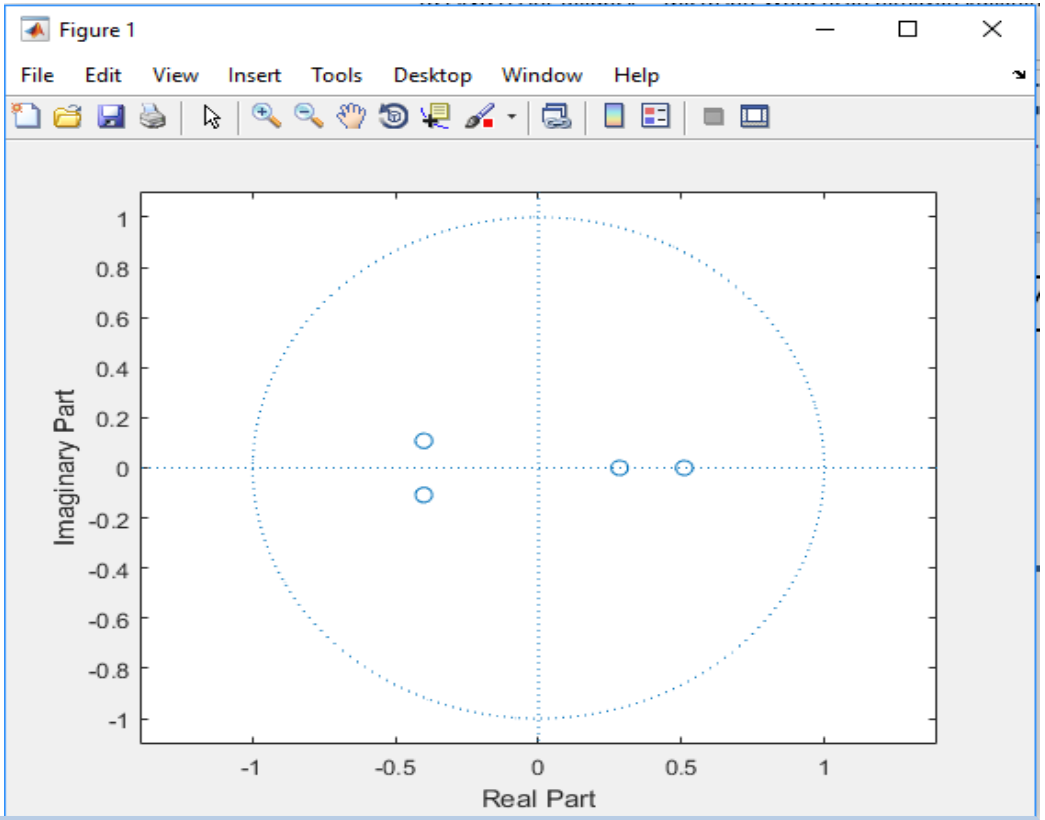
```
>> tt=[1 -1.24 0.48 -0.0576];

>> roots(tt)

ans =

   0.6000

   0.4000

   0.2400
```

(Gol kararlı yapıdadır)

```
>> Ggb=feedback(Gol,tf([1],[1]), -1)

Ggb =

  15 z^4 - 0.88 z^3 - 3.552 z^2 - 0.792 z + 0.432
  ----------------------------------------------
  15 z^4 + 0.12 z^3 - 4.792 z^2 - 0.312 z + 0.3744

Sample time: 1 seconds

Discrete-time transfer function.
```



```
>> pd=[15 0.12 -4.792 -0.312 0.3744];
>> roots(pd)
ans =
  -0.4010 + 0.1080i
  -0.4010 - 0.1080i
   0.5101 + 0.0000i
   0.2838 + 0.0000i
>> zplane(ans)
```



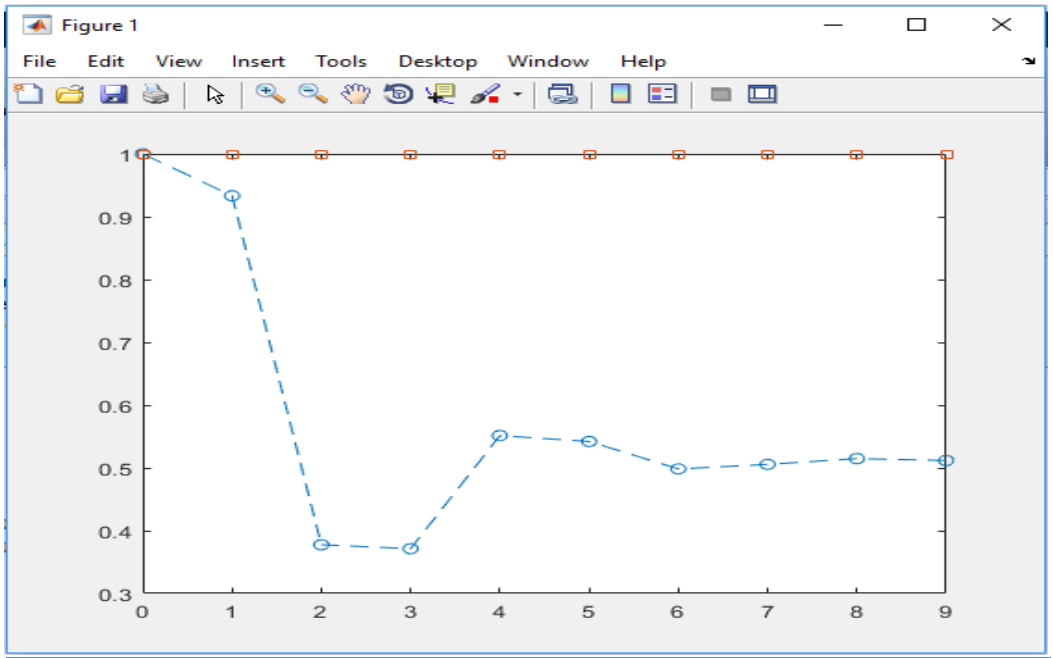
Karar: geri beslemeli sistem kullanılan kontrolör ayar parametreleri ile kararlı yapıdadır.

Bu geri beslemeli proses kontrol sistemine birim “Birim basamak” giriş değişkeni etkisi vererek sistem çıkış değişkeni cevabını kesikli zaman adımı sayısına göre elde edelim.

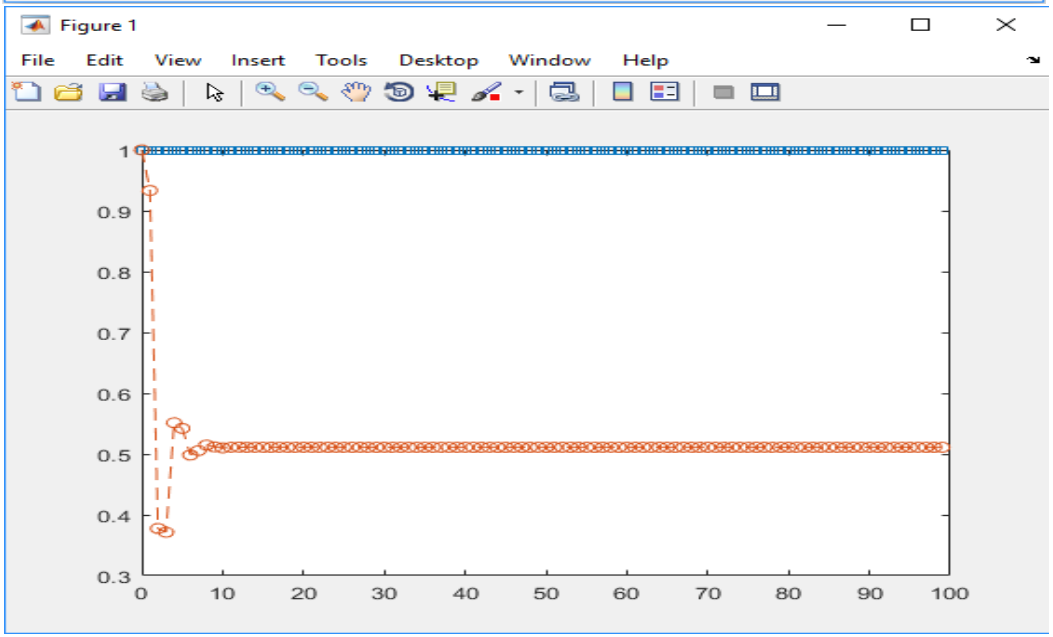
```
>> x=[1 ones(1,9)]
x =
     1     1     1     1     1     1     1     1     1     1
```

```
>> pay=[15 -0.88 -3.552 -0.792 0.432];
>> payda=[15 0.12 4.792 -0.312 0.3744];
>> y=filter(pay,payda,x);
```

```
>> k=0:9;
>> plot(k,y,'o--')
>> hold on
>> plot(k,x,'square')
>> hold off
```




```
>> x=[1 ones(1,99)];
>> y=filter(pay,payda,x);
>> k=0:99;
>> plot(k,x,'square')
>> hold on
>> plot(k,y,'o--')
>> hold off
```



Kararlı geri beslemeli kontrol sistemi çıkış değişkeni cevabı görülmektedir.