Concept of Feedback

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Why automatic control?

- Application of automation
  - Industrial: assembly lines
  - Various new gadgets:

  CD ROM drives, hard drives, robots, cruise control, electronic fuel injection, UAVs, printer, scanner, washing machine, xerox machine, ATM, missile systems, space rockets, … the list is endless

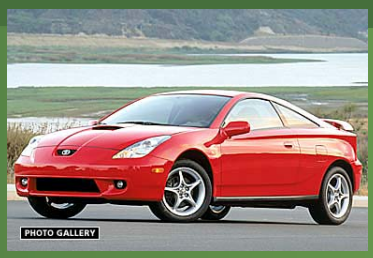
What is automatic control?

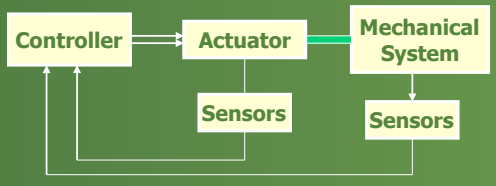
- Fundamental concept: Feedback
- Example: you driving a car/ bike

Feedback??

Elements of automatic control system (Mechatronics)

- Example "Driving of a car"
  - Actuators: Engine of the car, your hands, legs
  - Sensors: Your eyes, ears, etc.
  - Controller: "your brain"
  - Plant: Car
  - Feedback: position and speed of car





Typical elements of a Mechatronic system

Important Concepts

- What is feedback?
- Open Loop Vs Closed Loop Control
- How to process the desired feedback quantity?
- When goal is given, how to decide what should be the control algorithm? Is it unique?

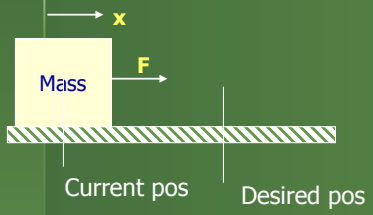
We will answer these questions in this part of course

What is feedback?

- Monitor the output
- Compare the output with the reference input
- Take decision based on the difference

In case of sprinkler: soil moisture as a possible feedback

Feedback: Example



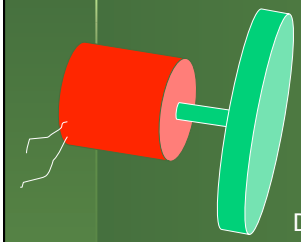
- Goal: to place mass at a desired position
- Feedback???

- Identify: quantity of interest (output) and quantity you can dictate (input)

Important points

- While simulating use fixed step size of ~0.01sec
- Think of control law (expression for F in terms of x) in linear domain
- Plot input Force as a function of time: can you see how acceleration would vary with your proposed control law

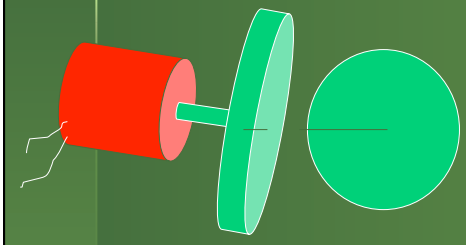
Feedback: Example



- Goal: to place disc at a desired angle
- Feedback???

- Identify: quantity of interest (output) and quantity you can dictate (input)

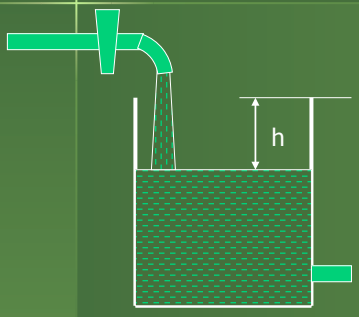
Feedback: Example



- Goal: to rotate disc with desired speed
- Feedback???
- Can the angle act as feedback?

- Identify: quantity of interest (output) and quantity you can dictate (input)

Feedback: Example



- Goal: to maintain height of liquid constant
- Feedback???

- Identify: quantity of interest (output) and quantity you can dictate (input)

Open Loop Control

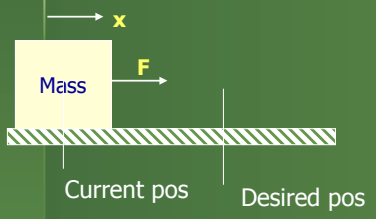
- No relation between input and output
- Useful for well-defined systems

Examples:

- A sprinkler programmed to run at set times

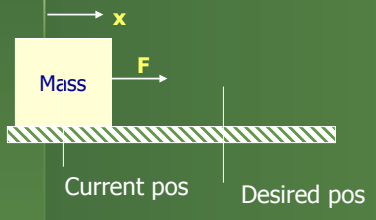
What if it is raining?

Example:

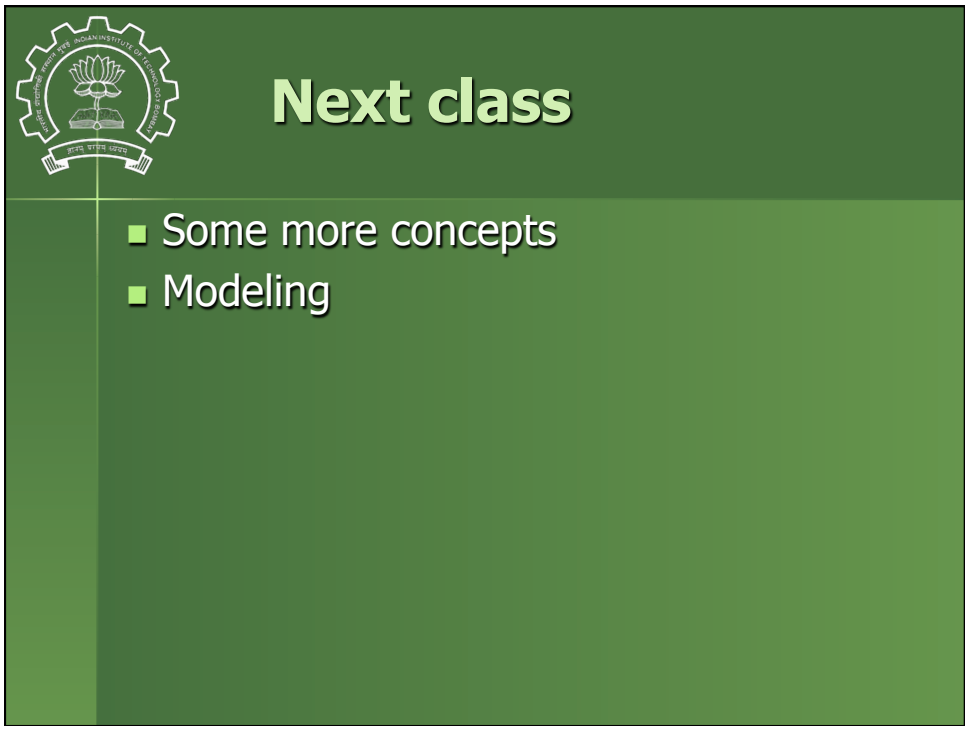


- So what? If we know what quantity is fed back and I know the inputs and outputs
- What's next?
- Q: How do I process position so as to reach desired position
  - in small time
  - Without exceeding the desired position

Example:



- Ok lets write equation of motion of mass under force F
- Think what will happen if force is
  - Constant
  - Sinusoidal
- Can you think and write force F as a function of x and xd such that the mass will go finally to xd?


Next class
Some more concepts
Modeling