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Title:Control System-First Order System: adding P,I,D controllers

```
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%Date:10/04/2021  
%Version:1.7
```

This Document has equation for motion differential system

```
%Equation:mdv/dt+bv=u
```

Math analysis

```
%dependent variables:v  
%independent variables:t,u  
%constant:m,b  
%Root:-b/m
```

Negative feedback

```
m1=1000;  
b1=5;  
Tau=m1/b1;  
CF=10;  
TF=CF*tf([0,1/b1],[Tau,1]);  
%S = stepinfo(TF)  
NCTF1=feedback(TF,1);  
subplot(3,2,1),plot(impz(NCTF1))  
title("Impulse with Negative Feedback")  
subplot(3,2,2),plot(step(NCTF1))  
title("Step with Negative Feedback")  
S1 = stepinfo(NCTF1)  
p1=pole(NCTF1)  
  
m1=1000;  
b1=5;  
Tau=m1/b1;  
CF=tf([0,1],[1,0]);
```

```

TF=CF*tf([0,1/b1],[Tau,1]);
NCTF2=feedback(TF,1);
subplot(3,2,3),plot(impz(NCTF2))
title("Impulse with integrator")
subplot(3,2,4),plot(step(NCTF2))
title("Step with integrator")
S2 = stepinfo(NCTF2)
p2=pole(NCTF2)
z2=zero(NCTF2)

m1=1000;
b1=5;
Tau=m1/b1;
CF=tf([1,0],[1]);
TF=CF*tf([0,1/b1],[Tau,1]);
T_R=4*Tau;
NCTF3=feedback(TF,1);
T_R=4*Tau;
subplot(3,2,5),plot(impz(NCTF3))
title("Impulse with diff")
subplot(3,2,6),plot(step(NCTF3))
title("Step with diff")
p3=pole(NCTF3)
S3 = stepinfo(NCTF3)

%%Analysis:
%1. Rise time of the system increases on adding the integrator.
%2. Rise time of the system decreases on adding the differentiator.
%3. settling time of the system increases on adding integrator system
    is
%taking some time to settle and operate.
%4. accuracy of system decreases on adding differentiator
%5. overshoot increase is greater on adding differentiator than
    integrator
%6. Peak increase is greater on adding integrator than differentiator
%7. all the poles of negative feedback present in left side of plane

S1 =

    struct with fields:

        RiseTime: 146.4671
        SettlingTime: 260.8050
        SettlingMin: 0.6030
        SettlingMax: 0.6666
        Overshoot: 0
        Undershoot: 0
        Peak: 0.6666
        PeakTime: 703.0560

p1 =

```

-0.0150

S2 =

struct with fields:

RiseTime: 35.0513
SettlingTime: 1.5129e+03
SettlingMin: 0.3925
SettlingMax: 1.7794
Overshoot: 77.9429
Undershoot: 0
Peak: 1.7794
PeakTime: 99.3459

p2 =

-0.0025 + 0.0315i
-0.0025 - 0.0315i

z2 =

0×1 empty double column vector

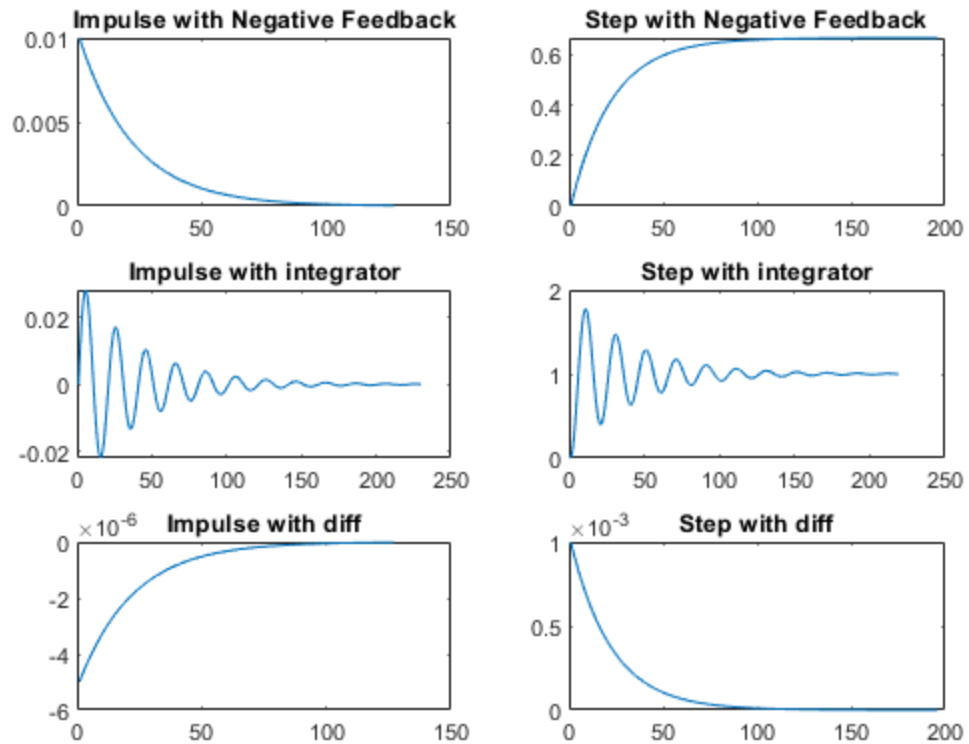
p3 =

-0.0050

S3 =

struct with fields:

RiseTime: 439.8407
SettlingTime: 783.1973
SettlingMin: 2.6276e-08
SettlingMax: 9.5404e-05
Overshoot: 4.6071e+17
Undershoot: 0
Peak: 9.9900e-04
PeakTime: 0



Positive feedback

```
figure
m1=1000;
b1=5;
Tau=m1/b1;
CF=10;
TF=CF*tf([0,1/b1],[Tau,1]);
%S = stepinfo(TF)
PCTF1=feedback(TF,-1);
subplot(3,2,1),plot(impz(PCTF1))
title("Impulse with Positive feedback")
subplot(3,2,2),plot(step(PCTF1))
title("Step with Positive feedback")
S = stepinfo(PCTF1)
p4=pole(PCTF1)

m1=1000;
b1=5;
Tau=m1/b1;
CF=tf([0,1],[1,0]);
TF=CF*tf([0,1/b1],[Tau,1]);
PCTF2=feedback(TF,-1);
subplot(3,2,3),plot(impz(PCTF2))
title("Impulse with integrator")
```

```

subplot(3,2,4),plot(step(PCTF2))
title("Step with integrator")
p5=pole(PCTF2)
S = stepinfo(PCTF2)

m1=1000;
b1=5;
Tau=m1/b1;
CF=tf([1,0],[1]);
TF=CF*tf([0,1/b1],[Tau,1]);
T_R=4*Tau;
PCTF3=feedback(TF,-1);
T_R=4*Tau;
subplot(3,2,5),plot(impulse(PCTF3))
title("Impulse with diff")
subplot(3,2,6),plot(step(PCTF3))
title("Step with diff")
p6=pole(PCTF3)
z2=zero(PCTF3)
S = stepinfo(PCTF3)

%%Analysis:
%1. on adding differentiator to positive feedback system, system is
%   becoming stable and poles got shifted to left side
%2. The system is unstable in case of positive feedback with gain
%   and integrator
%3. As the system is unstable in case of gain and integrator we are
%   not
%   getting parameters, also the peak is infinite
%4. Parameters can be obtained in differentiator as differentiator
%   making
%   the system stable
%5. positive feedback unstable system poles lies in right side of
%   plane

S =

    struct with fields:

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

p4 =

    0.0050

```

p5 =

-0.0342
0.0292

S =

struct with fields:

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

p6 =

-0.0050

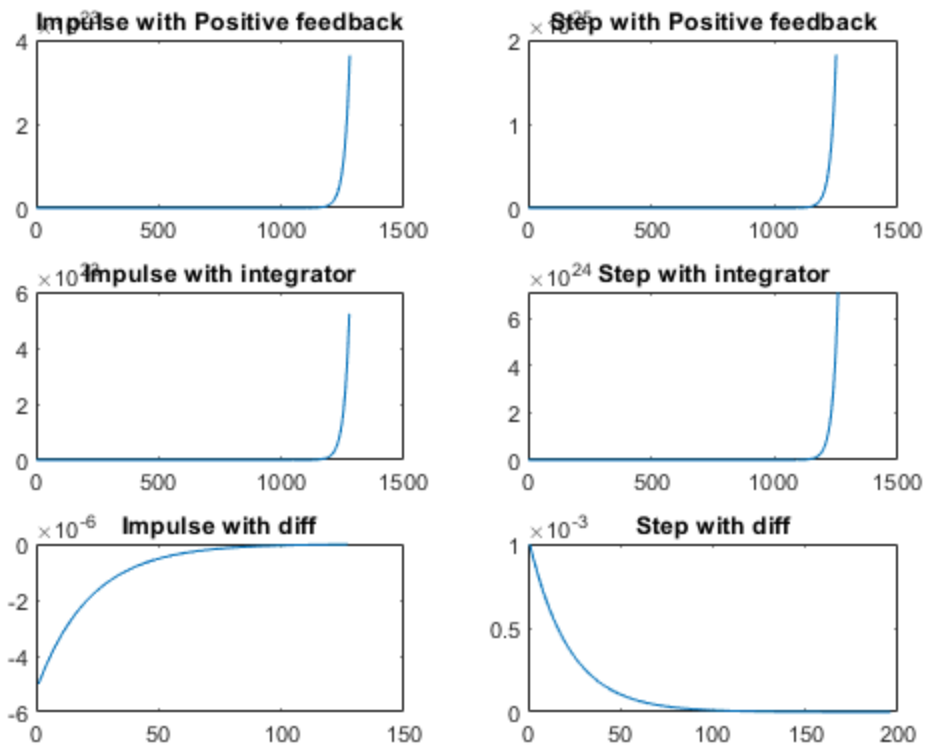
z2 =

0

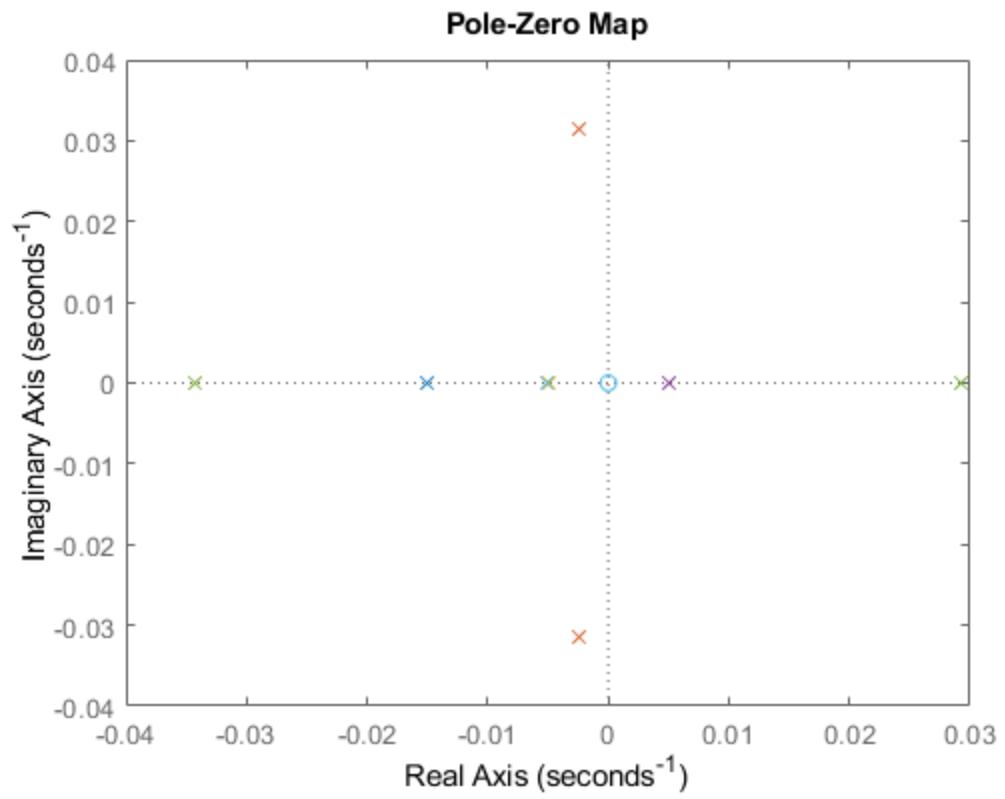
S =

struct with fields:

RiseTime: 438.9619
SettlingTime: 781.6325
SettlingMin: 2.6329e-08
SettlingMax: 9.5595e-05
Overshoot: Inf
Undershoot: 0
Peak: 0.0010
PeakTime: 0



```
figure
hold on
pzmap(NCTF1)
pzmap(NCTF2)
pzmap(NCTF3)
pzmap(PCTF1)
pzmap(PCTF2)
pzmap(PCTF3)
```



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