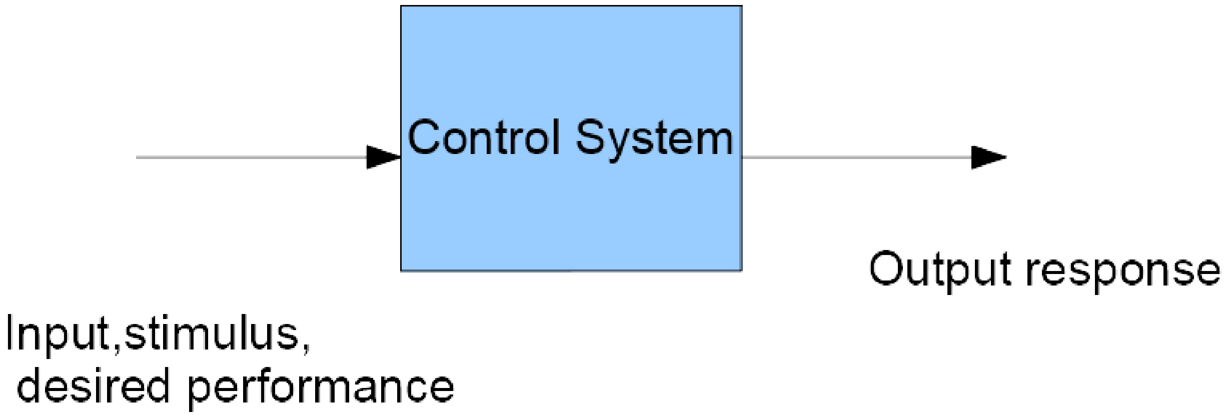
FEEDBACK CONTROL SYSTEMS

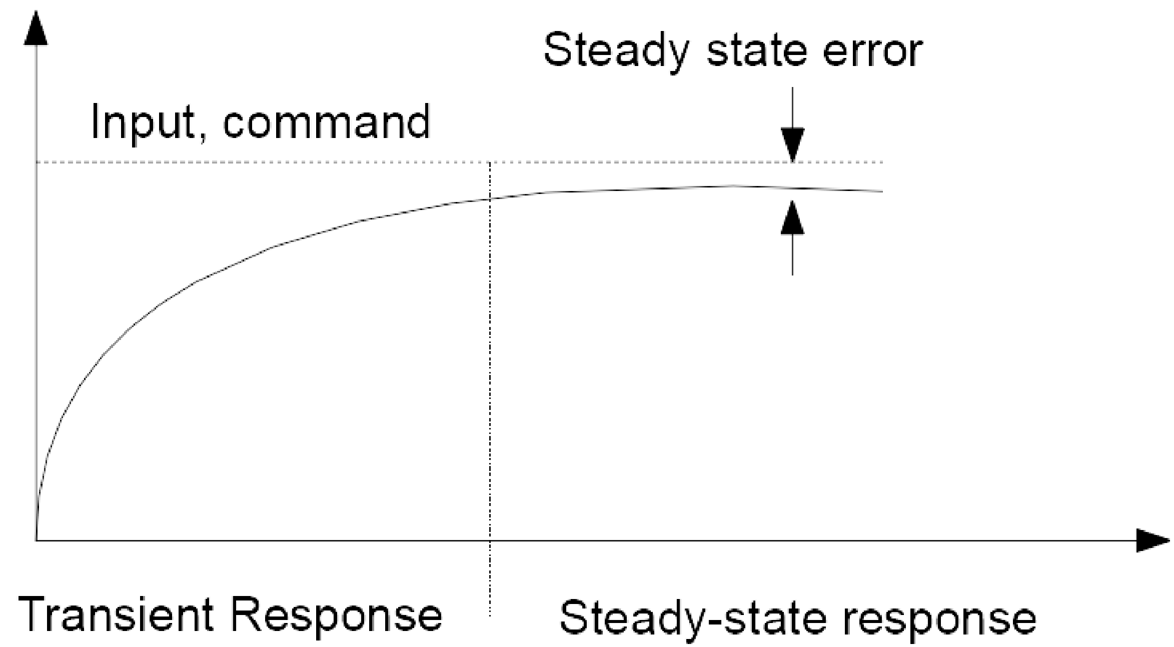
LECTURE NOTES-1

A control system is an interconnection of components (sub systems and processes (or plants)) forming a system configuration that will provide a desired system response with a desired performance



Example:

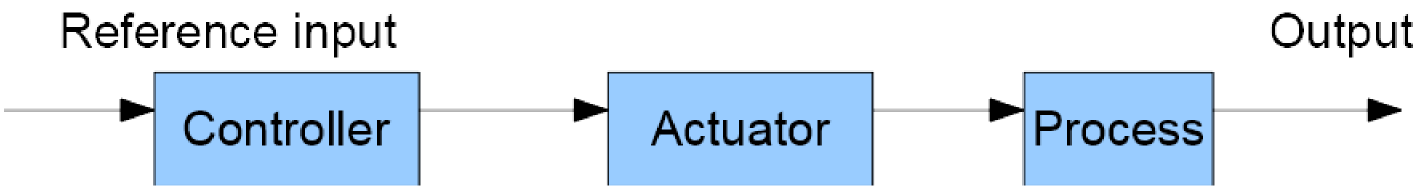
Consider an elevator at the first floor. If the 5th floor button is pressed



a) Rise to the 5th floor with a desired speed (as fast as possible)

b) Floor-level accuracy designed for passenger comfort

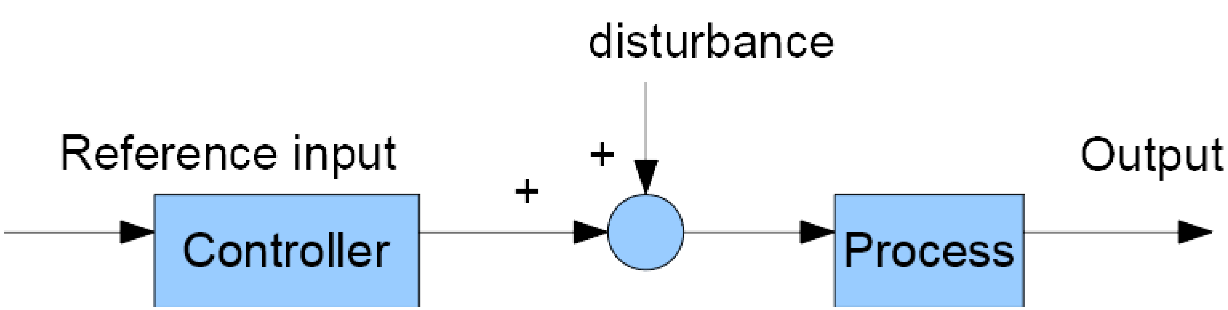
Open-loop System



Actuator is a type of motor that is responsible for moving a system

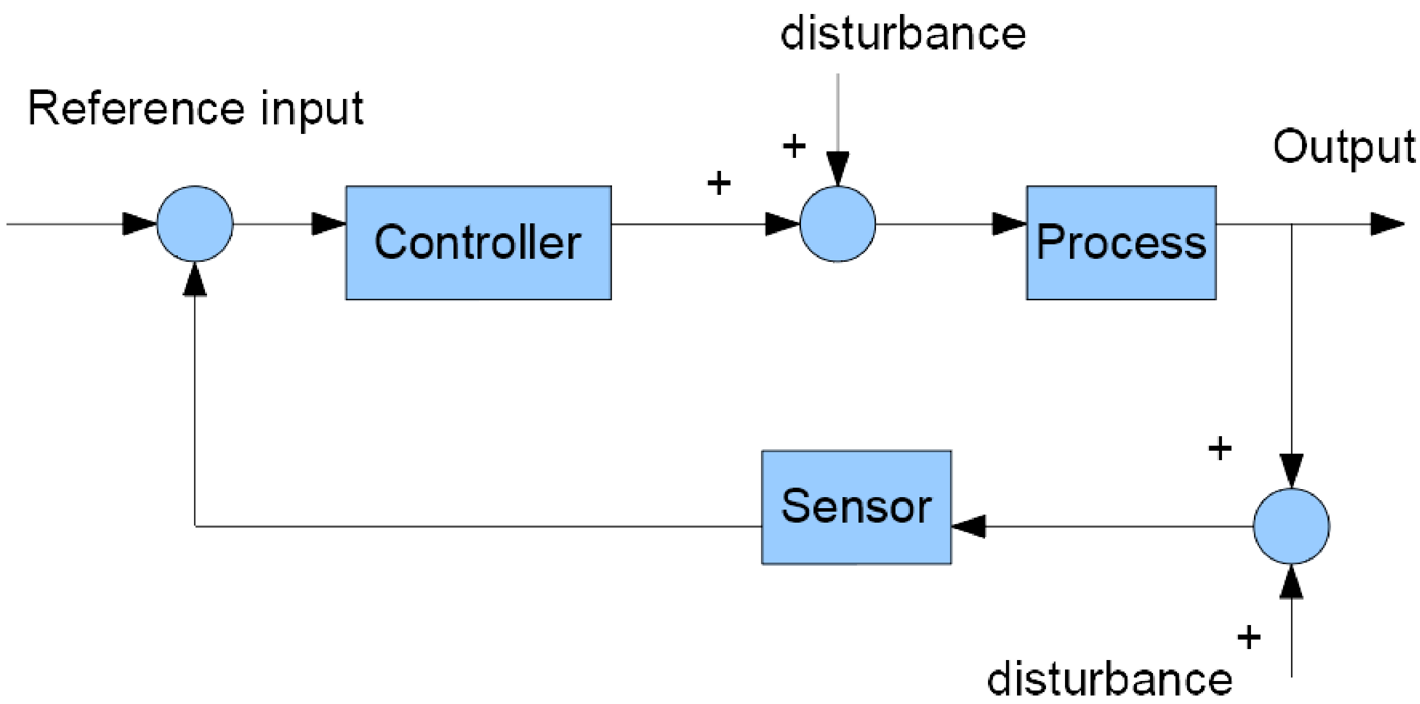
A system that does not monitor its output nor correct for disturbance

Disturbance is an un wanted signal that corrupts the input or output of a plant or process



Closed-Loop Systems

A system that monitors its output and corrects for disturbances.



Error is the difference between output of process under control and reference input

- Closed loop control ability to reject external disturbances which are inevitable in real-world applications

- Less sensitive to noise (disturbance)

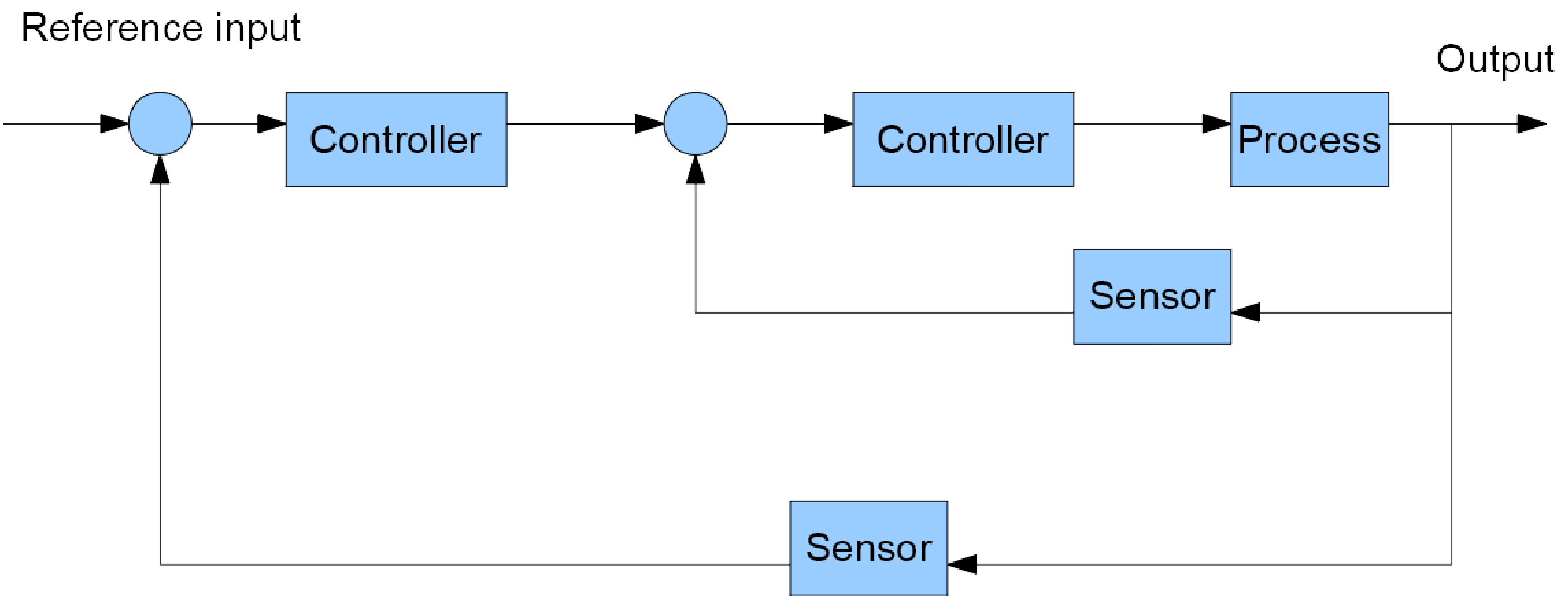
- Transient response and steady state error can be controlled more conveniently often by a single gain

- Compensator is a sub system inserting into forward or feedback path for the purpose of improving the transient response or steady state error

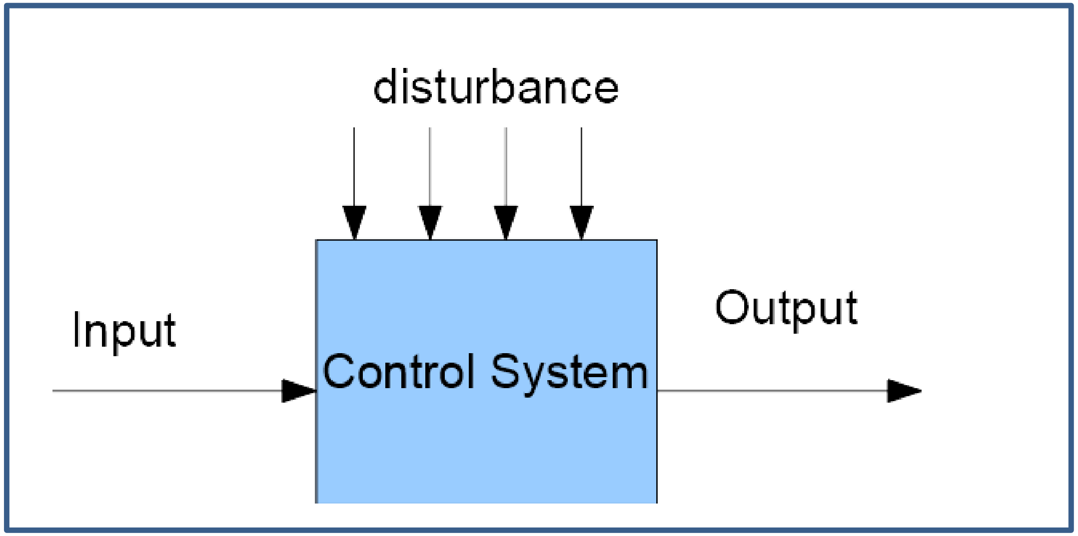
- More complex and expensive

Example:

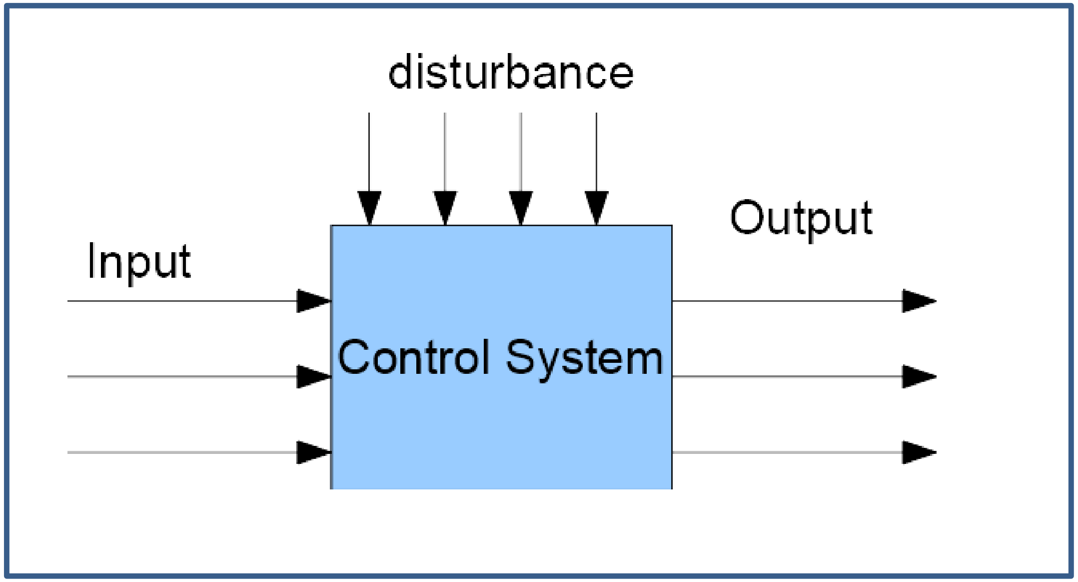
Multi-loop (cascaded) closed loop systems



SISO: Single Input Single Output



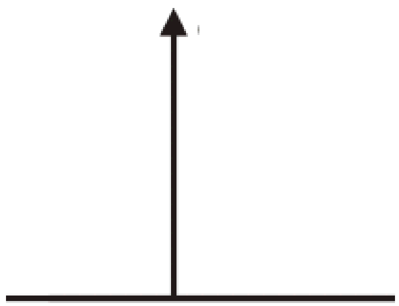
MIMO: Multi input multi output



Design:

- Determine a physical system and specifications from the requirements
- Draw a functional block diagram
- Transform the physical system into schematics
- Use schematic to obtain a block diagram representation
- If multiple blocks reduce to a single block
- Analyze design and test that requirements are met

Test Waveforms

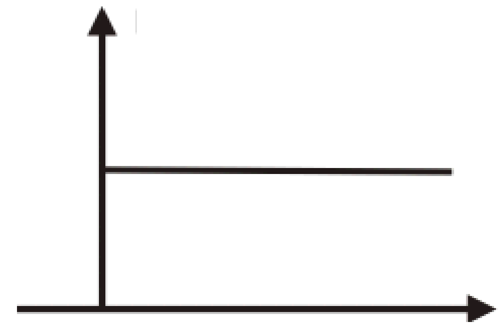


Impulse Signal

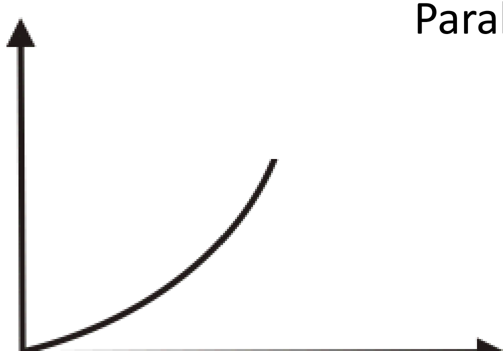
$$\delta(t)$$

Step Signal

$$u(t) = \begin{cases} 1 & t > 0 \\ 0 & t < 0 \end{cases}$$



$$0.5t^2u(t) = \begin{cases} 0.5t^2 & t > 0 \\ 0 & t < 0 \end{cases}$$



Parabola Signal

$$tu(t) = \begin{cases} t & t > 0 \\ 0 & t < 0 \end{cases}$$

Ramp Signal