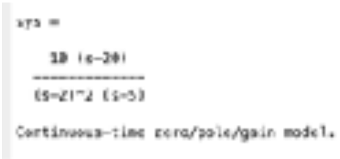
控工matlab指令

建立轉移函數

1.sys1=tf(num,den)

2.sys2=zpk(零點,極點,增益)



3.sysp=parallel(sys1,sys2)
4.syss=series(sys1,sys2)

*5.加了負回授的閉迴路轉移函數sysf=feedback(G,H,-1)

6.畫響應圖一定要記得t=1:0.1:10

7.輸入脈衝函數[yimpulse,t]=impulse(sys, t);

8.輸入步階函數[ystep,t]=step(sys, t);

*9.畫響應圖plot(x軸代表時間,y軸是magnitude)

10.記得打title(‘ ‘)，xlabel(‘ ‘)，ylabel(‘ ‘)，grid on，legend可以加註解，有需要的話text(x,y,’ ‘)可以在座標加說明

11.simulink需要的元件去continuous（轉移函數）,Math operations（回授的sum跟增益）,sinks（畫出圖的scope）,source（step輸入）找

二階系統的暫態響應

*12.求自然頻率omega_n=sqrt(den(3))

*13.求阻尼zeta=den(2)/(2*omega_n)

14.記得先給一個大概50的值設為m要設時間用的

**15.要討論zeta是否大於1，設一個if如果有符合再進去迴圈，不是大於1就直接令t1=0

16.elseif若是最大值就break

17.卷積用法是兩個多項式相乘conv([ ],[ ])

18.rlocus的題目要從圖找增益(K)

穩態分析（畫一堆圖）

**19.bode(num,den,omega)可以求相位＆大小

20.margin(sys)可以在圖上顯示gm,pm,wcp,wcg
21.[gm,pm,wcp,wcg]=margin(mag, phase, omega)
22.w=logspace(-1,1,100)切割頻率w

23.在log空間下畫圖semilogx(w,20*log10(mag))

24.在log空間下畫圖semilogx(phase)

*25.nyquist(num,den,w)畫出實軸虛軸plot(reapart,imagepart)

26.切割另外的頻率w2=linspace(0,2*pi,100)

27.axis([限制的範圍])

**28.畫根軌跡圖rlocus(num,den)或rlocus(sys)

29.rlocus的格線要用sgrid來叫而且不能加on

閉迴路系統重要的指令比較

3.sysf=feedback(G,H,正負回授)
3.[num1,den1]=cloop(num,den,-1)
實驗練習1_2

```
num = 1;
```

```
den = [1 1];
sys1 = tf(num,den)
```

$sys1 = \frac{1}{s+1}$

```
z = 20;
p = [2 2 5];
sys2 = zpk(z,p,1)
```

$sys2 = \frac{(s-20)}{(s-2)^2(s-5)}$

```
sysp = parallel(sys1,sys2);
syss = series(sys1,sys2);
sysf = feedback(sys1,1,-1)
```

$sysf = \frac{1}{s+2}$

```
[num_all,den_all] = tfdata(sysf,'v')
[z,p,k] = zpkdata(sysf,'v')

get(sys1);
```

實驗練習1_3

```
num = 1;
den = [1 1];
sys1 = tf(num,den);

t = 0:0.1:20;

[y_impulse,t] = impulse(sys1,t);
[y_step,t] = step(sys1,t);

figure();
grid on;

subplot(211);
plot(t,y_impulse,'b-X');%線的樣式（'顏色線條點'）
title('Impulse Response');
xlabel('Time(sec)');
ylabel('Magnitude');
text(3.9,0.02,'stable point');
legend('Impulse');
```

```
subplot(212);
plot(t,y_step,'k:*');%線的樣式
title('Step Response');
xlabel('Time(sec)');
ylabel('Magnitude');
text(3.9,0.97,'stable point');
legend('Step');
hold on;%直接加在最後就好
```

實驗練習1_4

```
num = 1;
den = [1 -2 1];
sys1 = tf(num,den);

z = [1 1];
p = [-3 -1 -1 -2];
sys2 = zpk(z,p,12);
```

$$\frac{12(s-1)^2}{(s+3)(s+1)^2(s+2)}$$

```
syss = series(sys1,sys2);
sysf = feedback(syss,1,-1);
u = sysf/sys2;%求某個輸出響應就要這樣

t = 0:0.1:30;

[y_step,t] = step(sysf,t);
[u_step,t] = step(u,t);

figure();
grid on;

subplot(211);
plot(t,y_step,'k:*');
title('Step Response Plot');
xlabel('Time(sec)');
ylabel('Magnitude');
text(0,0,'(0,0)');
legend('Step Response');
```

```
subplot(212);
plot(t,u_step,'r--o');
title('Step Response for u Plot');
xlabel('Time(sec)');
ylabel('Magnitude');
text(0,0,'(0,0)');
legend('Step Response for u');
hold on;
```

例題2-1

```
m = 50;
num = 0.2;
den = [1 0.25 0.2];
sys = tf(num,den);

omega_n = sqrt(den(3))
zeta = den(2)/(2*omega_n)
p_overshoot = (exp((-pi*zeta)/sqrt(1-zeta^2)))*100
Ts = 4/(omega_n*zeta)
Tp = pi/(omega_n*sqrt(1-zeta^2))
```

$$\%OS = e^{-\pi\zeta/\sqrt{1-\zeta^2}} \times 100$$

$$T_s = \frac{4}{\omega_n \cdot \zeta}$$

$$T_p = \frac{\pi}{\omega_n\sqrt{1-\zeta^2}}$$

```
t = 0:0.1:m;
[y_out,t] = step(sys,t);
max_y = max(y_out);
y_ss = polyval(num,0)/polyval(den,0);
```

y- steady state $= \dfrac{\text{polyval(num,0)}}{\text{polyval(den,0)}}$

```
%overdamped
if zeta>1
    for i = 1:m/0.1+1
        if y_out(i)<0.1*y_ss
            t1 = t(i);
        elseif y_out(i) == max_y
            break;
        end
    end
    for i = 1:m/0.1+1
```

第幾個輸出

1

```
        if y_out(i)<0.9*y_ss
            t2 = t(i);
        elseif y_out(i) == max_y
            break
        end
    end
end

t1 = 0;

for i = 1:m/0.1+1
    if y_out(i)<1.0*y_ss
        t2 = t(i);
    elseif y_out == max_y
        break;
    end
end

Tr = t2-t1

figure()
grid on;
plot(t,y_out,'c:*');
title('Step Response Plot');
xlabel('Time(sec)');
ylabel('Magnitude');
legend('step response');
text(0,0,'(0,0)');
hold on;
```

練習2-1

```
for K = 2.8615:0.00001:5
    num = K;
    den = [1 2 K];
    sys = tf(num,den);
    m = 20;
    t = 0:0.1:m;
```

```
omega_n = sqrt(den(3));
zeta = den(2)/(2*omega_n);
pos = (exp(-pi*zeta/sqrt(1-zeta^2)))*100;
Ts = 4/(zeta*omega_n);
Tp = pi/(omega_n*sqrt(1-zeta^2));
[y_out,t] = step(sys,t);
max_y = max(y_out);
yss = polyval(num,0)/polyval(den,0);

if 9.9 <= pos && pos <= 10.0 && 3.7 <= Ts && Ts <= 4.0
    if zeta>1
        for i = 1:m/0.1+1
            if y_out(i)<0.1*yss
                t01 = t(i);
            elseif y_out(i) == max_y
                break;
            end
        end
        for i = 1:m/0.1+1
            if y_out(i)<0.9*yss
                t2 = t(i);
            elseif y_out(i) == max_y
                break;
            end
        end
    end

    t1 = 0;
    for i =1:m/0.1+1
        if y_out(i)<1.0*yss
            t2 = t(i);
        elseif y_out(i) == max_y
            break;
        end
    end
    Tr = t2-t1;
```

```
        K
        pos
        Ts
    end
end
```

練習2-2

```
num = [1 3 3];
den = conv([1 1 0 0],[1 30 200]);
sys = tf(num,den);
rlocus(sys);
grid on;
%k=gain=613
```

例題3-1

```
num = 1;
den = poly([0 -1 -2]);%三次多項式
sys = tf(num,den);
[Gm,Pm,Wcp,Wcg] = margin(sys);
w = logspace(-1,1,100);
[mag,phase] = bode(num,den,w);
figure();
subplot(211);
semilogx(w,20*log10(mag));
title('Bode diagram for open loop system');
xlabel('Frequency(rad/sec)');
ylabel('Magnitude(db)');
grid on;

subplot(212);
semilogx(w,phase);
xlabel('Frequency(rad/sec)');
ylabel('Phase(degree)');
grid on;
```

例題3-2

```
num = 1;
den = poly([0 -1 -2]);%三次多項式
sys = tf(num,den);

figure();
w2 = linspace(0,2*pi,100);
ejw = exp(1i*w2);
r1 = real(ejw);
i1 = imag(ejw);
[r,i] = nyquist(num,den,w);
plot(r1,i1,r,i);
axis([-1,1,-1,1]);
grid on;
title('Nyquist diagram');
xlabel('Real Axes');
ylabel('Imaginary Axes');
```

例題3-3

```
num = 1;
den = poly([0 -1 -2]);%三次多項式
sys = tf(num,den);
[num2,den2] = cloop(num,den,1);
sys2= tf(num2,den2);
figure();
subplot(211);
w = logspace(-1,1,100);
[mag2,phase2] = bode(num2,den2,w);
semilogx(w,20*log10(mag2));
title('Bode diagram for closed loop system');
xlabel('Frequency(rad/sec)');
ylabel('Magnitude(db)');
grid on;

subplot(212);
rlocus(num,den);
sgrid;
```

```
title('Root Locus diagram');
xlabel('Real Axes');
ylabel('Imaginary Axes');
```

例題3-4

```
num = 1;
den = poly([0 -1 -2]);%三次多項式
sys = tf(num,den);
rangek = [0.25 0.4 1 1.5 2];
character = ['r' 'g' 'b' 'm' 'x'];
t = [0:0.2:20];
figure();
hold on;

for loop = 1:5
    [ntc,dtc] = cloop(num*rangek(loop),den,-1);
    sys = tf(ntc,dtc);
    y = step(sys,t);
    plot(t,y,character(loop));
    title('Step Response');
    xlabel('Time(sec)');
    ylabel('Amplitude');
    grid on;
end
```

練習3-1

```
a = 25;
b = 3.6;
kp = 400/a;
kd = (2*0.707*20-3.6)/25;
num = [a*kd a*kp];
den = [1 (b+a*kd) a*kp];
sys = tf(num,den);
figure();

subplot(311);
t = 0:0.01:1;
```

```
[y_out,t] = step(sys,t);
plot(t,y_out,'k:o');
title('Step Response plot');
xlabel('Time(sec)');
ylabel('Amplitude');
legend('step response');
text(0,0,'(0,0)');
grid on;

subplot(312);
w = logspace(-1,1,100);
[mag,phase] = bode(num,den,w);
semilogx(w,20*log10(mag));
title('Bode diagram for closed loop system');
xlabel('Frequency(rad/sec)');
ylabel('Magnitude(db)');
grid on;

subplot(313);
semilogx(w,phase);
xlabel('Frequency(rad/sec)');
ylabel('Phase(degree)');
grid on;
```

練習3-2

```
figure(1);
t = 0:0.01:2;
%open loop
num = 40;
den = conv([1 0],[1 2]);
syso = tf(num,den);
[y_open,t] = step(syso,t);

subplot(321);
plot(t,y_open,'b-*');
title('Step Response for open loop');
xlabel('Time(sec)');
```

```
ylabel('Amplitude');
grid on;

subplot(323);
w = logspace(-1,1,100);
[mag,phase] = bode(num,den,w);
semilogx(w,20*log10(mag));
title('Bode diagram for open loop');
xlabel('Frequency(rad/sec)');
ylabel('Magnitude(db)');
grid on;

subplot(325);
semilogx(w,phase);
xlabel('Frequency(rad/sec)');
ylabel('Phase(degree)');

%closed loop
[num1,den1] = cloop(num,den,1);
sysc = tf(num1,den1);
[y_closed,t] = step(sysc,t);

subplot(322);
plot(t,y_closed);
title('Step Response for closed loop');
xlabel('Time(sec)');
ylabel('Amplitude');
grid on;

subplot(324);
[mag1,phase1] = bode(num1,den1,w);
semilogx(w,20*log10(mag1));
title('Bode diagram for closed loop');
xlabel('Frequency(rad/sec)');
ylabel('Magnitude(db)');
grid on;
```

```
subplot(326);
semilogx(w,phase1);
xlabel('Frequency(rad/sec)');
ylabel('Phase(degree)');

figure(2);
rlocus(num,den);
sgrid;
title('Root Locus diagram');
xlabel('Real Axes');
ylabel('Imaginary Axes');

figure(3);
w2 = linspace(0,2*pi,100);
ejw = exp(1i*w2);
r1 = real(ejw);
i1 = imag(ejw);
[r,i] = nyquist(num,den,w);
plot(r1,i1,r,i);
axis([-1,1,-1,1]);
title('Nyquist diagram');
xlabel('Real Axes');
ylabel('Imaginary Axes');
grid on;

figure(4);
subplot(211)
g = tf(num,den);
bode(g);
margin(g);

subplot(212);
g1 = tf([1 1],[1 2]);
g2 = series(g,g1);
bode(g2);
```

```
margin(g2);
```