Contents

Ziegler–Nichols method

Control Type	K_p	K_i	K_d
P	$0.50K_u$	-	-
PI	$0.45K_u$	$0.54K_u/T_u$	-
PID	$0.60K_u$	$1.2K_u/T_u$	$3K_uT_u/40$

K_u tuning

K_u	result
0	straight
-0.1	unstable oscillations
-0.05	stable oscillations
-0.075	unstable oscillations
-0.0625	unstable oscillations
-0.05625	unstable oscillations
-0.052	K_u

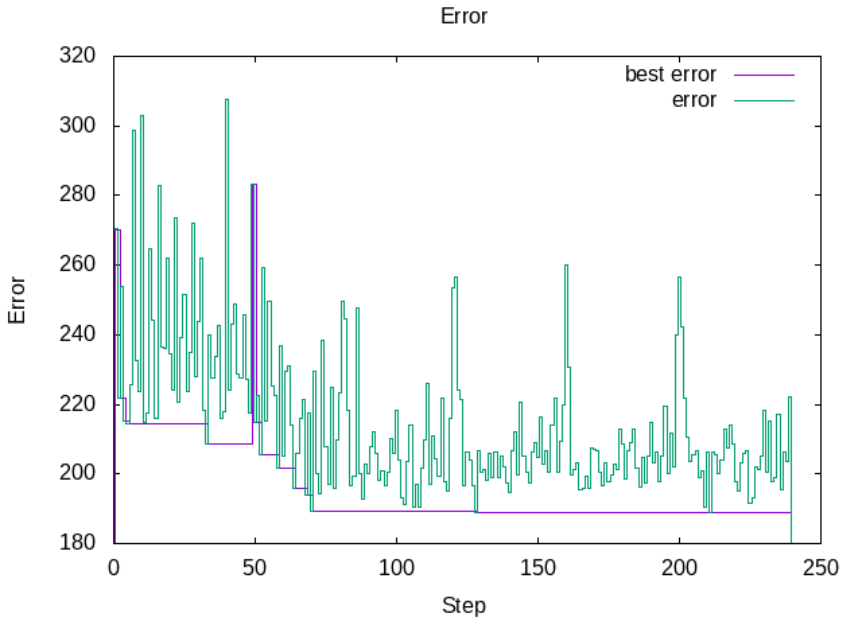
$K_u = -0.052$, $T_u = 18$

Control Type	K_p	K_i	K_d
PID	-0.0312	-3.46666666667 (-3)	-0.0702

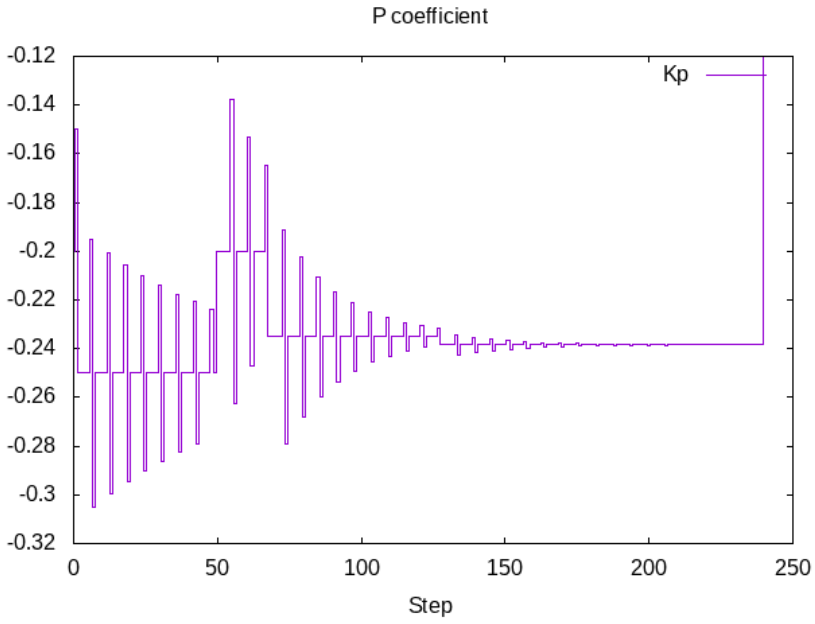
plot f(x) w lp lw 1, g(x) w p lw 2, h(x) w l lw 3 set xrange [-8:8] set xtics -8,2,8

set yrange [-20:70] set ytics -20,10,70

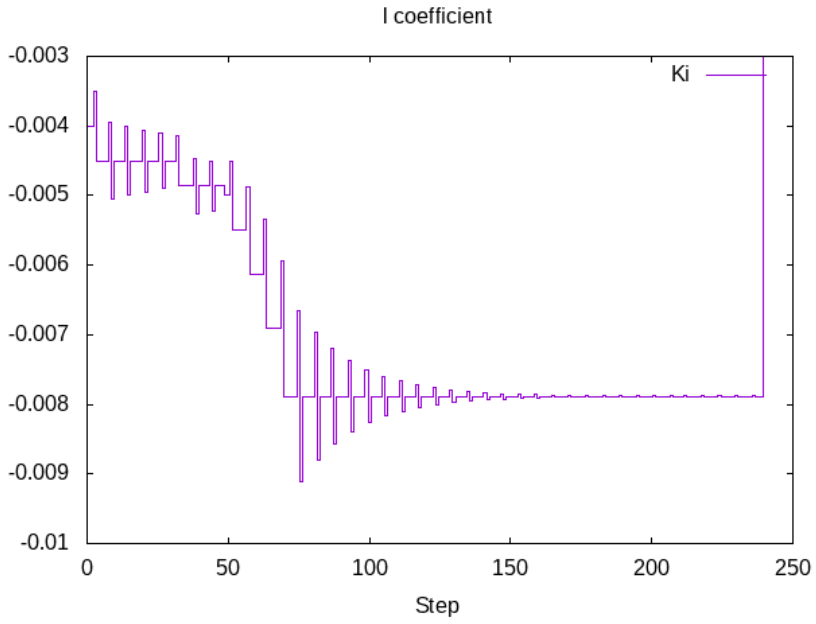
```
reset

set title "Error"
set xlabel "Step"
set ylabel "Error"

plot 'out.dat' using 0:1 with histeps title 'best error', 'out.dat' using 0:2 with hist
```



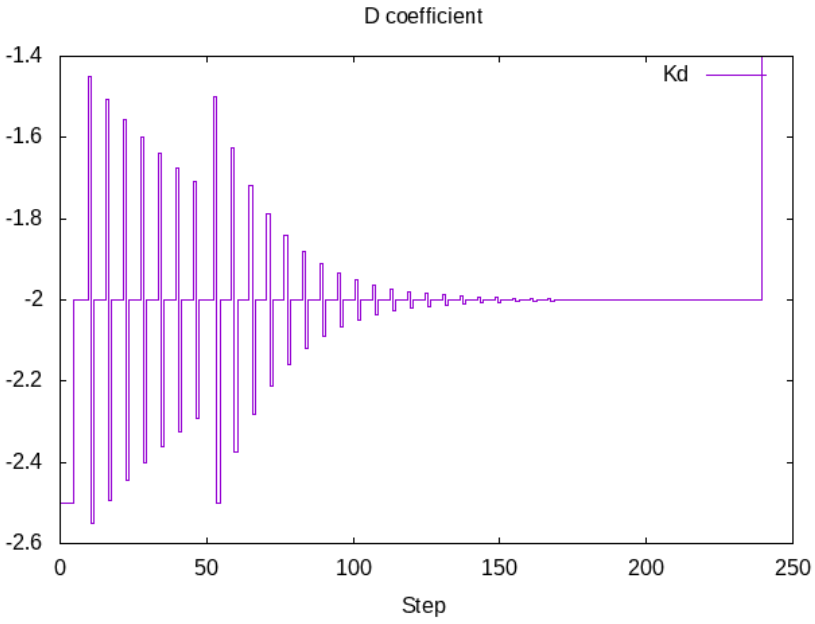

```
reset
set title "P coefficient"
set xlabel "Step"
plot 'out.dat' using 0:3 with histeps title 'Kp'
```




```
reset
set title "I coefficient"
set xlabel "Step"
plot 'out.dat' using 0:4 with histeps title 'Ki'
```




```
reset
set title "D coefficient"
set xlabel "Step"
plot 'out.dat' using 0:5 with histeps title 'Kd'
```


D coefficient
Kd
-1.4
-1.6
-1.8
-2
-2.2
-2.4
-2.6
0
50
100
150
200
250
Step