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

```
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%Date:8/04/2021
%Version:1.4
```

This Document has equation for motion differential system

```
%Equation:v=u+(dv/dt)T
```

Math analysis

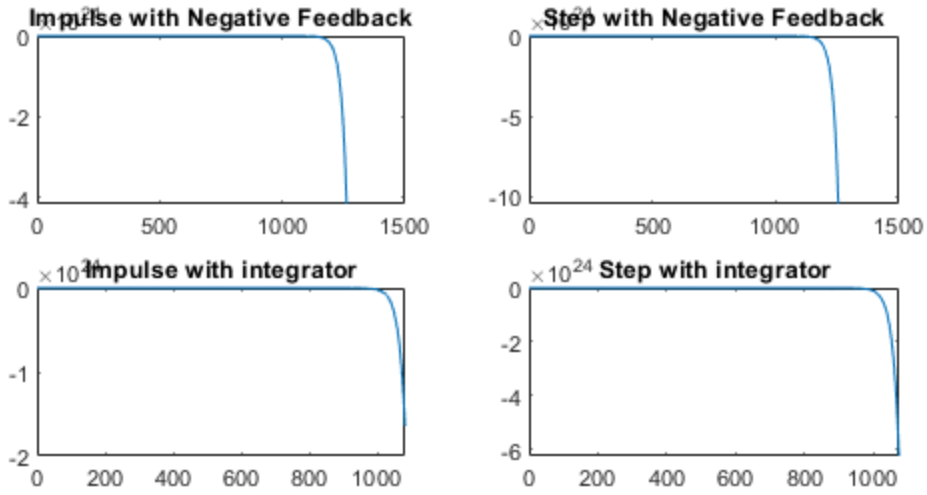
```
%dependent variables:v
%independent variables:t
%constant:T
%Root:1/T
```

Negative feedback

```
T1=40;
Tau=1/T1;
CF=10;
TF=CF*tf([0,-1/T1],[1,-Tau]);
%S = stepinfo(TF)
NCTF1=feedback(TF,1);
subplot(3,2,1),plot(impulse(NCTF1))
title("Impulse with Negative Feedback")
subplot(3,2,2),plot(step(NCTF1))
title("Step with Negative Feedback")
S1 = stepinfo(NCTF1)
p1=pole(NCTF1)

T1=40;
Tau=1/T1;
CF=tf([0,1],[1,0]);
```

```
TF=CF*tf([0,-1/T1],[1,-Tau]);
NCTF2=feedback(TF,1);
subplot(3,2,3),plot(impulse(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)
```

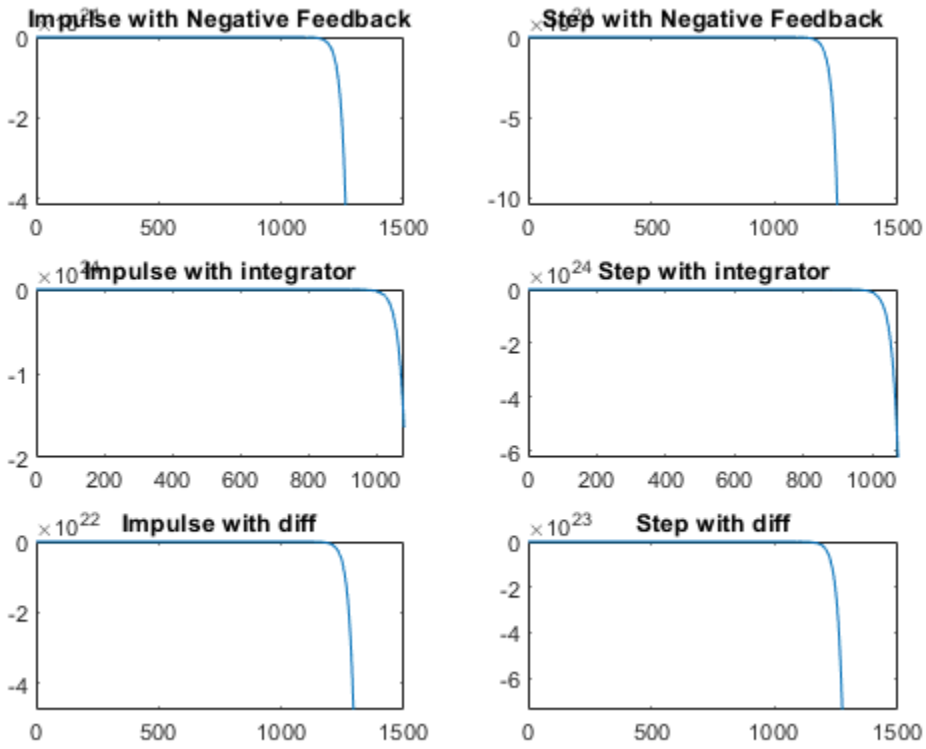
```
S1 =

  struct with fields:

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


p1 =

    0.2750


S2 =

  struct with fields:

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


p2 =

    0.1711
   -0.1461


z2 =

  0×1 empty double column vector
```




```
T1=40;
Tau=1/T1;
CF=tf([1,0],[1]);
TF=CF*tf([0,-1/T1],[1,-Tau]);
T_R=4*Tau;
NCTF3=feedback(TF,1);
T_R=4*Tau;
subplot(3,2,5),plot(impulse(NCTF3))
title("Impulse with diff")
subplot(3,2,6),plot(step(NCTF3))
title("Step with diff")
p3=pole(NCTF3)
z3=zero(NCTF3)
S3 = stepinfo(NCTF3)
```

```
p3 =

    0.0256


z3 =

     0
```

```
S3 =

  struct with fields:

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



Analysis:

1.System is becomming stable when Positive feedback is added with proportional controller
Because the pole is shifting from Right half of S plane to Left Part of S Plane.
Pole location is:-0.225

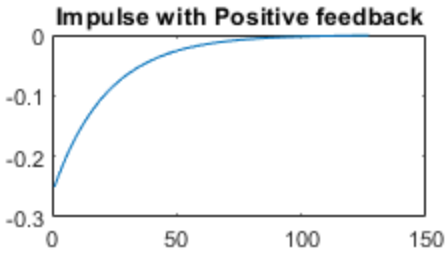
Positive feedback

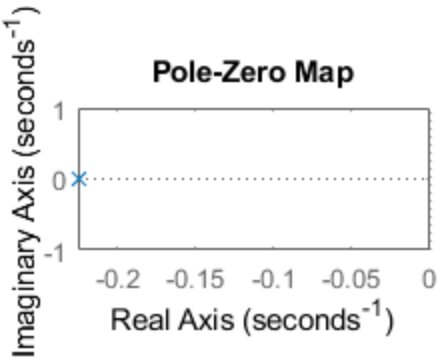
```
figure
```

```
T1=40;
Tau=1/T1;
CF=10;
TF=CF*tf([0,-1/T1],[1,-Tau]);
%S = stepinfo(TF)
PCTF1=feedback(TF,-1);
subplot(3,2,1),plot(impulse(PCTF1))
title("Impulse with Positive feedback")
subplot(3,2,2),plot(step(PCTF1))
title("Step with Positive feedback")
S = stepinfo(PCTF1)
p4=pole(PCTF1)
pzmap(PCTF1)
```

```
S =

  struct with fields:

        RiseTime: 9.7645
    SettlingTime: 17.3870
     SettlingMin: -1.1111
     SettlingMax: -1.0050
       Overshoot: 0
      Undershoot: 0
            Peak: 1.1111
        PeakTime: 46.8704
```

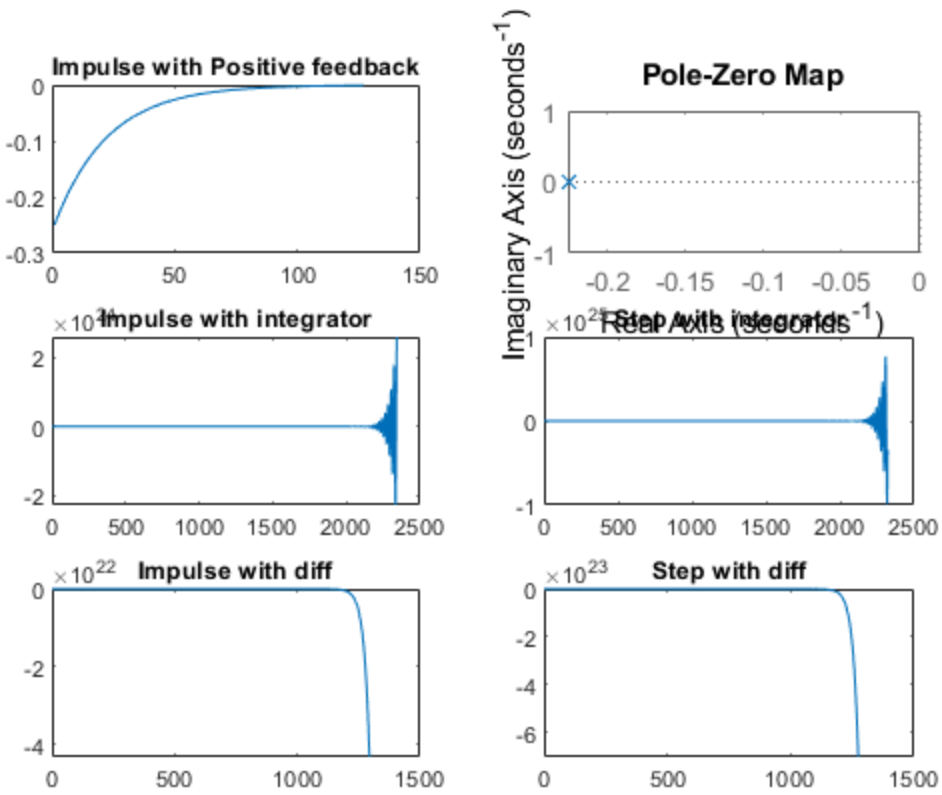
```
p4 =

   -0.2250
```



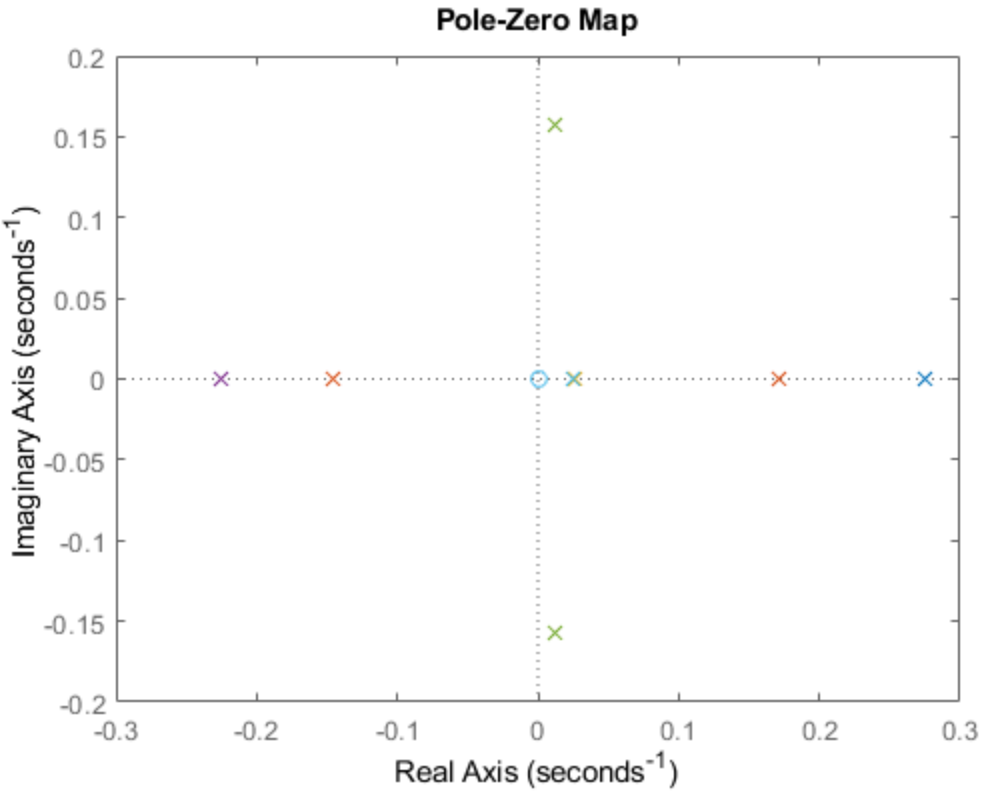



```
T1=40;
Tau=1/T1;
CF=tf([0,1],[1,0]);
TF=CF*tf([0,-1/T1],[1,-Tau]);
PCTF2=feedback(TF,-1);
subplot(3,2,3),plot(impulse(PCTF2))
title("Impulse with integrator")
subplot(3,2,4),plot(step(PCTF2))
title("Step with integrator")
p5=pole(PCTF2)
S = stepinfo(PCTF2)

T1=40;
Tau=1/T1;
CF=tf([1,0],[1]);
TF=CF*tf([0,-1/T1],[1,-Tau]);
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


p5 =

   0.0125 + 0.1576i
   0.0125 - 0.1576i


S =

  struct with fields:

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


p6 =

    0.0244


z2 =

     0


S =

  struct with fields:

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




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



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