SNS COLLEGE OF TECHNOLOGY

Coimbatore-12
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DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

19ECT212 – CONTROL SYSTEMS

II YEAR/ IV SEMESTER

UNIT II – TIME RESPONSE ANALYSIS

TOPIC 8- PID COMPENSATION

OUTLINE

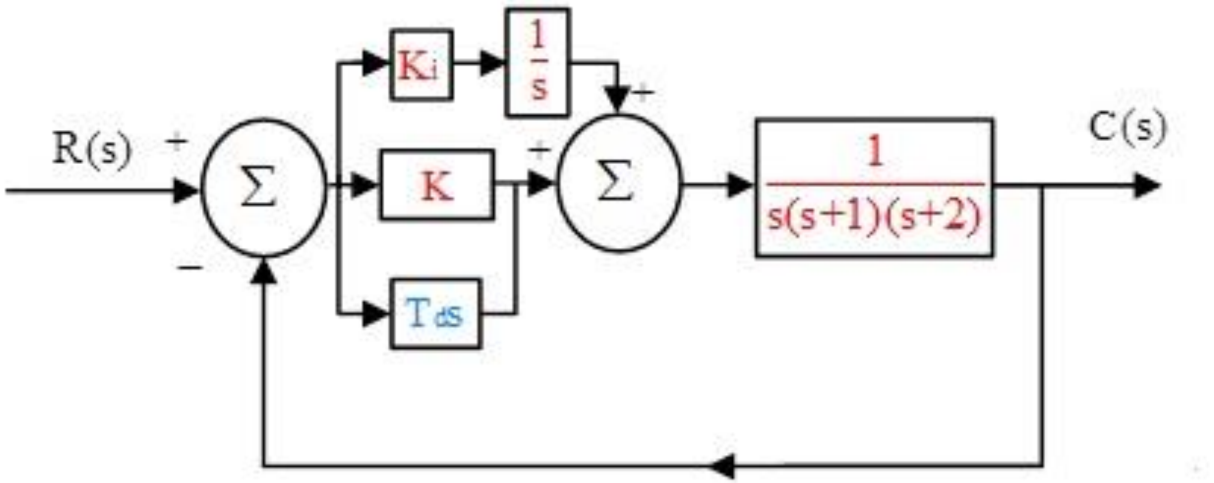
- REVIEW ABOUT PREVIOUS CLASS
- DIAGRAM OF PID-CONTROLLER
- EXAMPLE: PID CONTROLLERS
- GENERAL GUIDELINES FOR DESIGNING A PID CONTROLLER
- ACTIVITY
- PROBLEM EXAMPLE
- CLOSED LOOP CONTROLLER
- PID CONTROLLER
- ANALYSIS
- SUMMARY

DIAGRAM OF PID-CONTROLLER

Proportional plus Integral plus Derivative Controller (PID Controller)

A PID controller is generally used in industrial control applications to regulate temperature, flow, pressure, speed, and other process variables.

Closed loop control system with PID Controller



PID-CONTROLLER

The transfer function of the PID Controller can be found as:

$$Tds + K + \frac{Ki}{s} \quad \text{OR} \quad \frac{Tds^2 + Ks + Ki}{s}$$

- It can be observed that one pole at origin is fixed, remaining parameters T_d, K, and Ki decide the position of two zeros.

- In this case, we can keep two complex zeros or two real zeros as per the requirement,

- Hence PID controller can provide better tuning.

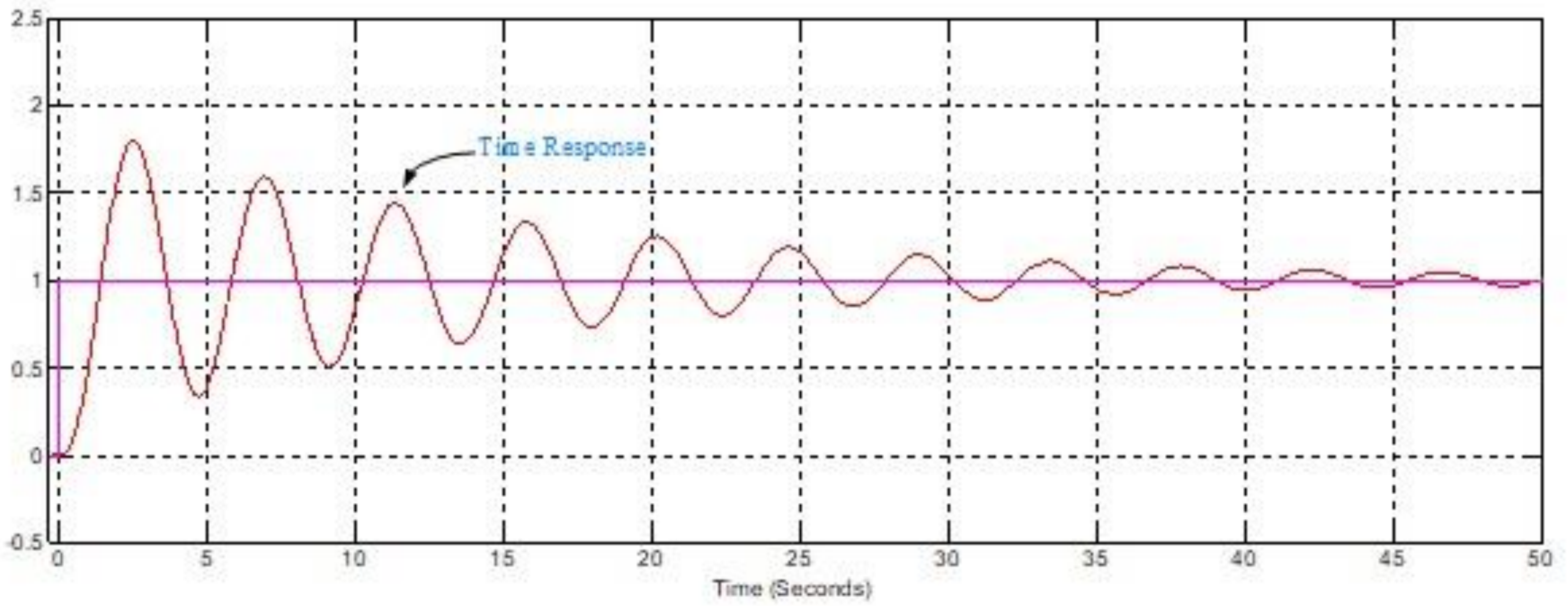
- In the olden days, the PI controller was one of the best choice of control engineers, because designing (tuning of parameters) of the PID controller was a little difficult.

- But nowadays, due to the development of software designing of PID controllers have become an easy task.

EXAMPLE: PID CONTROLLERS.

Against step input, For the values of K=5.8, K_i=0.2, and T_d=0.5, Its time response, is shown in Fig. Compare Fig with previous Fig (We have taken values such that all the time response can be compared).

Figure: Response of system shown in Figure.previous , with K=5.8, Td=0.5, Ki=0.2



GENERAL GUIDELINES FOR DESIGNING A PID CONTROLLER

To obtain the desired response are as follows:

- Obtain the transient response of closed-loop transfer function and determine what needs to be improved.
- Insert the proportional controller, Design the value of ‘K’ through Routh-Hurwitz or suitable software.
- Add an integral part to reduce steady-state error.
- Add the derivative part to increase damping (damping should be between 0.6-0.9). The derivative part will reduce overshoots & transient time.
- Sisotool, available in MATLAB can also be used for proper tuning and to obtain a desired overall response.
- Please note, above steps of tuning of parameters (designing of a control system) are general guidelines. There are no fixed steps for designing controllers.

ACTIVITY-DIFFERENT WORDS

4 Clinomania (n.)
Excessive desire to stay in bed.
Example: I definitely have clinomania; I love sleeping, making mornings a struggle for me.

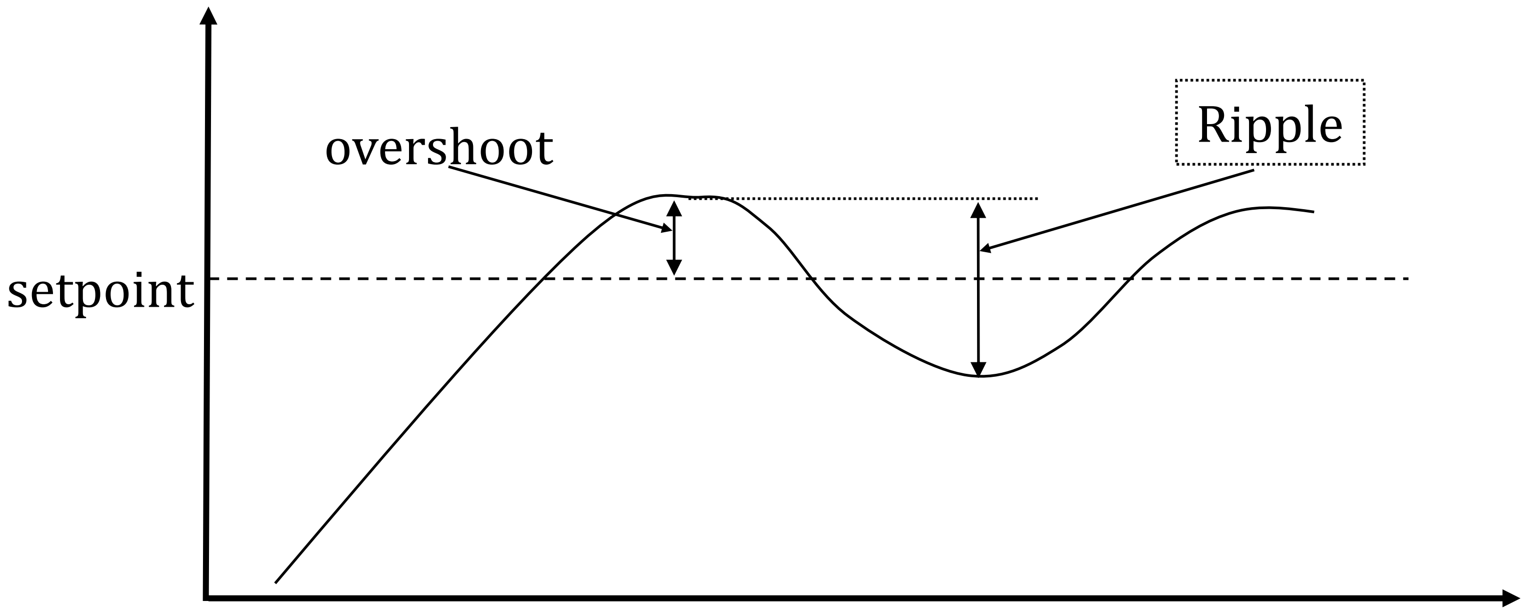
3 Pluviophile (n.)
A lover of rain; someone who finds joy and peace of mind during rainy days.
Example: My sister is a real pluviophile; she really enjoys the weather in the rainy season.

2 Euphoria (n.)
A feeling or state of intense excitement and happiness.
Example: The euphoria of passing my final exam is a feeling I will never forget.

1 Sequoia (n.)
(A 7 letter word that has the letter Q and all 5 vowels) A redwood tree, especially the California redwood.
Example: I love visiting forests where you can see a sequoia.

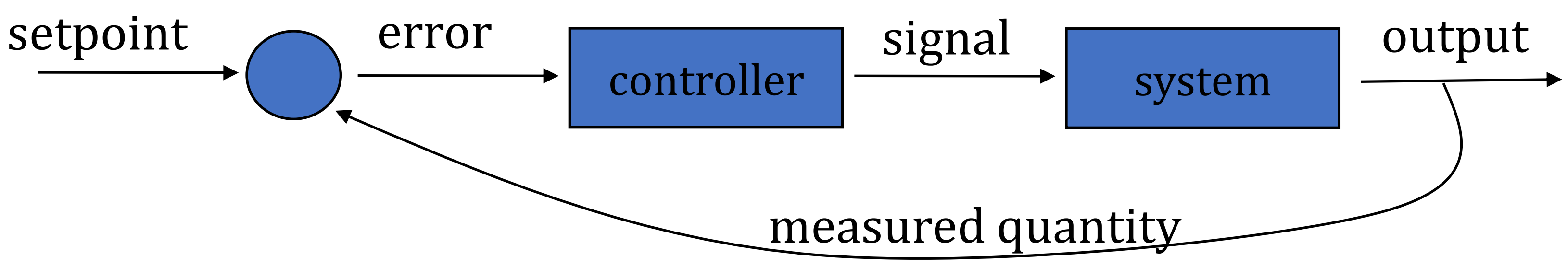
CAN YOU SAY ANY DIFFERENT WORDS WITH MEANING AND EXAMPLE???

PROBLEM EXAMPLE



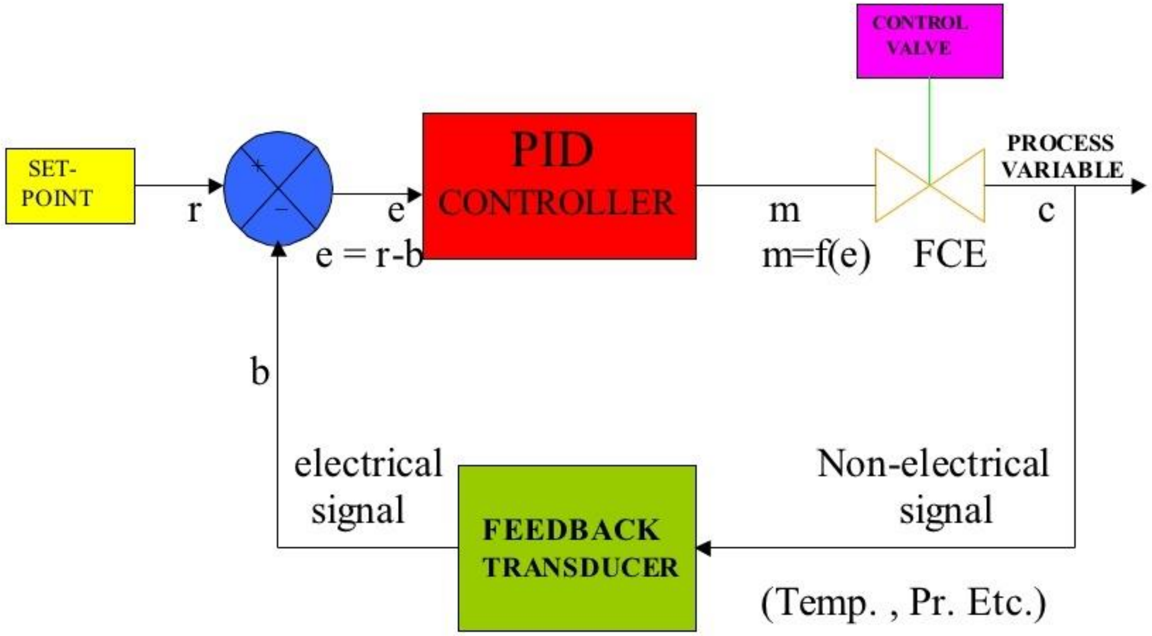
- Increase the quantity until you get to the setpoint
  - Temperature, angle, speed, etc
- If too much, reduce the quantity, until the setpoint

CLOSED LOOP CONTROLLER



- Closed loop because it has feedback
- Output is measured at a certain frequency
- Signal is generated at a certain frequency
- Which frequency is not smaller?

PID CONTROLLER



r = ref. Point / Set-point
b = feedback variable
e = error(actuating) signal
m= manipulated variable
c = controlled variable / Process variable
FCE= Final Control Element

PID CONTROLLER

The additive combination of Prop. , Integral & Derivative control actions is known as PID-control.

$$m= Kc*e + (Kc/Ti)*\int e\, dt +(Kc*Td)*(de/dt) +M$$

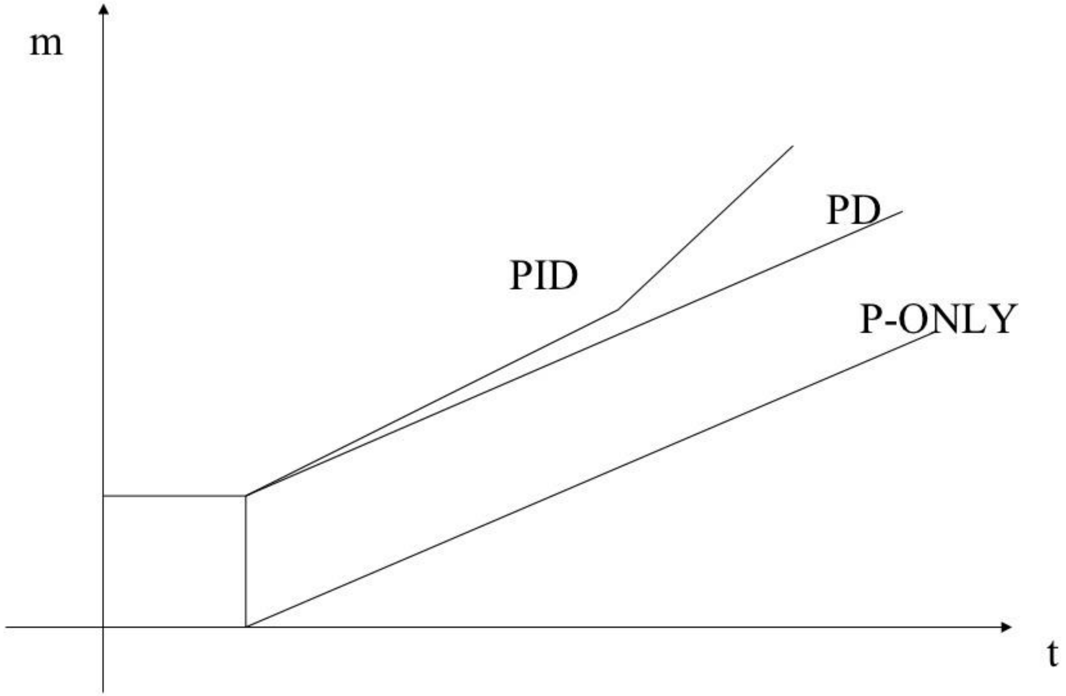
$$\mathbf{m-M = Kc\ [1+(1/Ti*s)+Td*s]\ \ e}$$

For a linear change of deviation : $e = Et$

$$\mathbf{m-M = Kc\ [1+ (1/Ti*s) +Td*s]\ Et}$$

$$\mathbf{m-M = KcE\ (t+t^2/2Ti+Td)}$$

ANALYSIS



ANALYSIS

By using all three control algorithms together, process operators can:

- Achieve rapid response to major disturbances with derivative control
- Hold the process near setpoint without major fluctuations with proportional control
- Eliminate offset with integral control

Controlled Variable	Proportional Control	PI Control	PID Control
Flow	Yes	Yes	No
Level	Yes	Yes	Rare
Temperature	Yes	Yes	Yes
Pressure	Yes	Yes	Rare
Analytical	Yes	Yes	Rare

SUMMARY& THANK YOU

- Different types of controllers
- PID hardest task is tuning

Controller	Response time	Overshoot	Error
On-off	Smallest	Highest	Large
Proportional	Small	Large	Small
Integral	Decreases	Increases	Zero
Derivative	Increases	Decreases	Small change