Proportional Control

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Process Dynamics and Control

Basic components in a control loop

- Process being controlled
  - System of interest
- Sensor-transmitter combination
  - Composition analyzer-transmitter (AT) - measure composition and transmits electrical signal
- Feedback controller
  - Feedback controller (AC) - takes AT electrical signal and calculates appropriate output electrical signal
- Current-to-pressure transducer
  - Current-to-pressure transducer (I/P) - converts electrical signal to pneumatic (air) signal
- Final control element - adjusts manipulated variable
  - Control valve - takes in electrical or pneumatic signal and changes flow rate
- Transmission lines between instruments
  - Electrical cables
  - Pneumatic tubing

Proportional controller has output proportional to the error signal

- Objective: deviation (error) from set point is 0
  - Error signal = Set point - Measured controlled variable

$$e(t) = y_{sp}(t) - y_m(t)$$

- Proportional control

$$p(t) = \overline{p} + K_c e(t)$$

Controller gain could be positive or negative

- Want to maintain constant flow rate w to tank

- Want to maintain constant composition x in tank

Transfer function for proportional controller is the controller gain

Ex. Show that the proportional controller transfer function is

$$\boxed{\frac{P'(s)}{E(s)} - K_s}$$

- Proportional controller:

$$p(t) = \overline{p} + K_c e(t)$$

Proportional band can be used instead of controller gain

- Proportional band

$$\mathrm{PB} \equiv \frac{1}{K_c} \times 100\%$$

Advantages and disadvantages of proportional controllers

- Advantage
  - Simple
    - Great if exact value of controlled value is not important: prevent overflow/empty
- Disadvantage
  - **Offset** - steady-state error
    - Set point change
    - Sustained disturbance