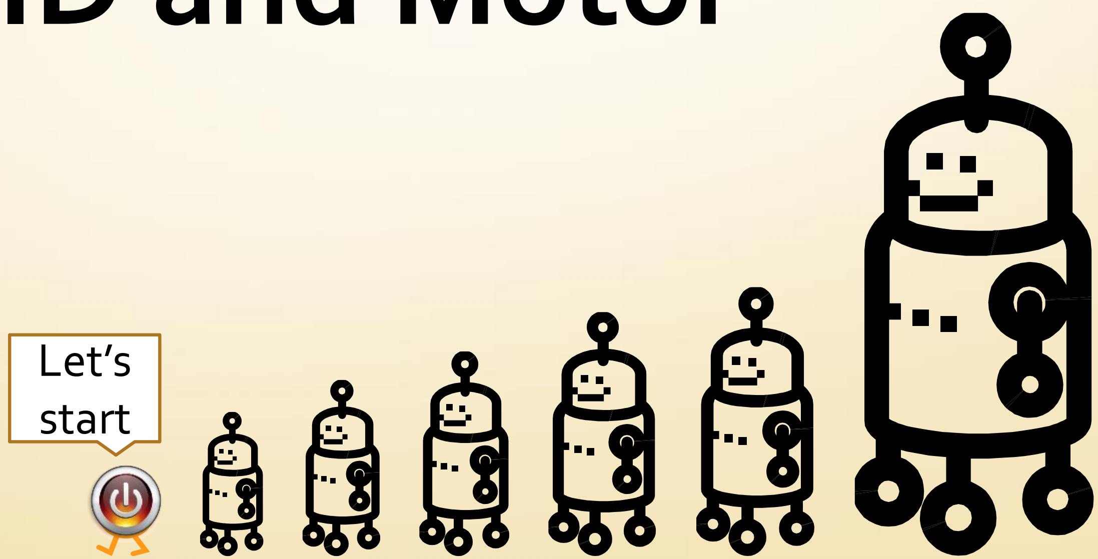
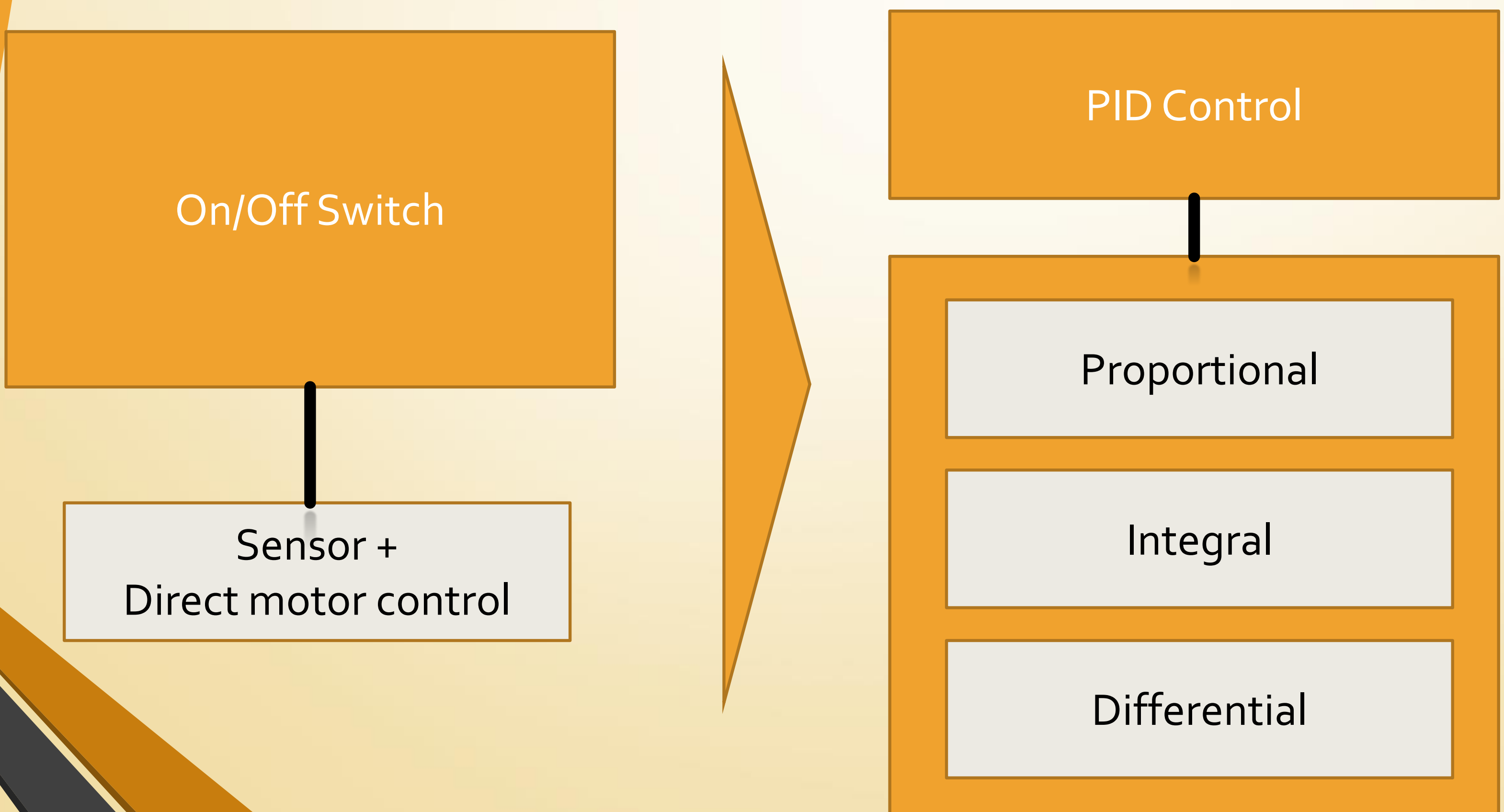
Study on control of PID and Motor

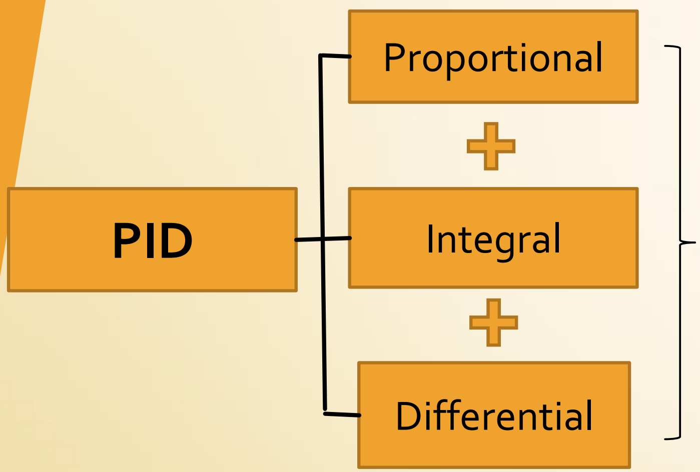


Robot control base

We tried to apply knowledge from mathematics and PID control
to robot control, which is a new approach from traditional ‘sensor+motor ‘control
with on/off switch basis

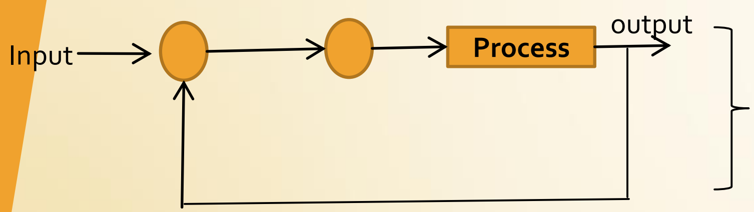


Definition of 'PID control' (1)

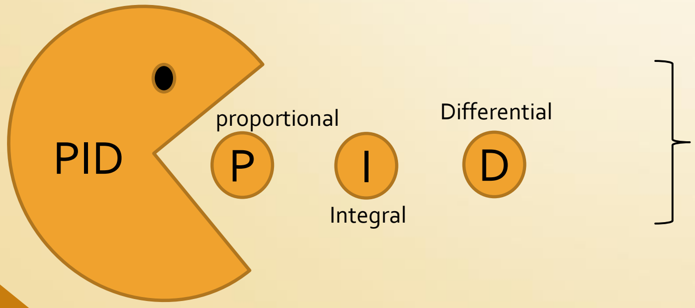


PID is a reaction to errors to adjust current status to desired status by reducing error level To set point and is proportional to size of error

Definition of 'PID control' (2)

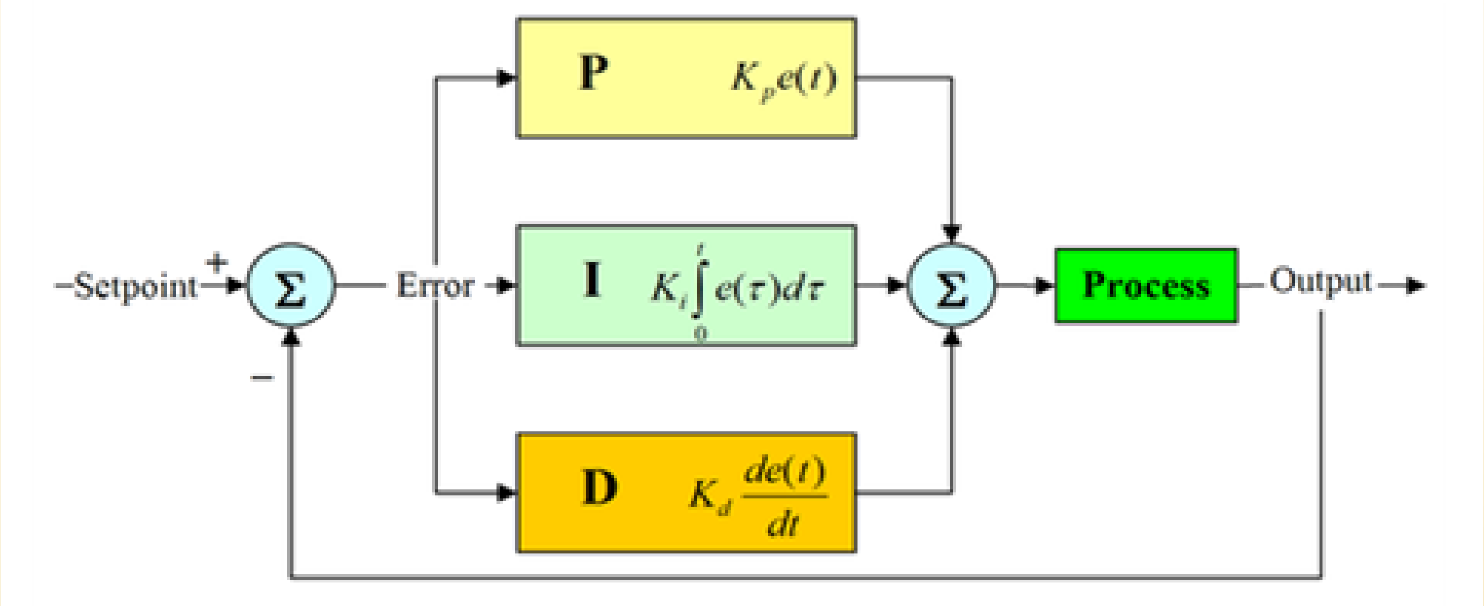


Controller attempts to minimize error from output by adjusting the input process control.
PID also stops in case of abrupt change to block overshoot to secure a stabilization.



PID possesses all characteristics from proportional control, differential control and integral control at the same

PID control diagram



Feedback

Output is feedback to input to adjust error value to set point

P-Control

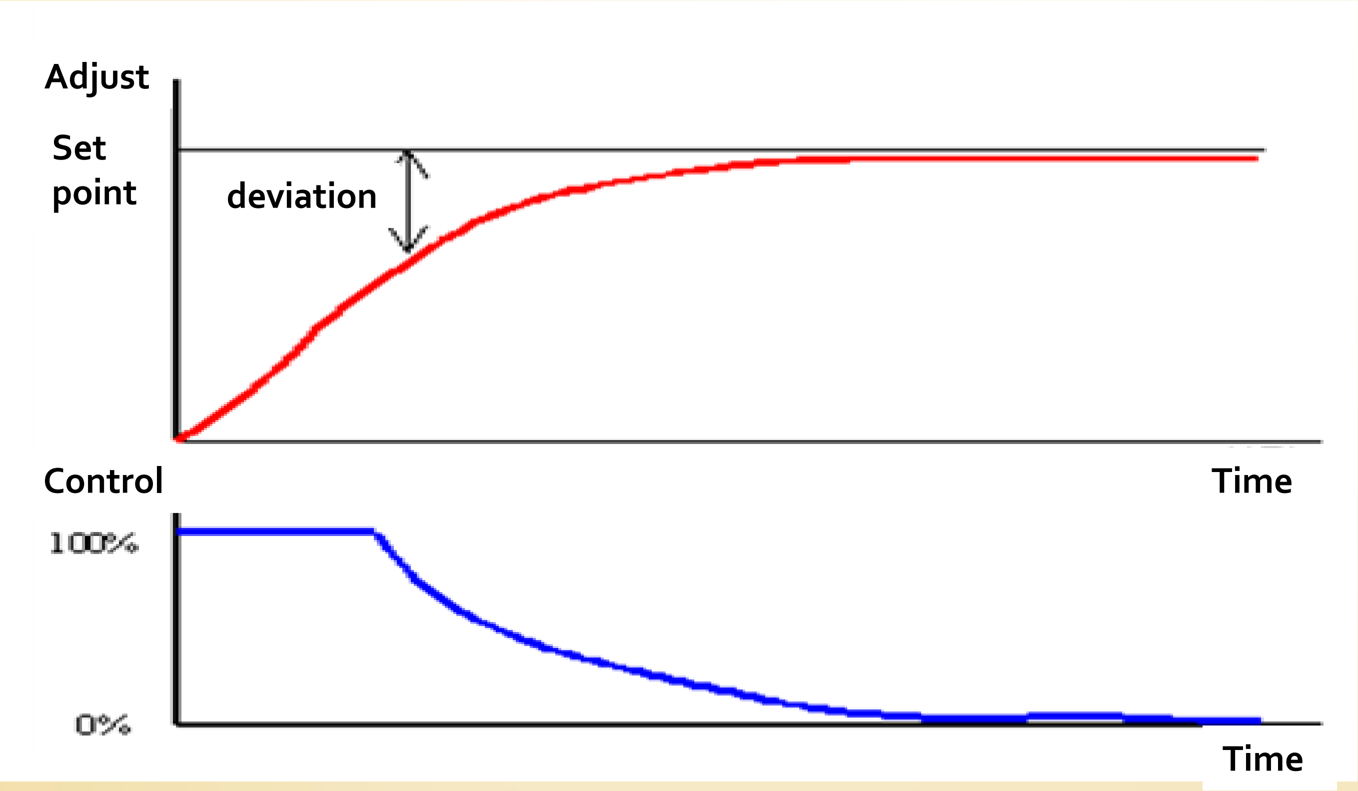


Diagram shows P-Control adjusts deviation to zero to meet desired value as time goes

Pros and Cons of P,I and D

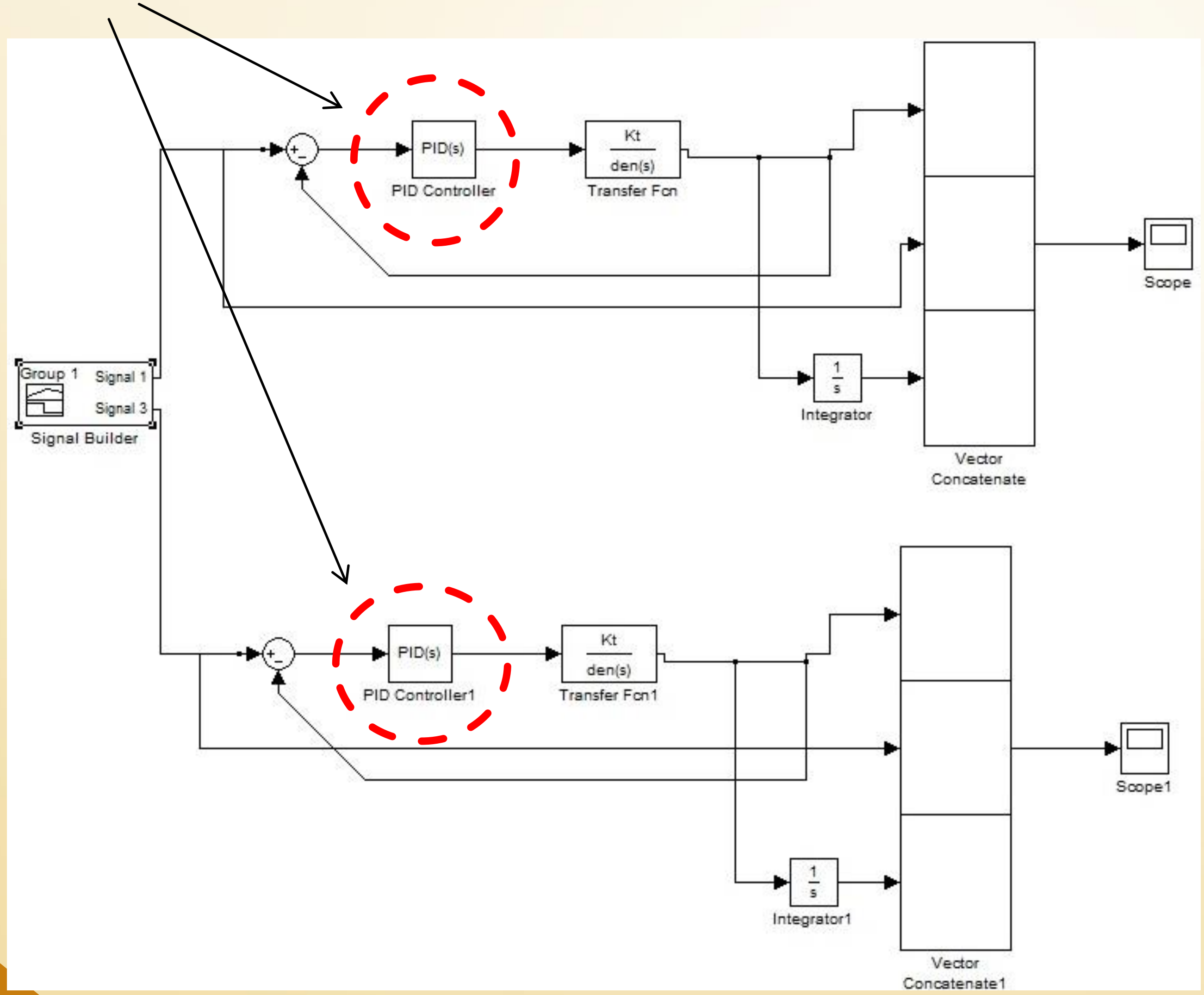
Classification	Pros	Cons
P Control	Reduce time to target	Unable to remove offset
I Control	Exactness to target	Overshoot
D Control	Stable control	Vulnerable to noise

Each P,I,and D control has its advantages and disadvantages, thus need to collaborate each advantages

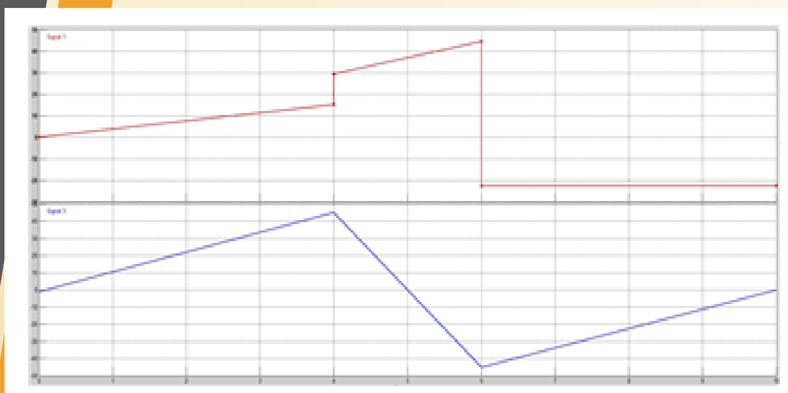
PID Control
simulation results

Block Diagram

PID controller



Input signal for simulation test and setup value



Input Signal for test

Controller parameters

Proportional (P): 100

Integral (I): 50

Derivative (D): 30

Filter coefficient (N): 1000

Compensator formula

$$P+I\frac{1}{s}+D\frac{N}{1+N\frac{1}{s}}$$

Tune...

Controller parameters

Proportional (P): 100

Integral (I): 50

Derivative (D): 100

Filter coefficient (N): 1000

Compensator formula

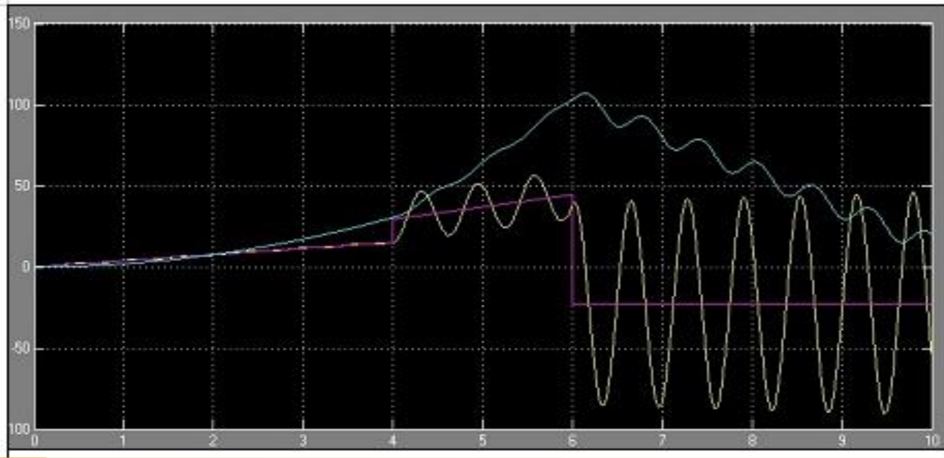
$$P+I\frac{1}{s}+D\frac{N}{1+N\frac{1}{s}}$$

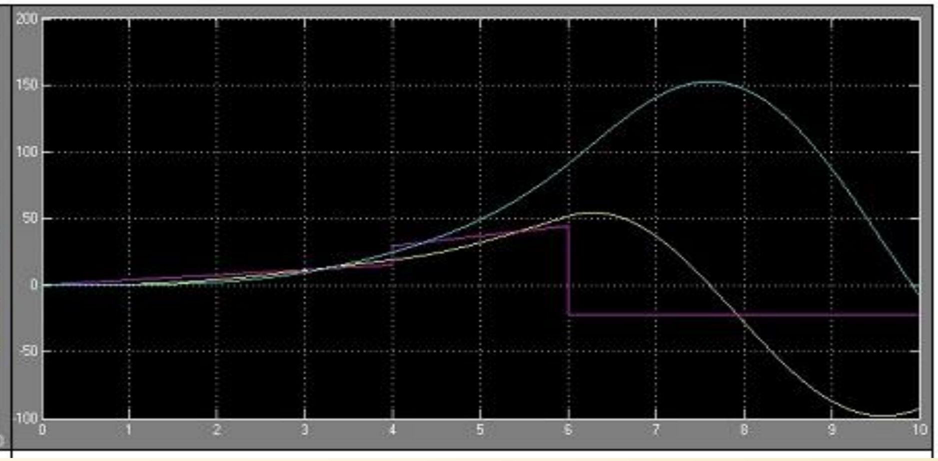
Tune...

```
Jm=0.02;
b=0.001;
Ke=0.02;
Ra=10;
La=0.01;
p=15;
z=0.8;
Kt=0.02;
num=[Kt Kt*z];
den=[Jm*La Jm*Ra+b*La+p*Jm*La b*Ra+Kt*Ke+p*(Jm*Ra+b*La) p*(b*Ra+Kt*Ke)-Kt -Kt*p];
sys=tf(num,den);
rlocus(sys);
k=rlocfind(sys);
```

Simulation results
of P,I, and D individually

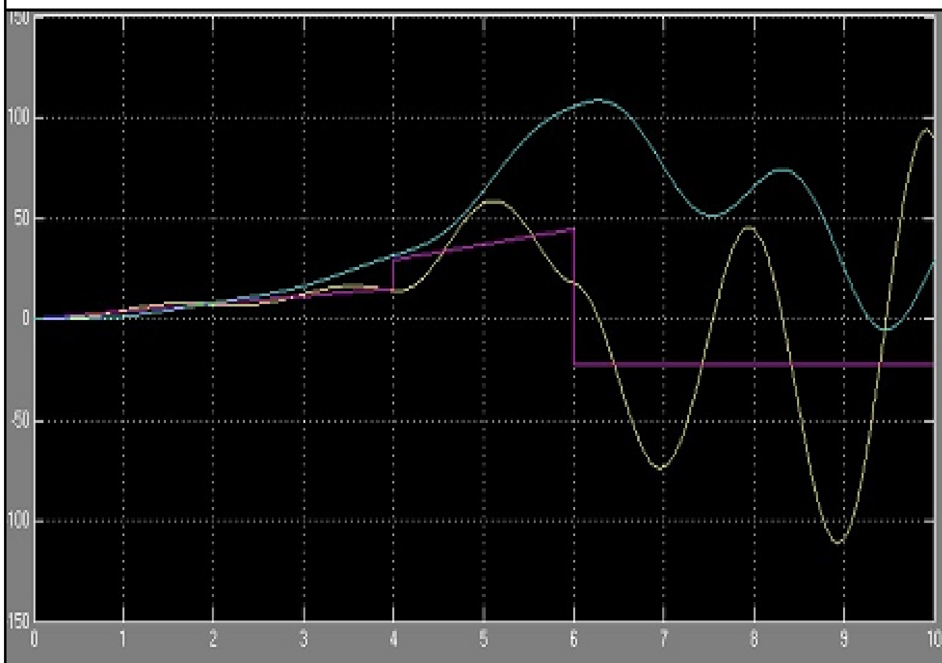
Result shows us that there is a diffusion when P value is too high whereas there is slow responsiveness when P value is too low



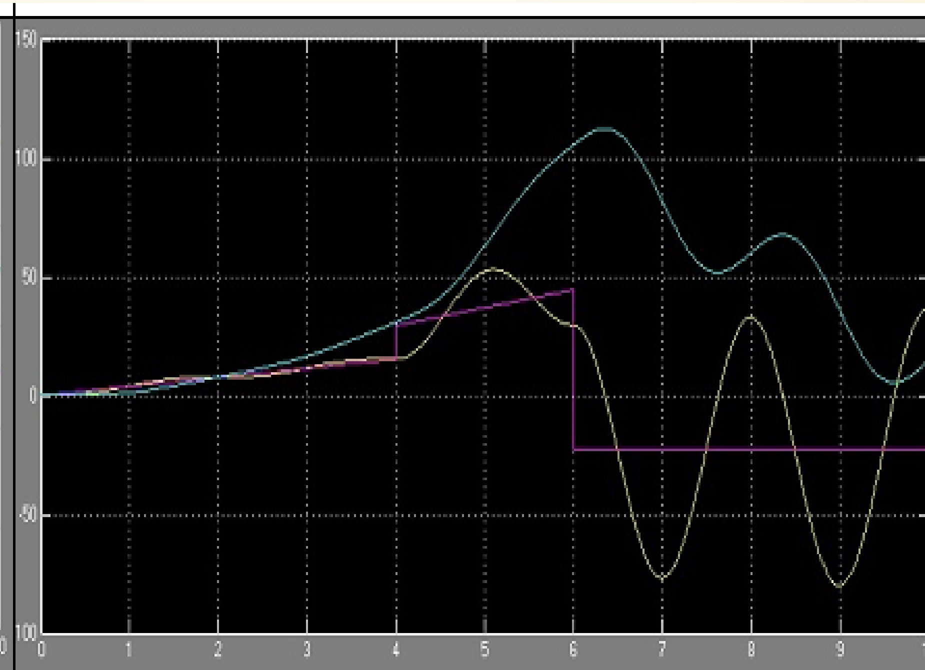


Diffusion from too high P value	Slow responsiveness from too low P value

Result also shows that like P value case, there is a diffusion when I value is too high whereas there is responsiveness when I value is low

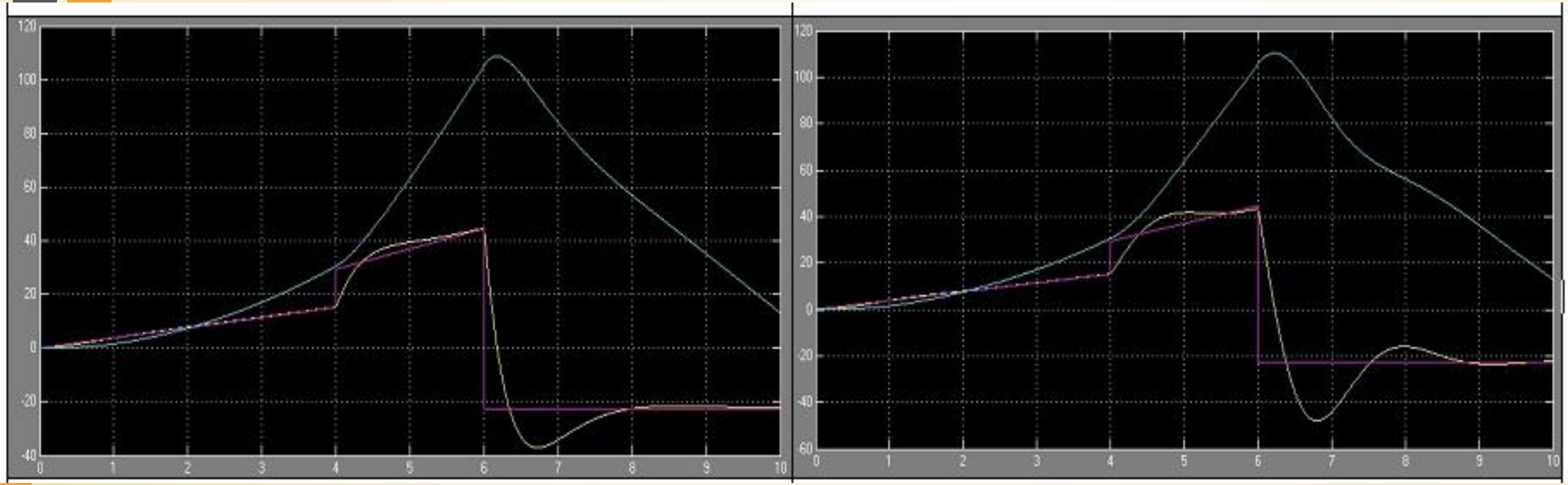


Diffusion from too high I value



Low I value

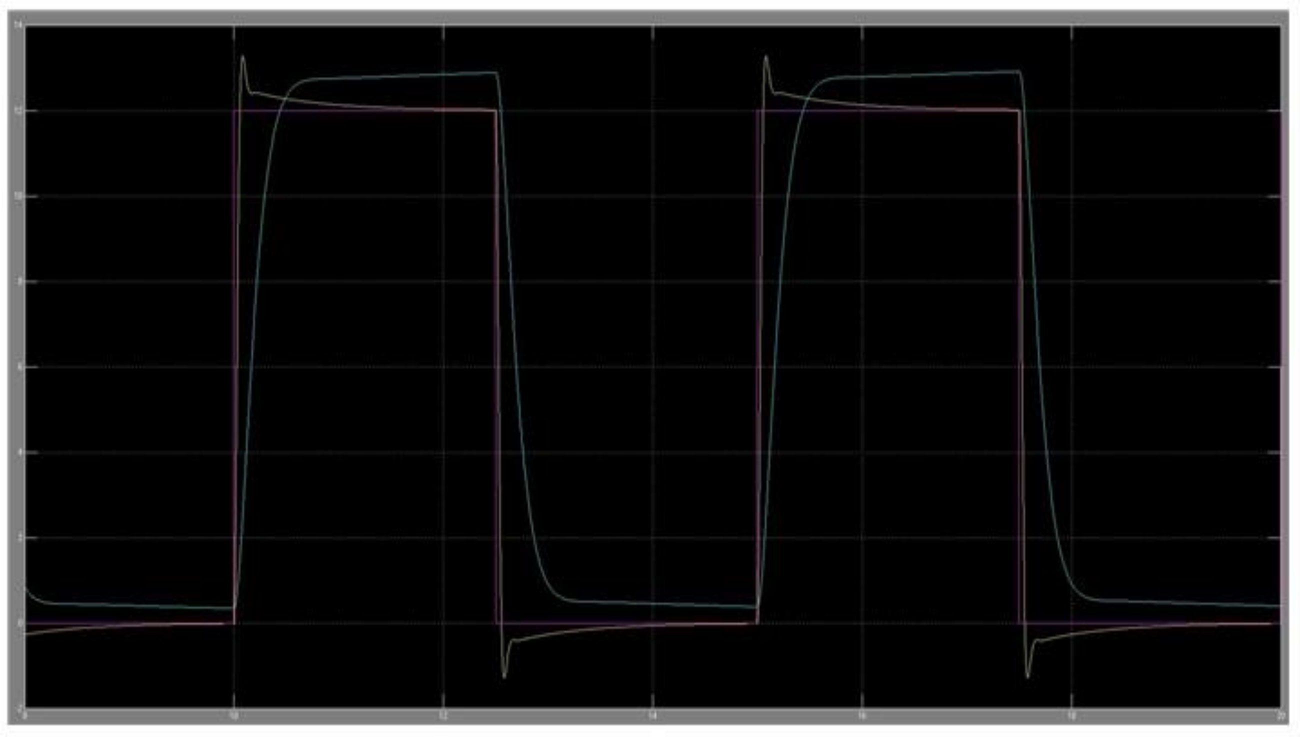
If D value is not set proper and is low, then it creates big error gap



D value is proper	D value is low

Simulation result with PID control

Simulation shows that with PID control, it reached desired value without residual deviation



Further application of PID

PID can be further applied to diverse application such as motor and temperature control

Motor or temperature control

- Cruise control of Automobile
- Propeller velocity control of quad-copter


Thank You