

Welcome to

PID Controller Design Using Simulink

Outline

- Simulink
- Hardware
- PID controller
- Z-N method
- Tuning

Simulink

- Intuitive graphical programming environment for modeling, simulating and analyzing multi domain dynamic systems.
- Large library
- Going to use Quarc tool which is compatible with our hardware.

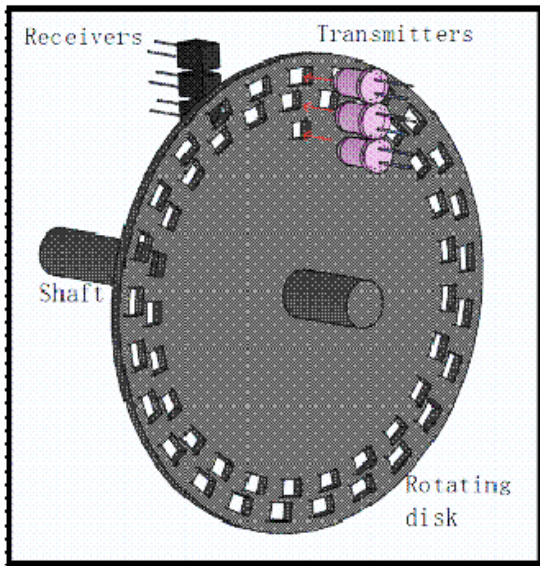
Hardware

- Input : Voltage
- Sensor : Encoder



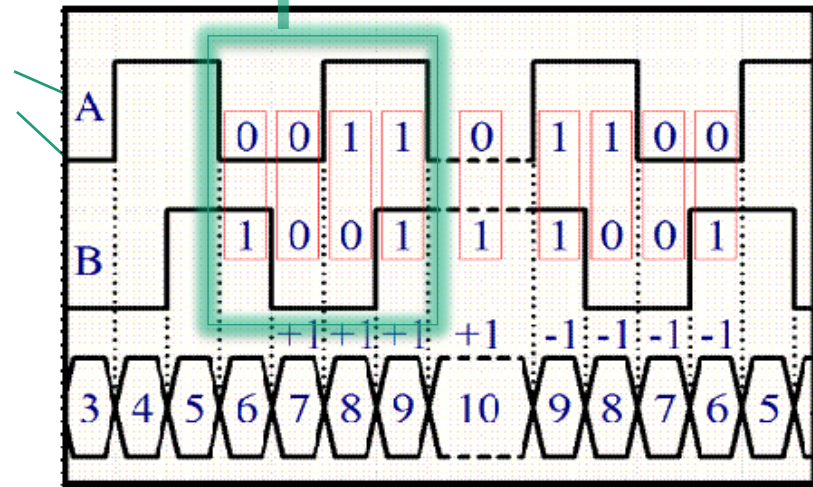
Encoder

- Quadrature Encoders

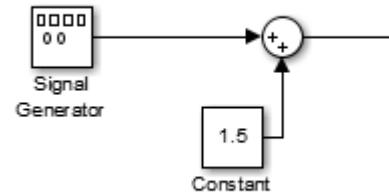
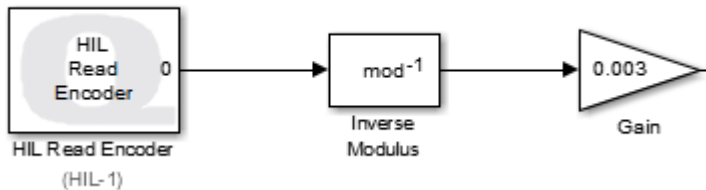
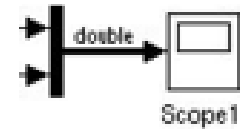
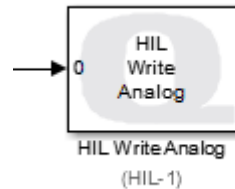


512 pulses/revolution
4 different combinations per pulse
each combination represents $360^\circ/2048$
 $\Rightarrow 0.175^\circ/\text{combination}$
 $\Rightarrow 0.003 \text{ rad}/\text{combination}$

Resolution



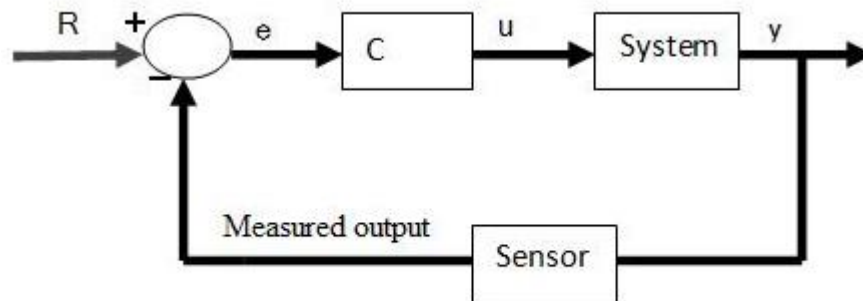
Blocks to Use



Input Command

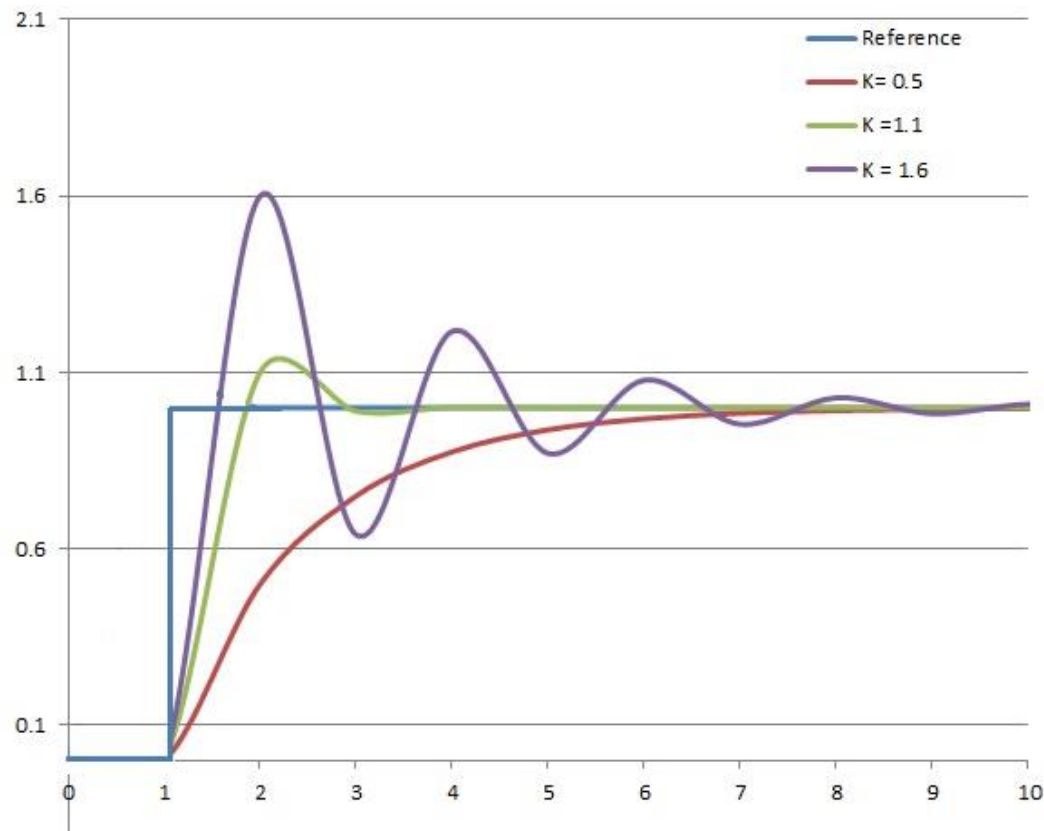
What is a PID Controller?

A control loop feedback controller that continuously calculates an "error value" as the difference between a measured process variable and desired set point.



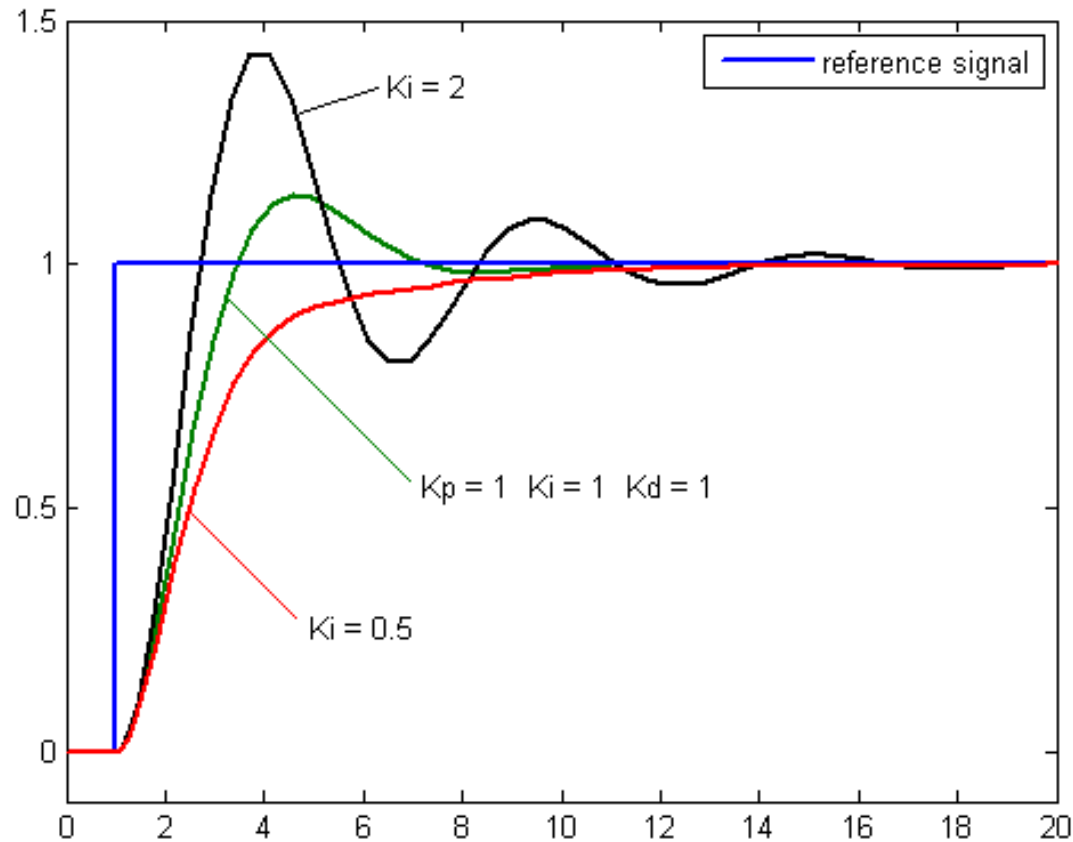
P in PID

- **P** : Proportional -accounts for present values of the error



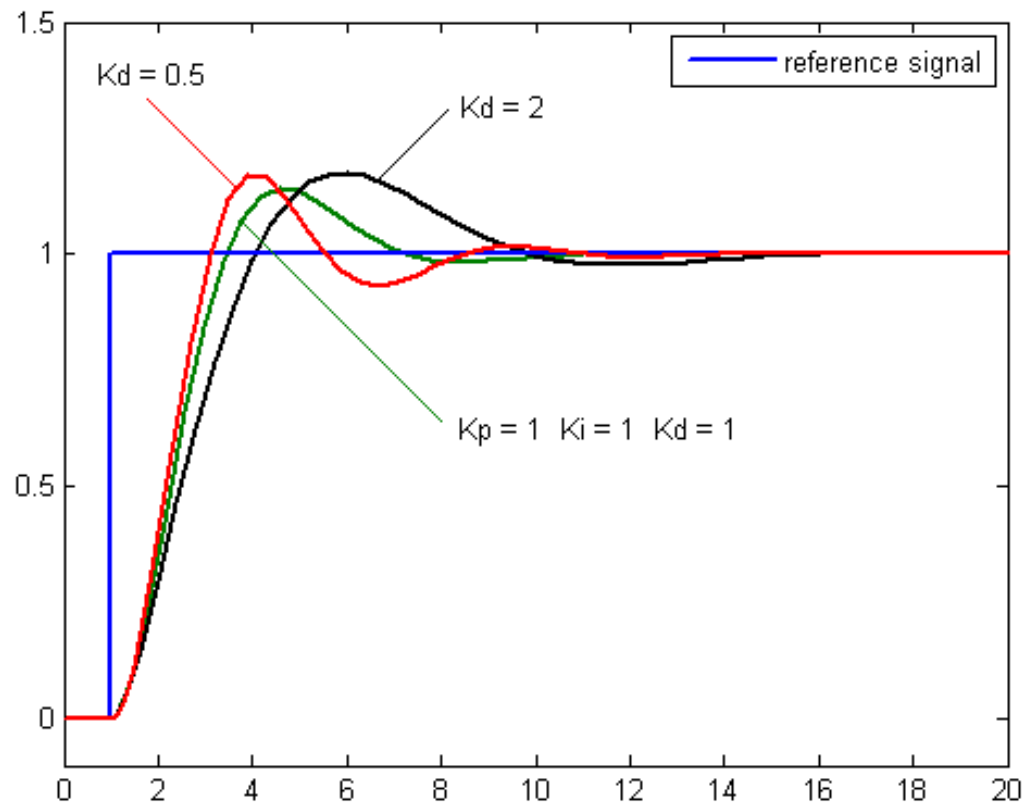
I in PID

- **I** : Integral - accounts for past values of the error



D in PID

- **D** : Derivative - accounts for future values of the error



Zeigler Nichols Method

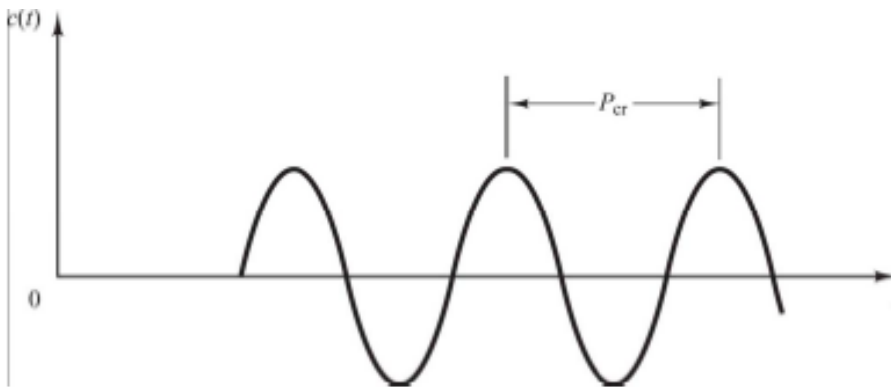
- Tuning Method
- Gives start values for the controller constant.
- Used the following transfer function:

$$G_c(s) = K_p \left(1 + \frac{1}{T_i s} + T_d s \right)$$

Steps

1- set $T_i = \infty$ and $T_d = 0$.

2- Increase K_p from 0 to a critical value K_{cr} at which the output FIRST exhibits sustained oscillations.



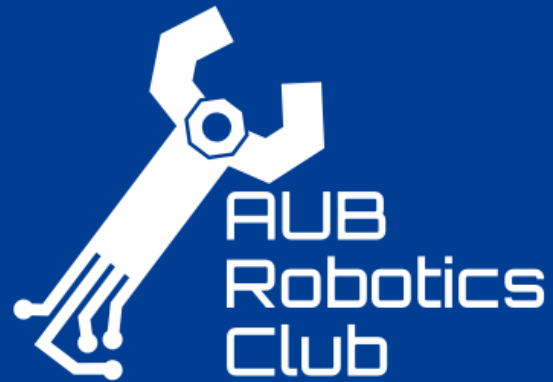
3- Calculate k_p, T_i , and T_d

K_p	T_i	T_d
$0.6 K_{cr}$	$0.5 P_{cr}$	$0.125 P_{cr}$

Tuning:

Effects of increasing a parameter independently

Parameter	Rise time	Overshoot	Settling time	Steady-state error	Stability
K_p	Decrease	Increase	Small change	Decrease	Degrade
K_i	Decrease	Increase	Increase	Decrease significantly	Degrade
K_d	Minor decrease	Minor decrease	Minor decrease	No effect in theory	Improve if K_d small



Thank You 😊