Automatic Control Systems

Lab 3 : Pid Controllers

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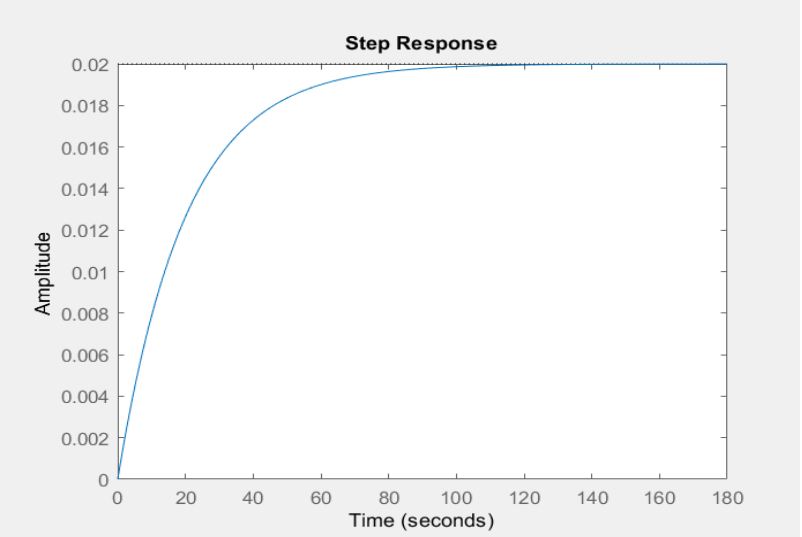
Section : 8

1- Open loop system :

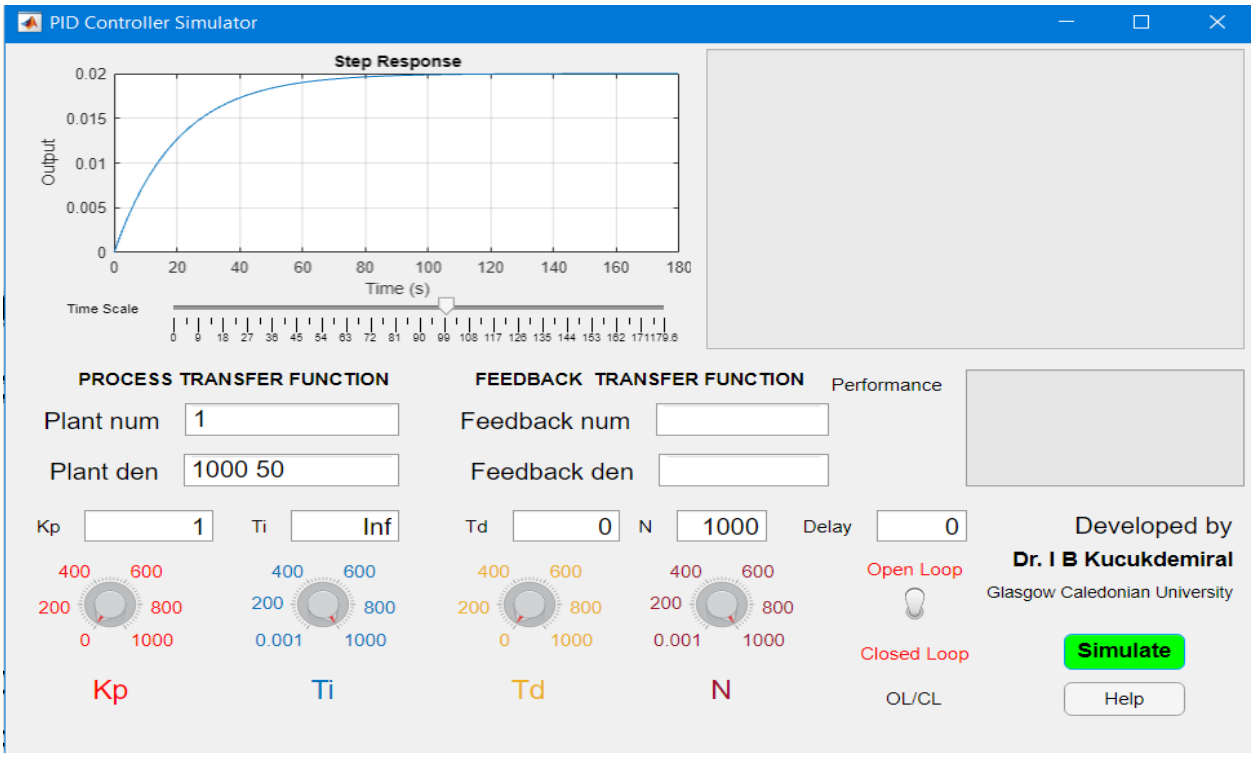
- Code and step response

```
1   %% Cruise Control using PID controllers
2   % Openloop system
3 - m = 1000; b = 50;
4 - Plant_Tf = tf(1, [m b]);
5 - step(Plant_Tf);
6 - info = stepinfo(ss(Plant_Tf));
```

```
      RiseTime: 43.9401
  SettlingTime: 78.2415
   SettlingMin: 0.0181
   SettlingMax: 0.0200
     Overshoot: 0
    Undershoot: 0
          Peak: 0.0200
      PeakTime: 210.9168
```



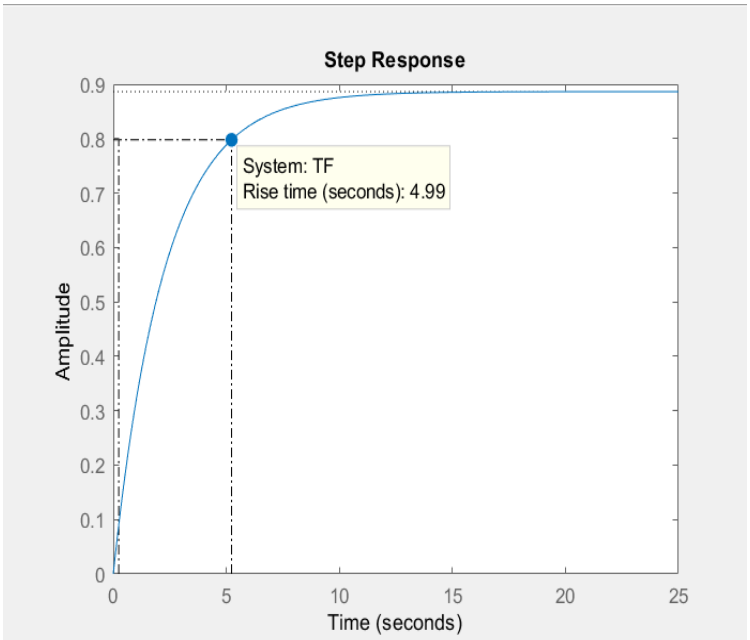
- Using pid Controller simulator



2- Adjusting the PID parameters

a) Adjusting Kp to get (tr < 5 sec)

```
7    %% Adjusting Kp to get RiseTime < 5sec
8 -  m = 1000; b = 50;
9 -  Plant_Tf = tf(1, [m b]);
10 - Kp = 1;
11 - C = pid(Kp);
12 - TF = feedback(C*Plant_Tf, 1);
13 - info = stepinfo(ss(TF));
14 - while info.RiseTime > 5
15 -     Kp = Kp + 1;
16 -     C = pid(Kp);
17 -     TF = feedback(C*Plant_Tf, 1);
18 -     info = stepinfo(ss(TF));
19 - end
20 - max_Kp = Kp;
21 - info;
22 - step(TF)
23   % no overshot then kd = 0;
```

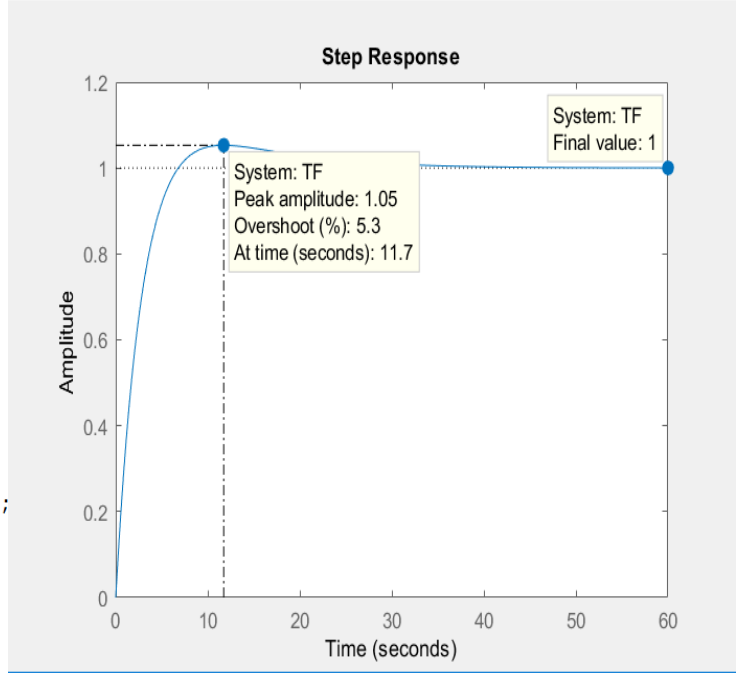


- The max value of Kp to have rise time less than 5sec is 390.
- It's also obvios from the step info below that when Kd=0 Overshot is equal to 0 so we will keep it 0.

RiseTime	4.9932
SettlingTime	8.8911
SettlingMin	0.8017
SettlingMax	0.8863
Overshoot	0
Undershoot	0
Peak	0.8863
PeakTime	23.9678

b) Adjusting Ki to get (ess < 2%)

```
24  %%
25  m = 1000; b = 50;
26  Plant_Tf = tf(1, [m b]);
27  Ki = 1;
28  C = pid(390, Ki, 0);
29  TF = feedback(C*Plant_Tf, 1);
30  info = stepinfo(ss(TF));
31  ss_error = abs(1-(info.SettlingMax + info.SettlingMin)/2);
32  while ss_error > 0.02
33      Ki = Ki + 1;
34      C = pid(390, Ki, 0);
35      TF = feedback(C*Plant_Tf, 1);
36      info = stepinfo(ss(TF));
37      ss_error = abs(1-(info.SettlingMax + info.SettlingMin)/2);
38  end
39  max_ki = Ki;
40  info;
41  step(TF)
```



- The max value of Ki to have steady-state error < 2% is 38 while keeping Kp = 390.
- It's also obvios from the step info below that when Kd=0 Overshot is still less than 10% , so we will keep it 0.

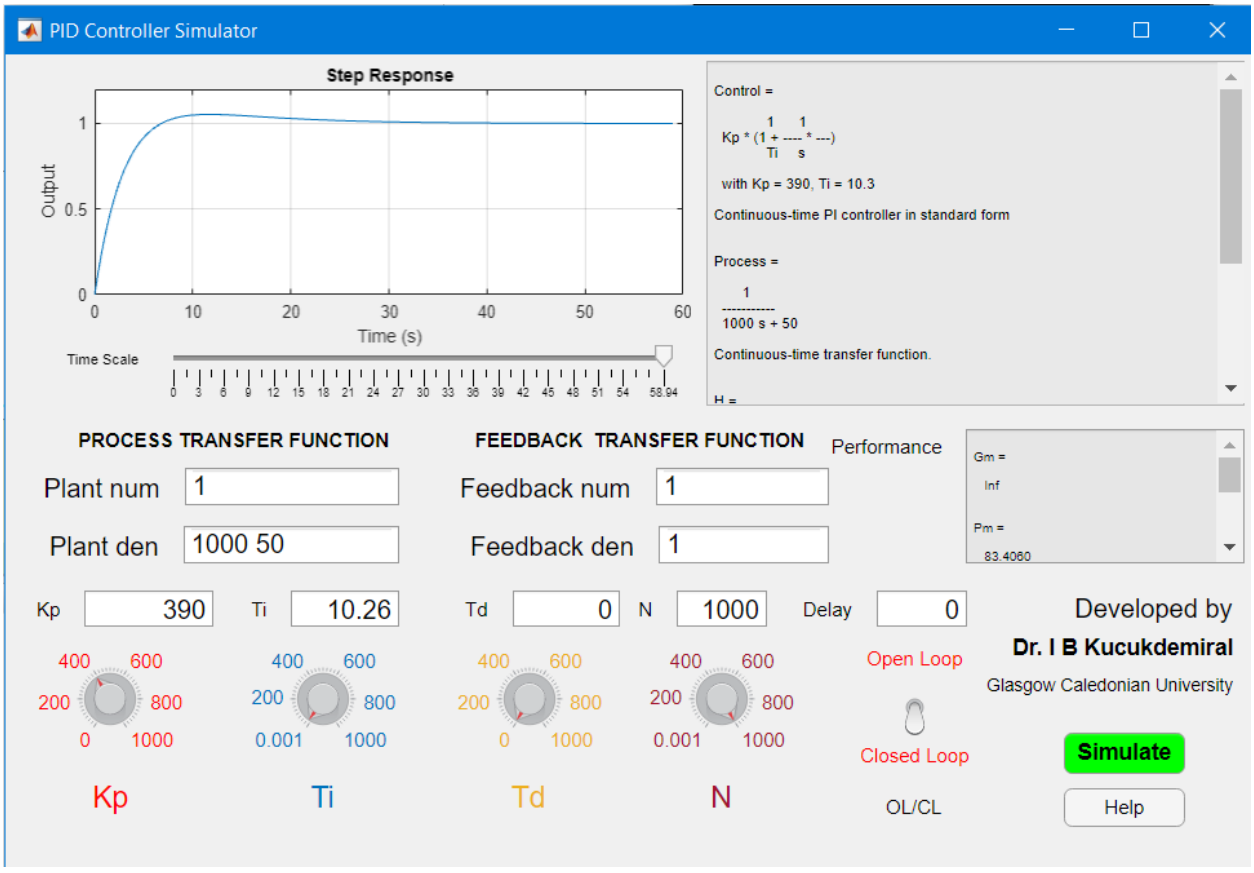
RiseTime	4.4641
SettlingTime	23.5616
SettlingMin	0.9093
SettlingMax	1.0530
Overshoot	5.3003
Undershoot	0
Peak	1.0530
PeakTime	11.7282

- From the previous Outputs we figured out that to have : - Rise time < 5sec
  - Overshot < 10%
  - Steady-state error < 2%

Kp = 390, Ki = 38, Kd = 0.

We also can tune these parameters while keeping the specs above.

c) Using pid controller simulator



- We got the same results as using code.

- Trying other values Kp=440, Ti=6.567
- we still remain the specs mentioned.