What is Feedback Control?

Control: Process of causing a system (output) variable to conform to some desired value (reference)

e.g. temperature

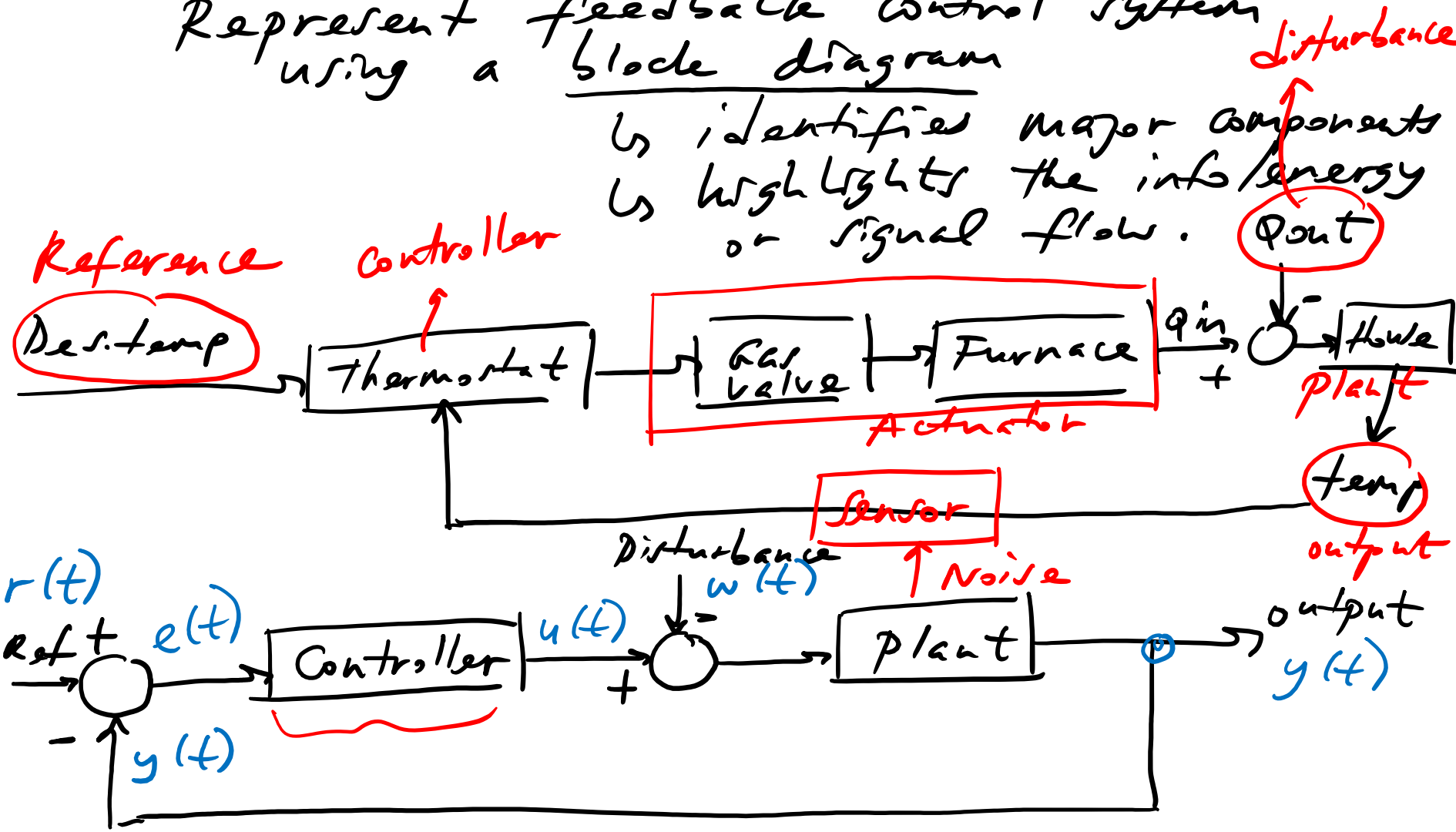
Feedback: measuring the output and using that info. to adjust the input (control variable) to influence the value of that output.

* Feedback is not necessary for control!

Necessary to deal w/ uncertainty.

Represent feedback control system using a block diagram

- identifies major components
- highlights the info/energy or signal flow.

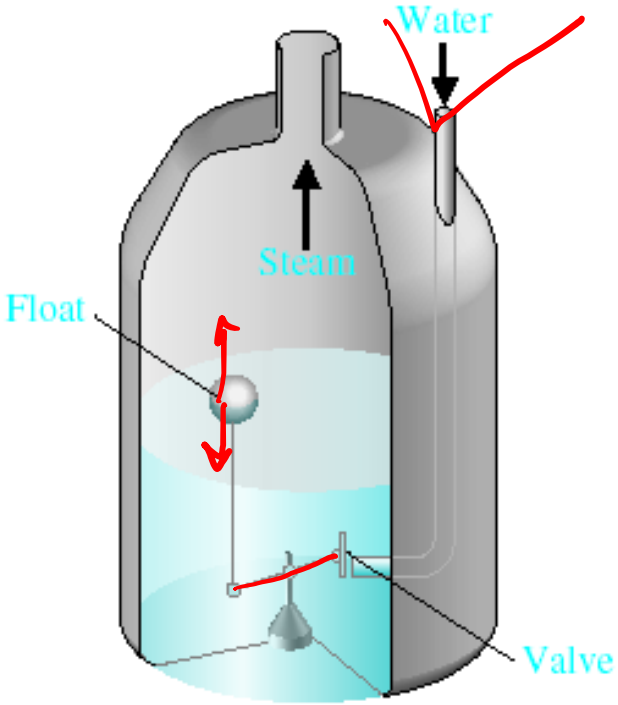


> General feedback control system <

Control system objectives

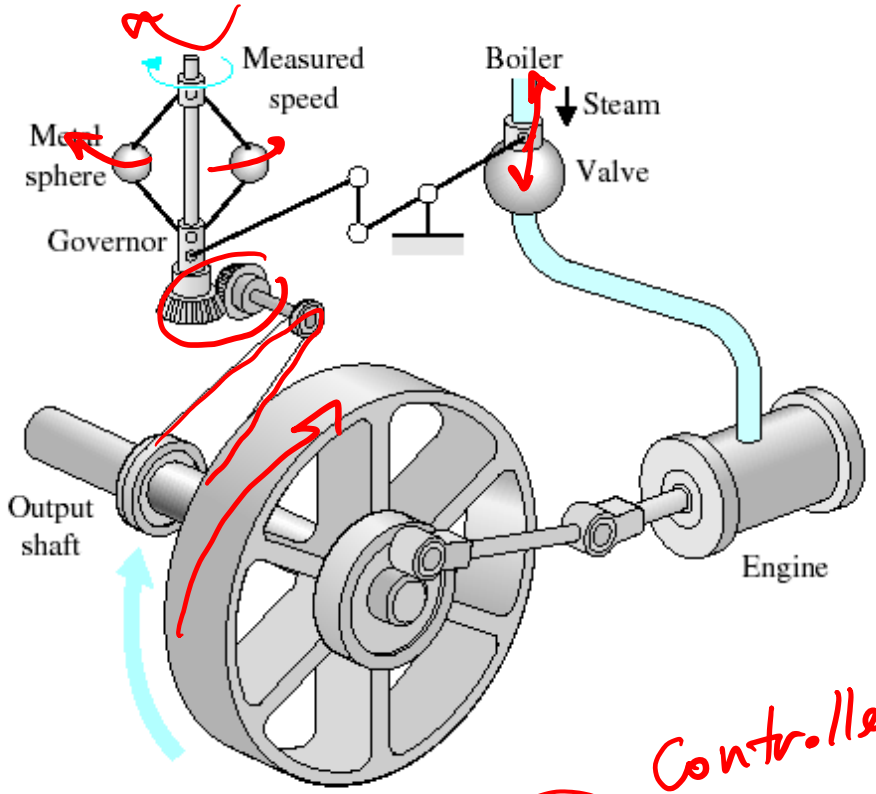
1) Reject disturbance (minimize the plant response to disturbance)
2) Acceptable long-term performance (steady-state response)
3) Acceptable short-term performance (transient response)
4) Minimize sensitivity to plant parameter variations (robustness)

EXAMPLES



FLAMES

Water-level float regulator (BC)



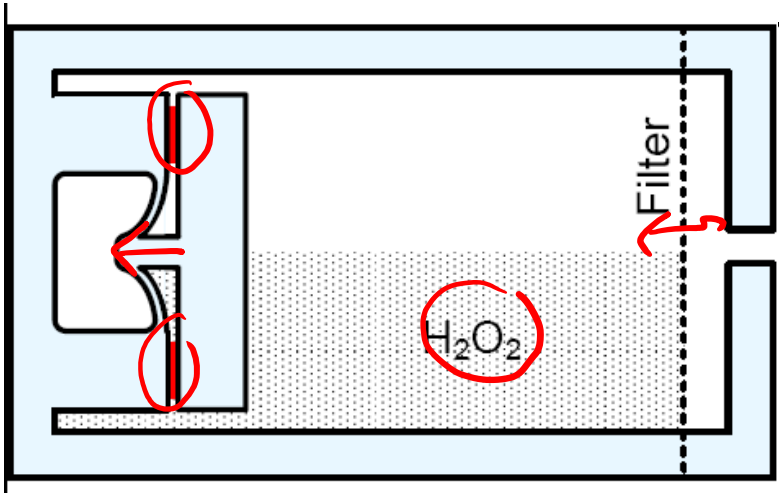
Controller

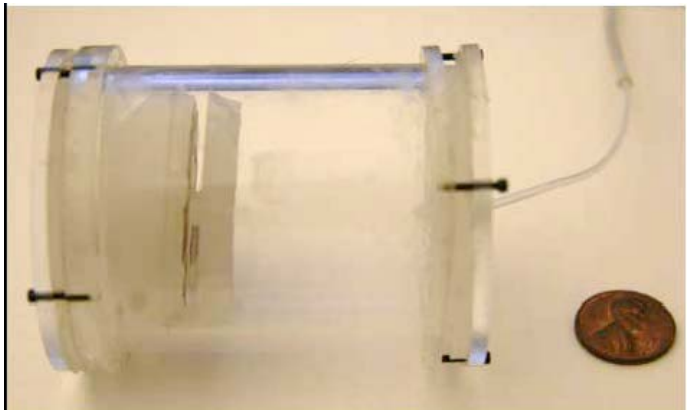
Watt's Flyball Governor (18th century)

Portable Pneumatic Battery

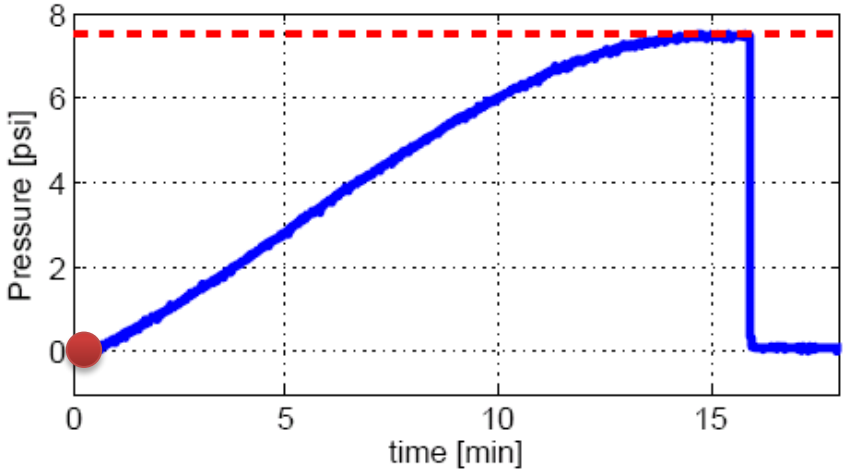
[*ISRR 2011*]

Self-regulating chemical pressure generator





Experimental data of pressure self-regulation



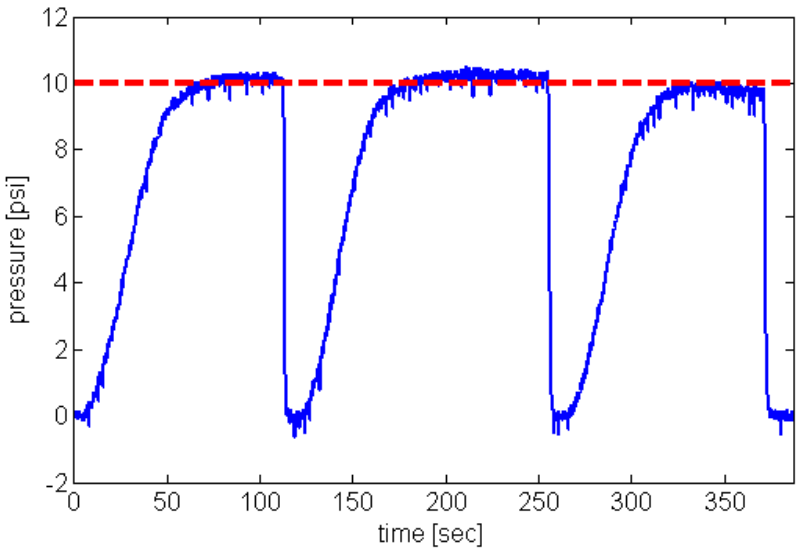
- $2H_2O_2 \xrightarrow{\text{Catalyst}} 2H_2O + O_2$
- 10% H_2O_2 solution in water

Portable Pneumatic Battery

[*ISRR 2011*]

- Deflector membrane deforms and covers catalyst for self regulation:

$$w(r) = \frac{\Delta P r_m^4}{64K}\left(1 - \left(\frac{r}{r_m}\right)^2\right)^2$$



- Air chamber internal pressure must satisfy:

$$\frac{r_m^4}{192K}P_{in}^2 + \left(h - \frac{P_c r_m^4}{192K}\right)P_{in} - hP_o = 0$$

- 50% H_2O_2 solution in water
- 10 psi cut-off pressure (P_c)

Methodology

0. Choose sensors and actuators
1. Develop models
2. Design controller → based on models, design criteria
3. Evaluate design (simulations, experiments)
4. Iterate!