ME451: Control Systems

Lecture 1
Introduction

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Instructor

- Class Instructor: Dr. Jongeun Choi,
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- Office Hours
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- Laboratory Instructor: Dr. C. J. Radcliffe,
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Course information

- Lecture:
  - When: MWF: 11:30am-12:20pm,
  - Where: C103 McDonel Hall
- Class website: http://www.egr.msu.edu/classes/me451/jchoi/2008/
- Laboratory website: http://www.egr.msu.edu/classes/me451/radcliff/lab
- Required Text:
  - Feedback Control Systems, C. L. Phillips and R. D. Harbor, Prentice Hall, 4th edition, 2000

Main components of the course

- Lectures (about 40 lectures)
- Midterm1 (October 3rd, Friday, in class)
- Midterm2
- Final (Final exam period)
- Laboratory work
- Grading:
  - Homework (15%), Exam 1 (15%), Exam 2 (15%), Final Exam (comprehensive) (30%), Laboratory work (25%)
  - Homework will be due in one week from the day it is assigned

Tips to pass this course

- Come to the lectures as many times as you can.
- Print out and bring lecture slides to the lecture.
- Do "Exercises" given at the end of each lecture.
- Do homework every week.
- Read the textbook and the slides.
- Make use of instructor's office hours.
- If you want to get a very good grade…
  - Read the textbook thoroughly.
  - Read optional references too.
  - Do more than given "Exercises".
  - Use and be familiar with Matlab.

What is "Control"?

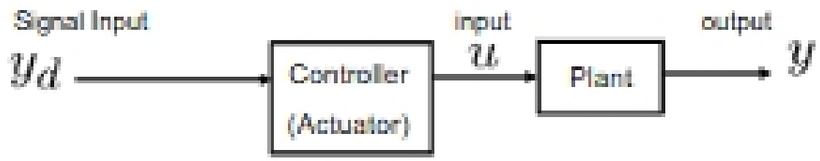
- Make some object (called ***system, or plant***) behave as we desire.
- Imagine "control" around you!
  - Room temperature control
  - Car/bicycle driving
  - Voice volume control
  - "Control" (move) the position of the pointer
  - Cruise control or speed control
  - Process control
  - etc.

What is "Control Systems"?

- Why do we need control systems?
  - Convenient (room temperature control, laundry machine)
  - Dangerous (hot/cold places, space, bomb removal)
  - Impossible for human (nanometer scale precision positioning, work inside the small space that human cannot enter)
  - They exist in nature. (human body temperature control)
  - Lower cost, high efficiency (factory automation), etc.
- Many examples of control systems around us

Open-Loop Control

- Open-loop Control System
  - Toaster, microwave oven, shooting a basketball



- Calibration is the key!
- Can be sensitive to disturbances

Example: Toaster

- A toaster toasts bread, by setting timer.

- Objective: make bread golden browned and crisp.
- A toaster does not measure the color of bread during the toasting process.
- For a fixed setting, in winter, the toast can be white and in summer, the toast can be black (Calibration!)
- A toaster would be more expensive with sensors to measure the color and actuators to adjust the timer based on the measured color.

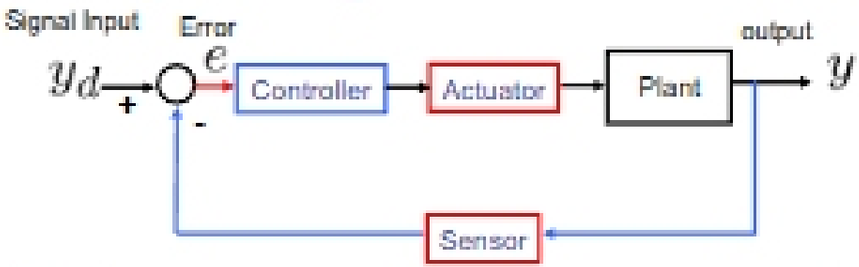
Example: Laundry machine

- A laundry machine washes clothes, by setting a program.

- A laundry machine does not measure how clean the clothes become.
- Control without measuring devices (sensors) are called *open-loop control*.

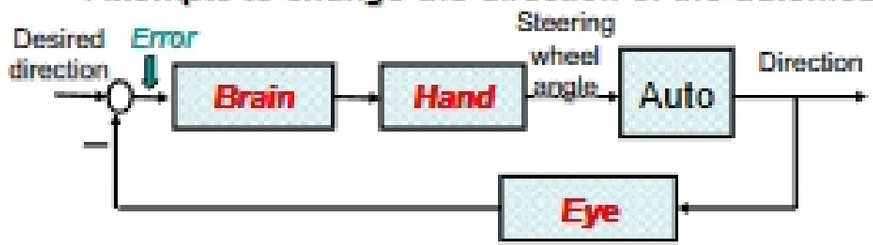
Closed-Loop (Feedback) Control

- Compare actual behavior with desired behavior
- Make corrections based on the error
- The sensor and the actuator are key elements of a feedback loop
- Design control algorithm



Ex: Automobile direction control

- Attempts to change the direction of the automobile.



- Manual closed-loop (*feedback*) control.
- Although the controlled system is "Automobile", the *input* and the *output* of the system can be different, depending on *control objectives*!