Industrial Process Control

If you have a smart project, you can say "I'm an engineer"

Staff boarder

Dr. Mostafa Elsayed Abdelmonem

Industrial Process Control
MDP 454

- Course aims:
  - Understand the classic control strategies
  - Understand the artificial intelligent systems
  - Create and innovate the real model to simulate the some cases
- References

•Dorf, R. C., & Bishop, R. H. (2001). Modern control systems. Upper Saddle River, NJ: Prentice Hall. (Ref-01)

•Burns, R. S. (2001). Advanced control engineering. Oxford: Butterworth-Heinemann. (Ref-02)

Course plan

week	Date	Contents	Requirements	Laboratory	References	Marks
1	24-9	Introduction Syllable/Course specs Control system classifications System Modeling			Ref-01	
2	1-10	Mathematical Modeling (Mechanical-Hydraulic)		Sensor and instrumentation		
3	8-10	Modeling (electrical system and motors)				5/3 quizes
4	15-10	Modeling of combined systems Block diagram		Electrical- mechanical analogy		
5	22-10	Transfer function and State space				5/3 quizes
6	29-10	Time Response (2^{nd} order)		Filters		
7	5-11	steady state Error, Stability analysis				
8	12-11	Midterm				15

Course plan

week	Date	Contents	Requirements	Laboratory	References	Marks
9	19-11	Frequency Response Bode Plot			Ref-01	
10	26-11	Design Controller and system compensation	Reports (instrumentation in Labview)	DC- motor Kit		5
11	3-12	PID / Design	Quiz	Operational amplifier circuits		5/3 quizes
12	10-12	Optimal and LQR control Fuzzy Logic Control			Ref-02	
13	17-12	Neural Network (Case study)				
14	24-12	Corrective exam and Receive project				10 for exam 20 for project

Evaluation rules

Report Contents

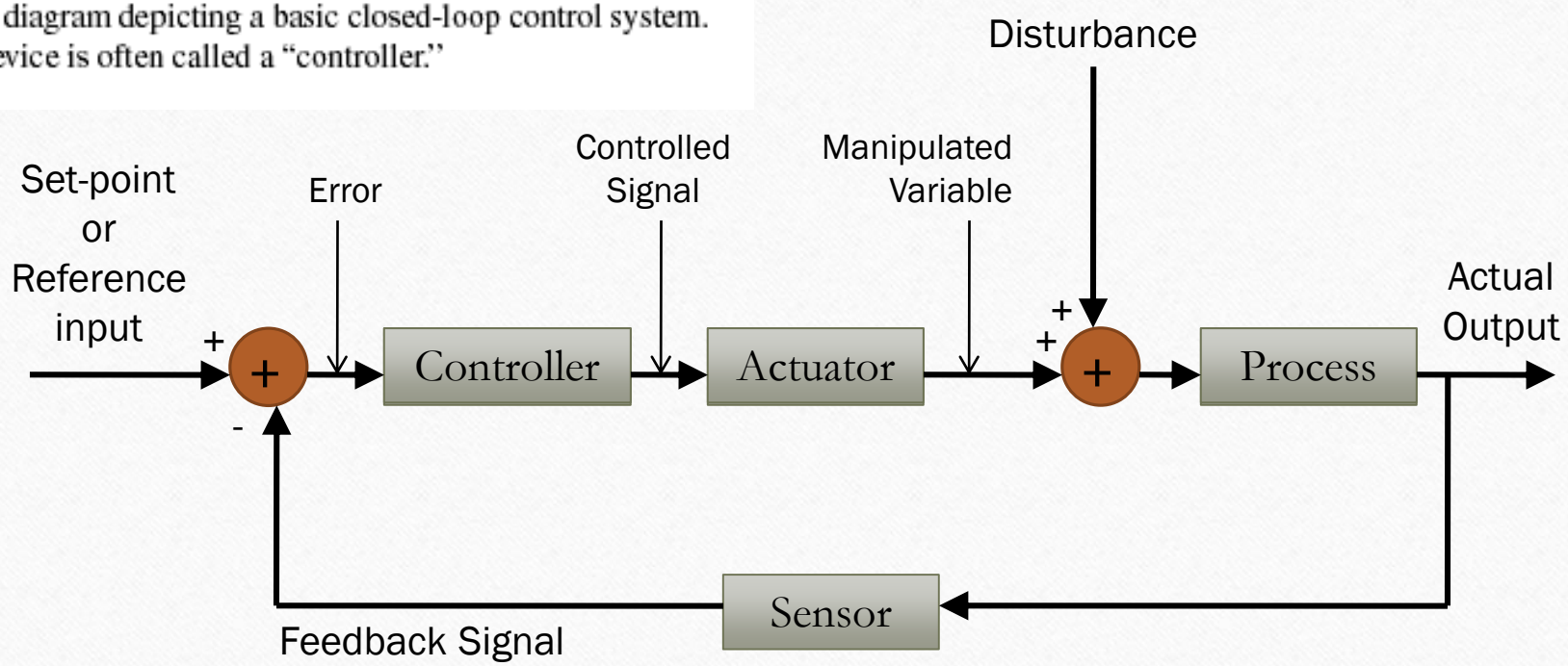
- Research plane
- Problem statement / Aim
- Tools/facilities
- Methodology/control strategy
- Experimental works
- Result/ conclusions

Marks distribution

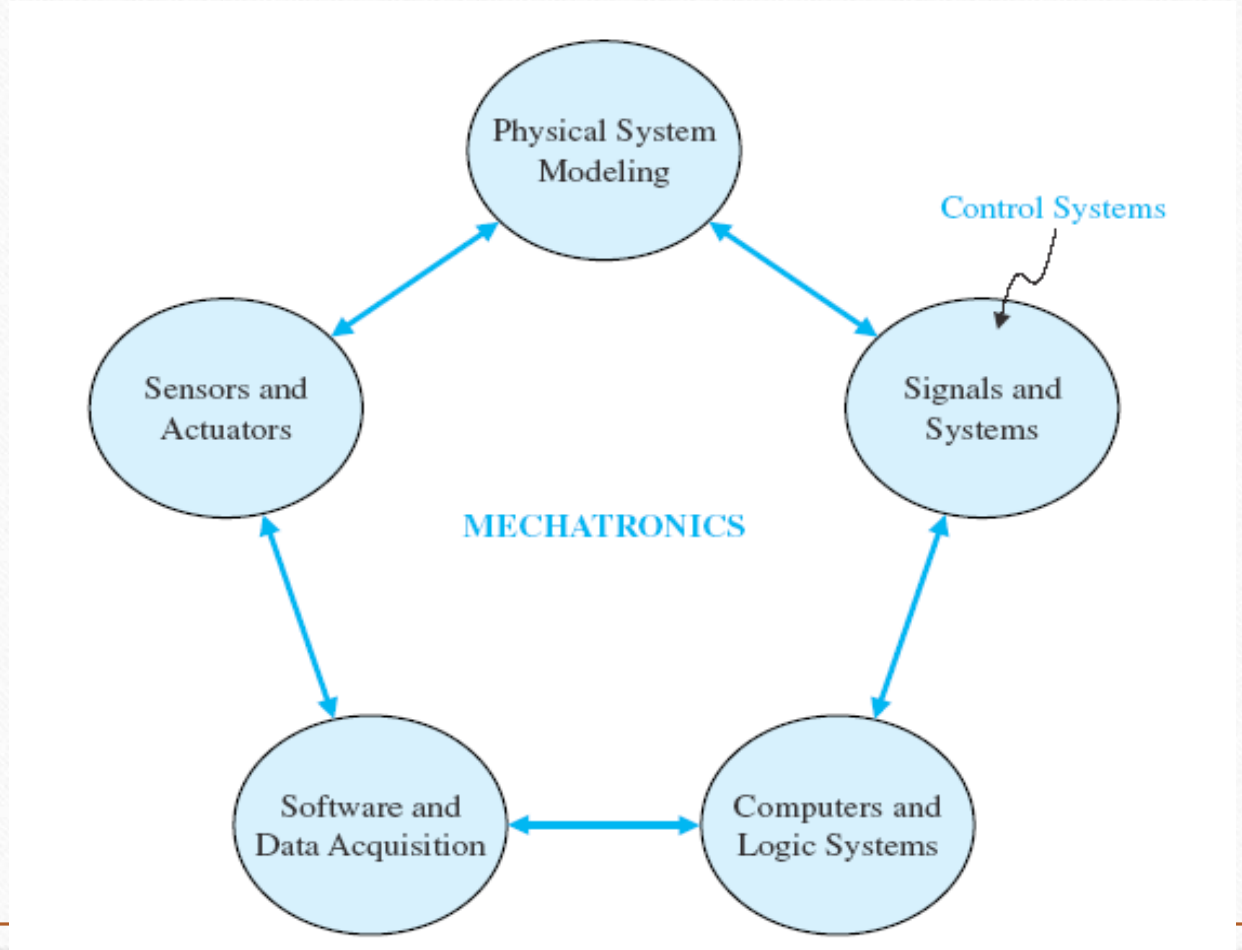
Marks \ assesments	Assessments		Final Exam	Total
	• MidTerm	15	80	
	• Projects	20		
	• Report	5		
	• quizes	5		
TOTAL		45	80	125

Automatic control system

A negative feedback system block diagram depicting a basic closed-loop control system. The control device is often called a "controller."

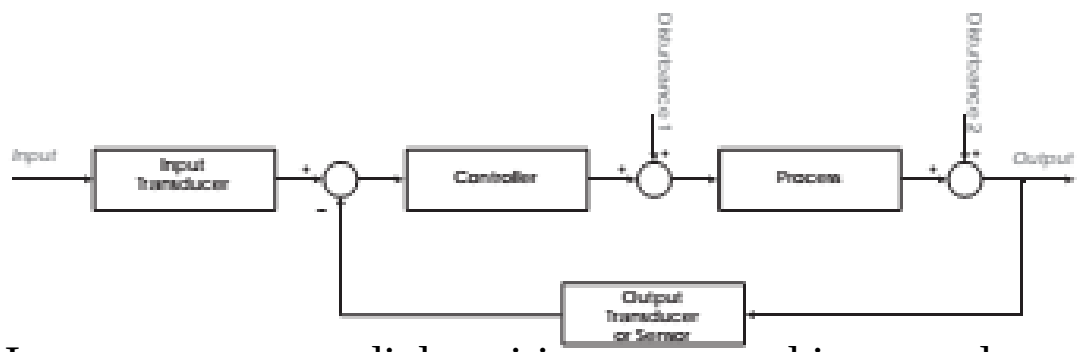


Automatic control system



Automatic control system

Closed-Loop Control System

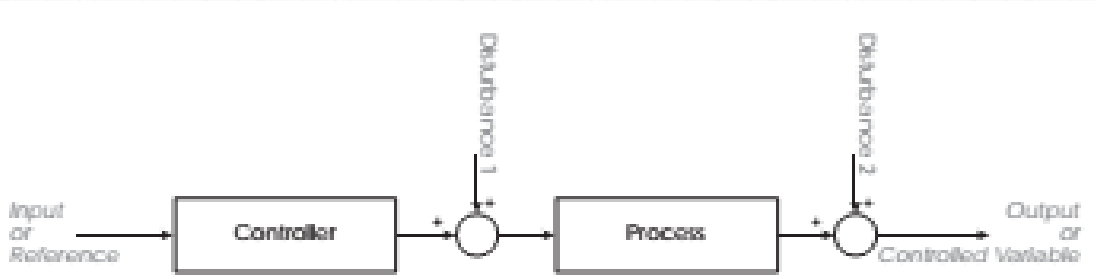


Input temperature dial position converted into a voltage by a potentiometer.

Output temperature converted to a voltage by a thermistor.

Differencing circuit subtracts output from input result is actuating signal controller drives the plant only if there is a difference

Open-Loop Control System



Process is a boiler, input is fuel, output is heat.

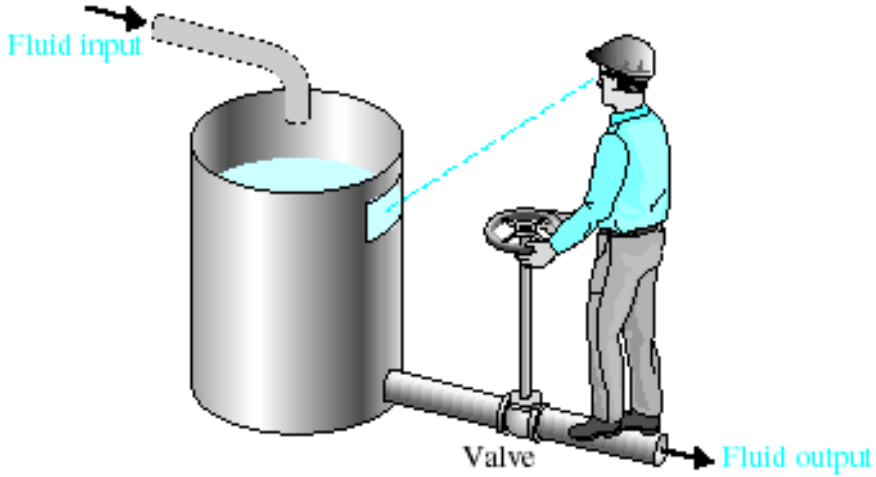
Controller is electronics, valves, etc. that control fuel flow into furnace.

Input is thermostat position

Automatic control system

Examples of Modern Control Systems

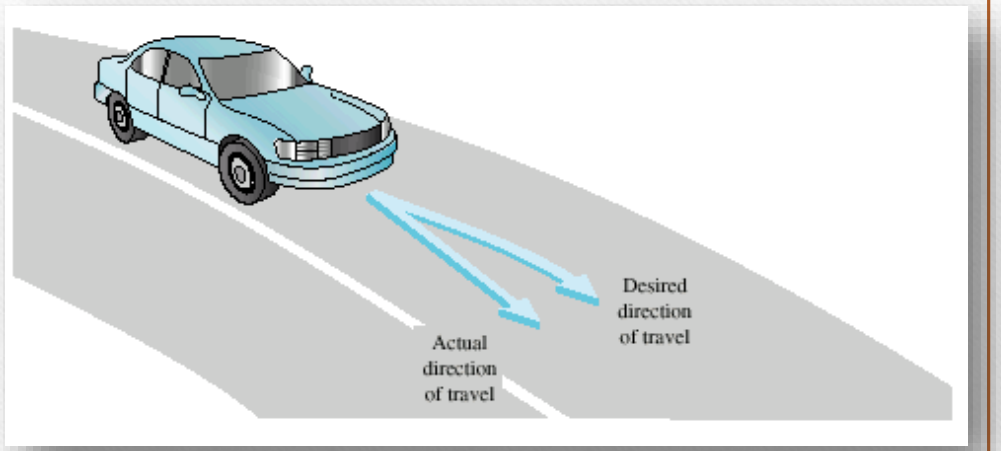
A manual control system for regulating the level of fluid in a tank by adjusting the output valve. The operator views the level of fluid through a port in the side of the tank.



Automatic control system

Transportation

Car and Driver

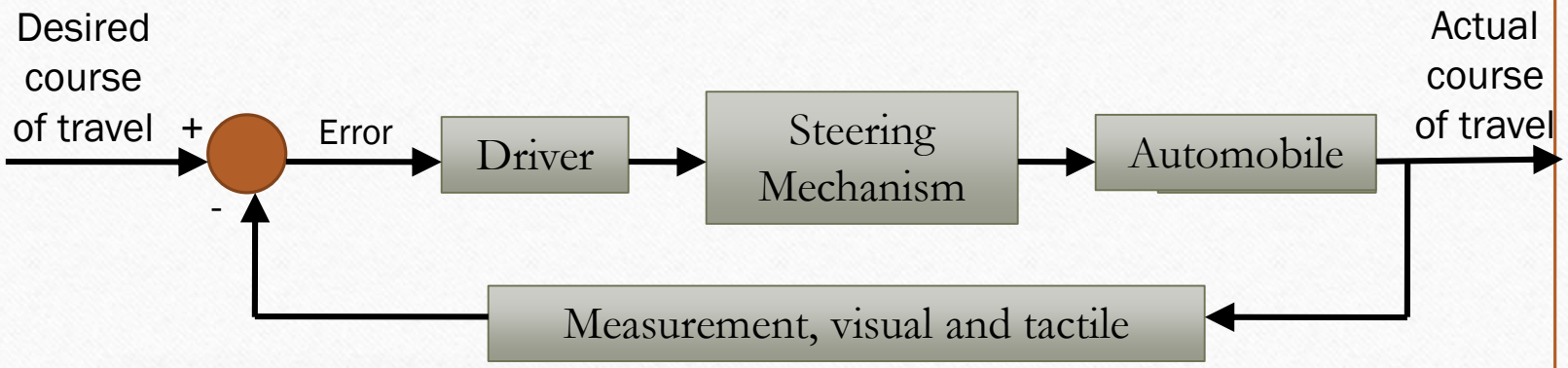


- Objective: To control direction and speed of car
- Outputs: Actual direction and speed of car
- Control inputs: Road markings and speed signs
- Disturbances: Road surface and grade, wind, obstacles
- Possible subsystems: The car alone, power steering system, breaking system

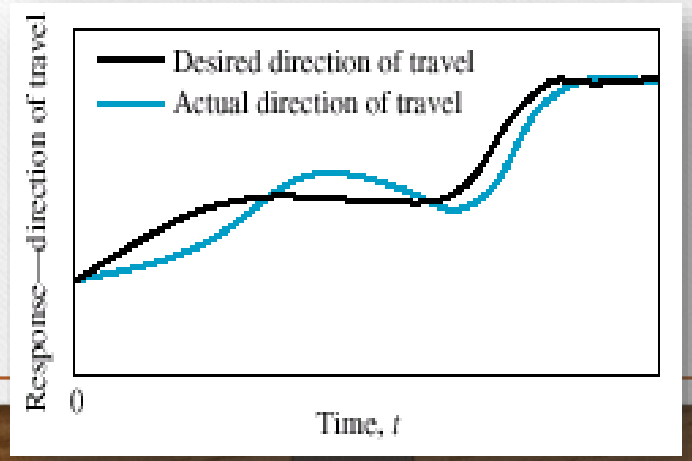
Automatic control system

Transportation

- Functional block diagram:



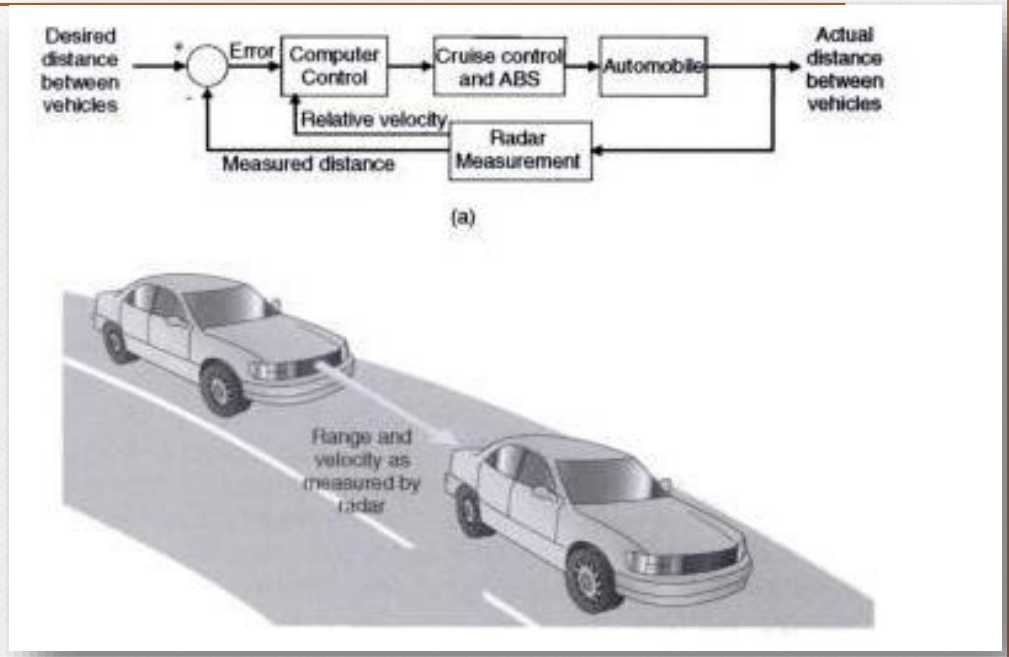
- Time response:



Automatic control system

Transportation

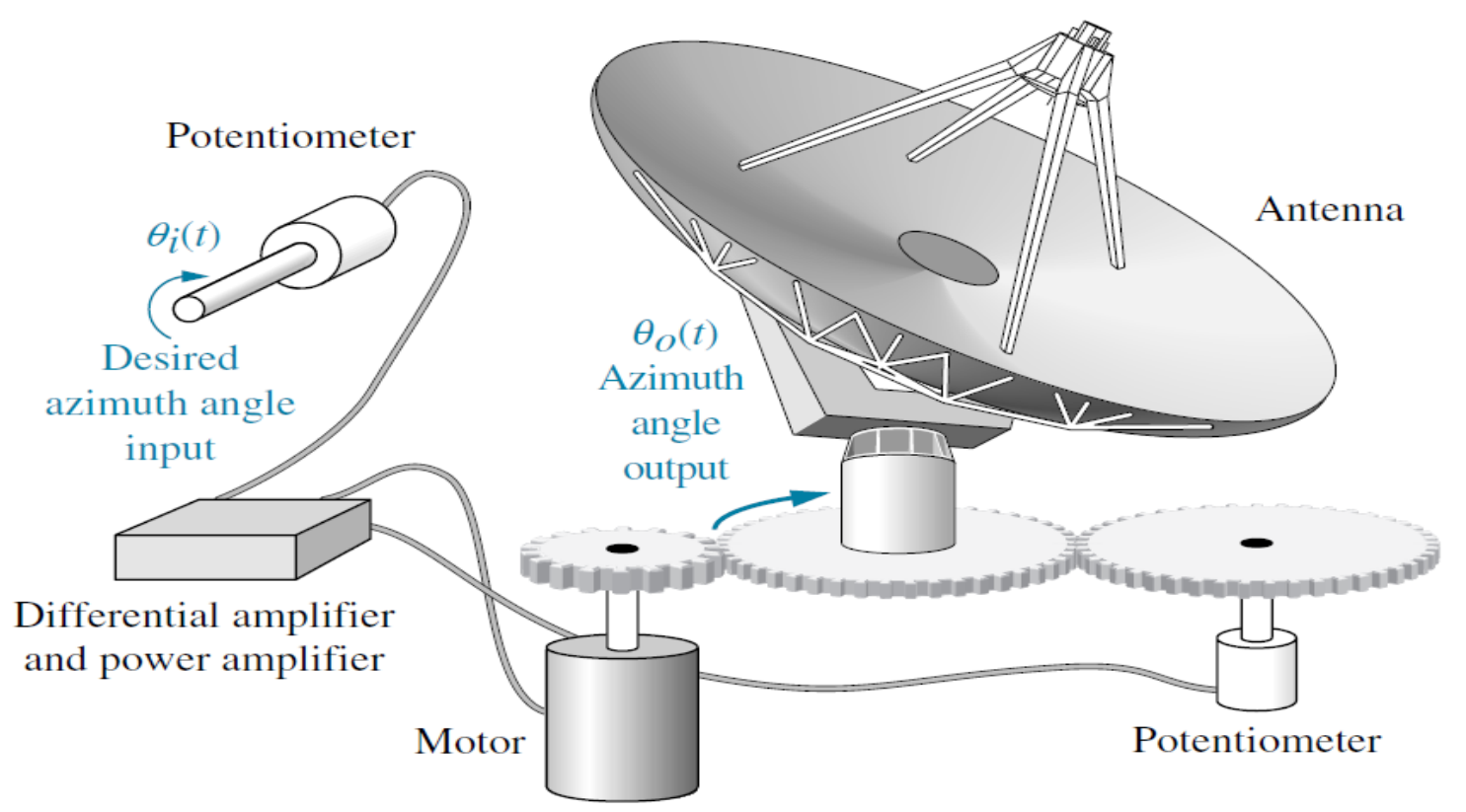
- Consider using a radar to measure distance and velocity to autonomously maintain distance between vehicles.



- Automotive: Engine regulation, active suspension, anti-lock breaking system (ABS)
- Steering of missiles, planes, aircraft and ships at sear.

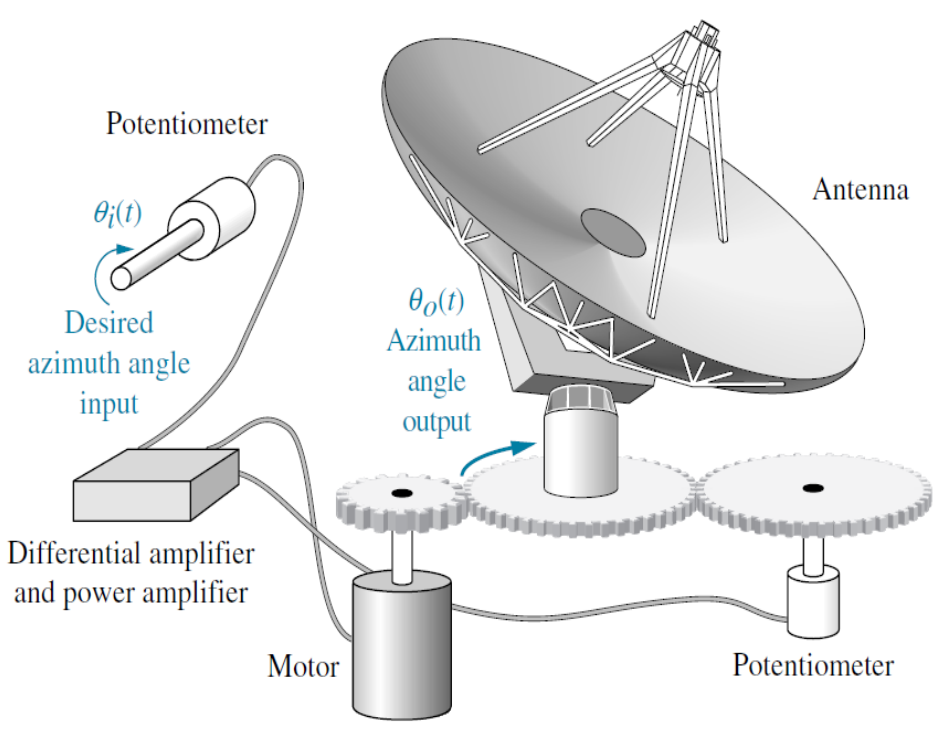
Automatic control system

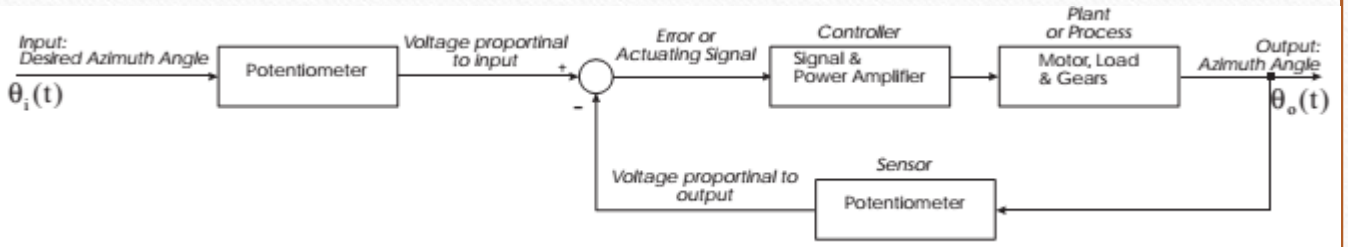
- Azimuth Position Control System Example



Automatic control system

Azimuth Position Control System Example

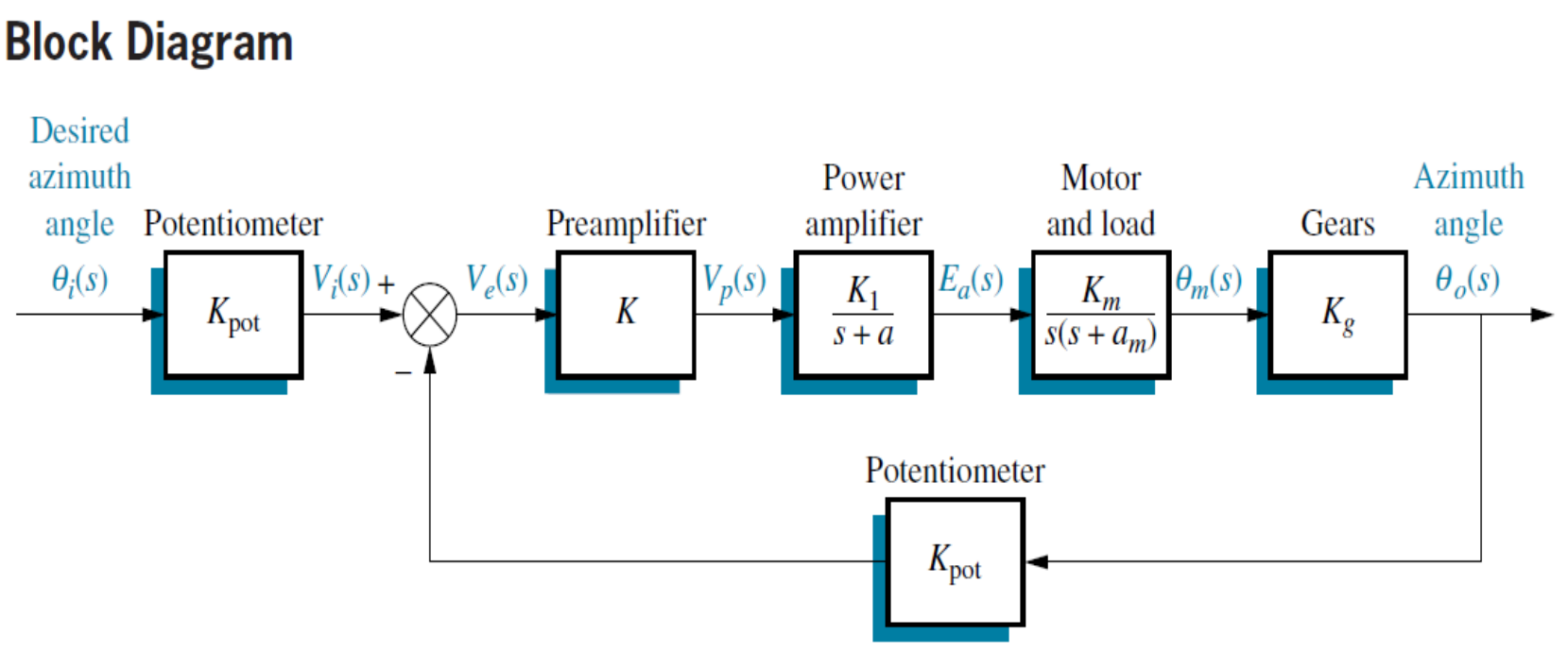




Block Schematic Diagram

Automatic control system

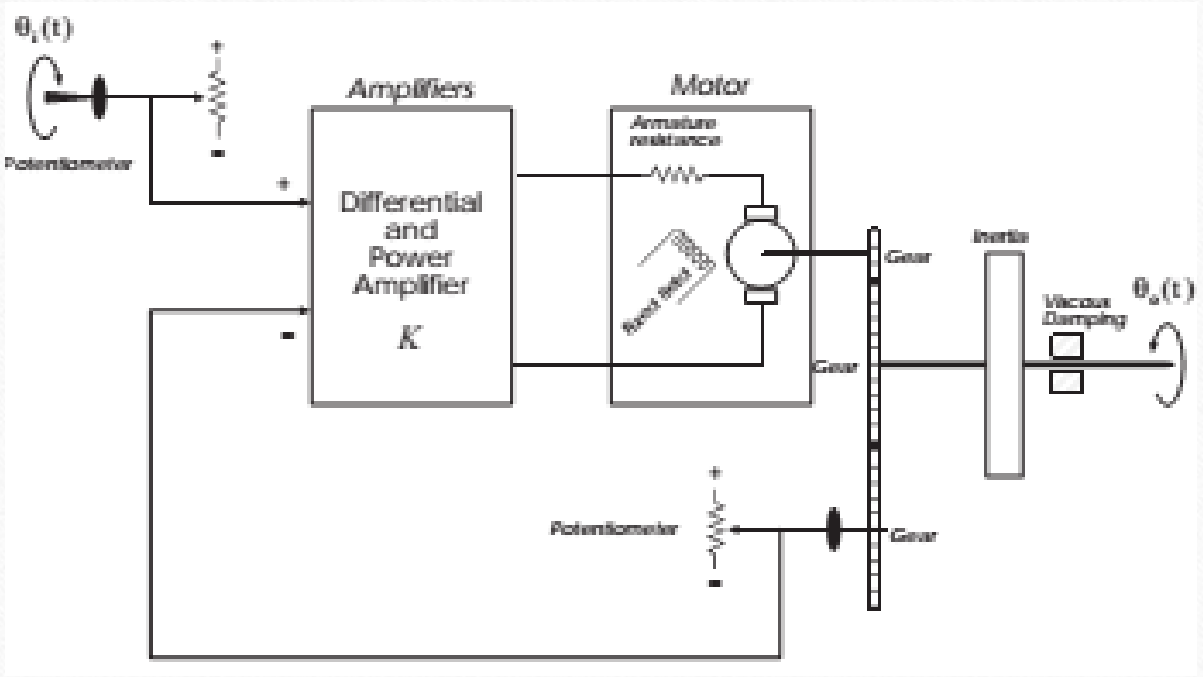
- Azimuth Position Control System Example



Automatic control system

Transform the Physical System into a Schematic

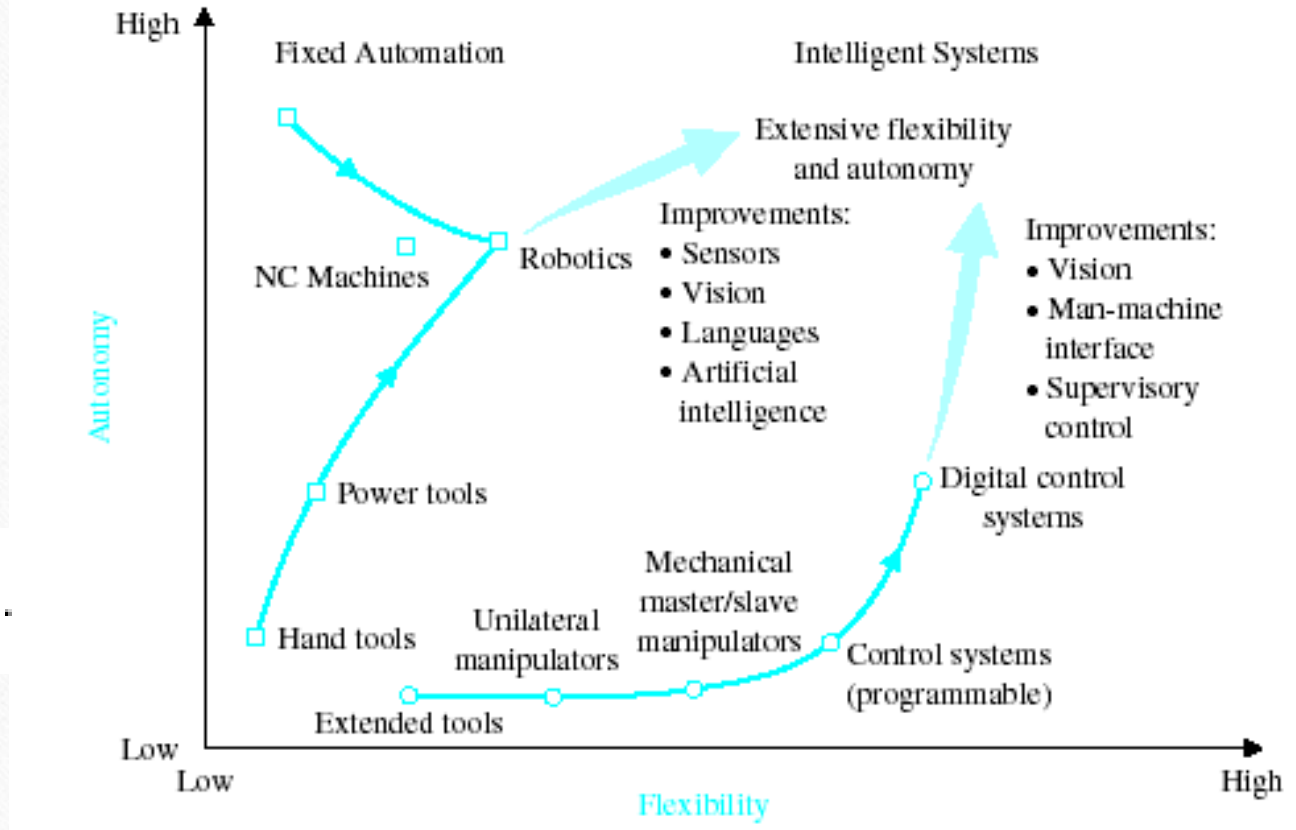
- Makes relationships more concrete
- Enables decisions to be made about what can be neglected in formulating the mathematical model.
- Assumptions made can be easily reviewed and schematic and/or model adjusted as necessary.
- Should be kept as simple as possible:
  - Checked by analysis and simulation
  - Phenomena added if results do not agree with observed behavior



Block Schematic Diagram

Automatic control system

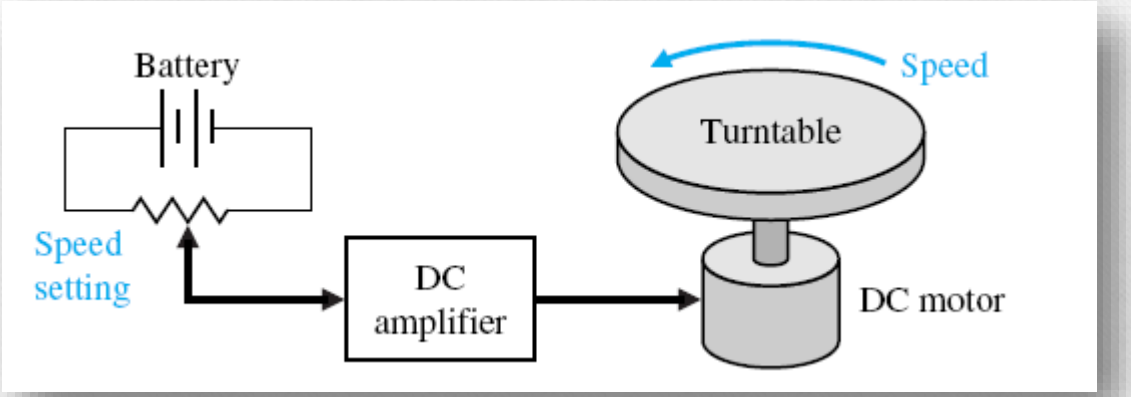
The Future of Control Systems



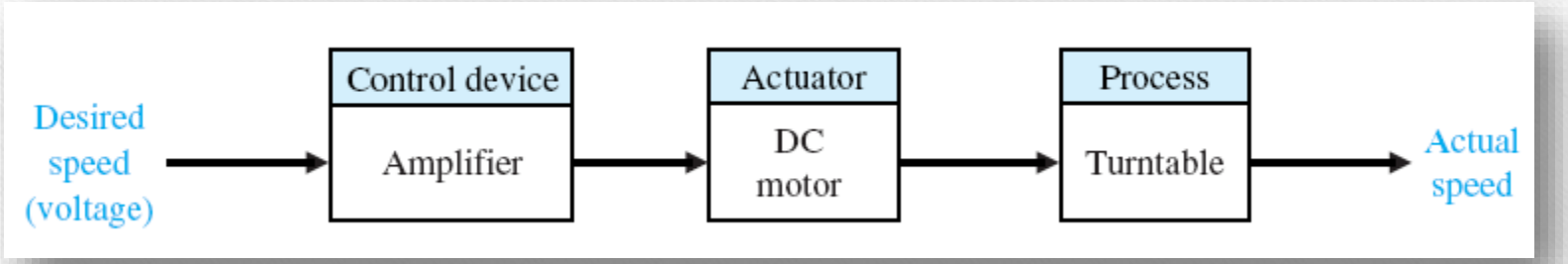
Future evolution of control systems and robotics.

Turntable Speed Control

- Application: CD player, computer disk drive
- Requirement: Constant speed of rotation
- Open loop control system:

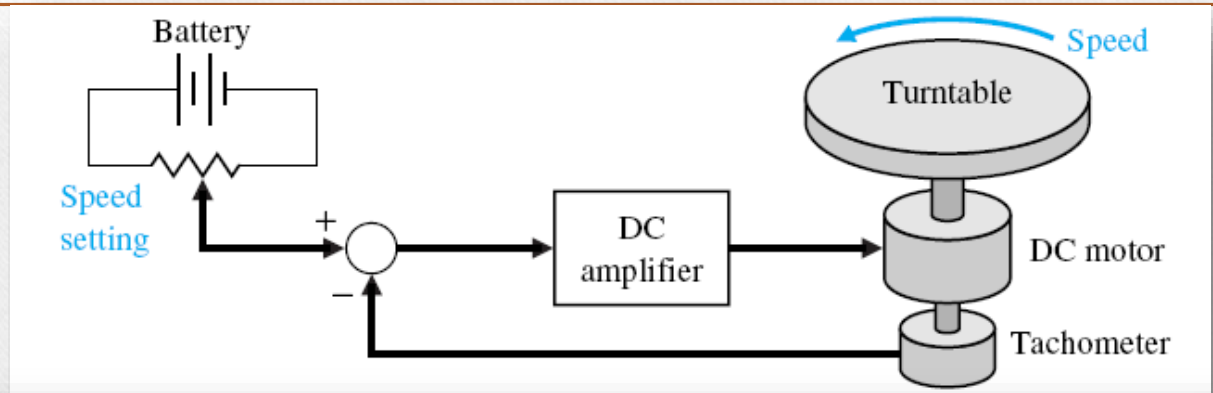


- Block diagram representation:

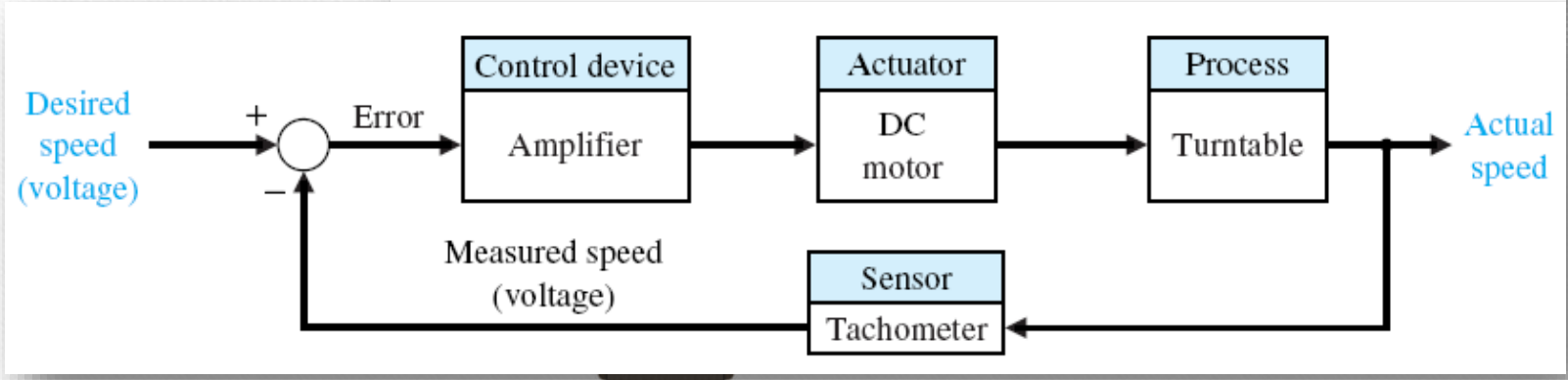


Turntable Speed Control

- Closed-loop control system:

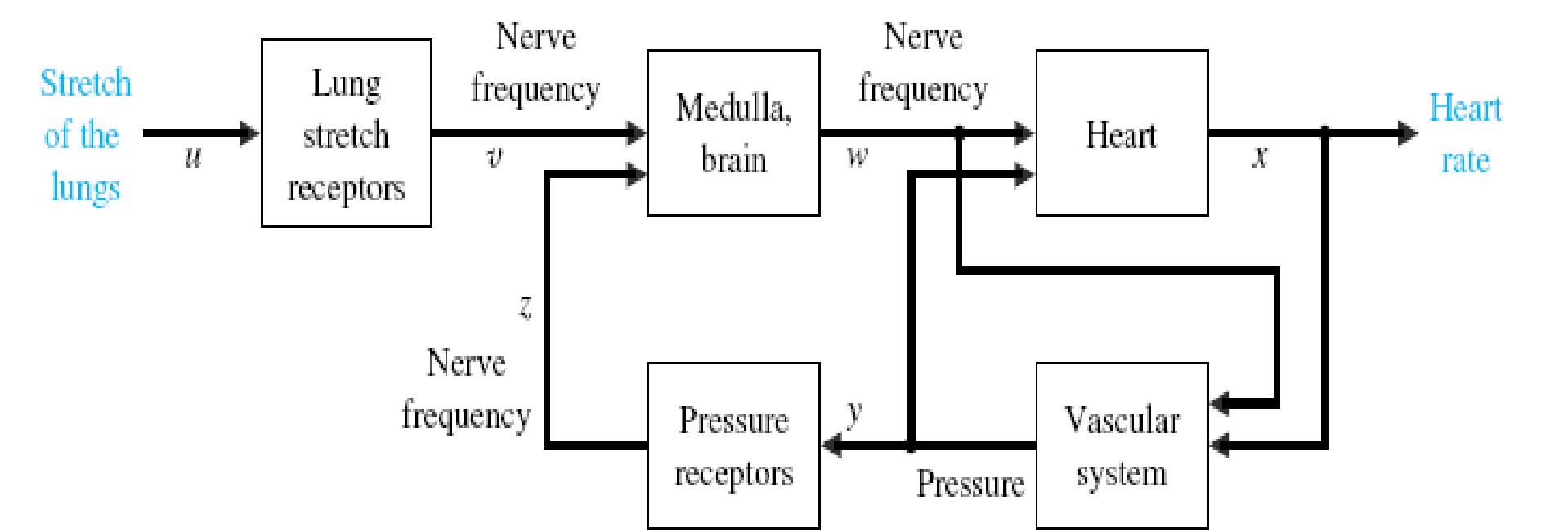


- Block diagram representation:



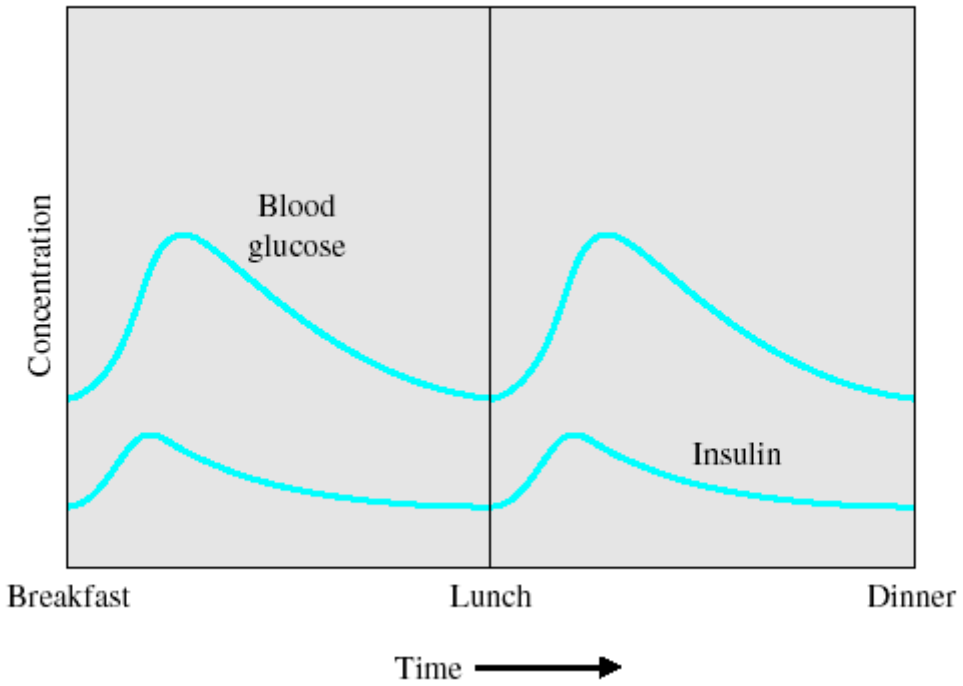
Automatic control system

Design Example



Automatic control system

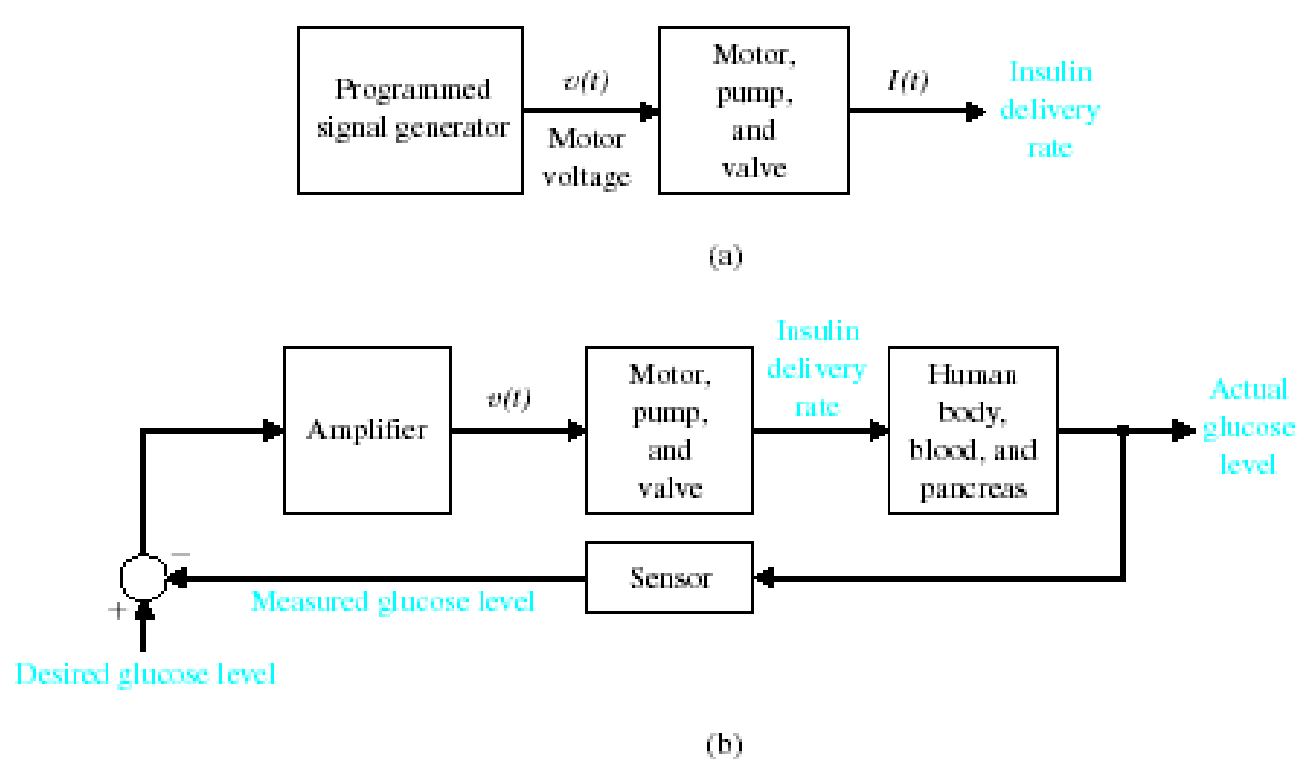
Design Example



The blood glucose and insulin levels for a healthy person.

Automatic control system

Design Example



(a) Open-loop (without feedback) control and (b) closed-loop control of blood glucose.

Projects

***Project. 1**

process control application in Food drying

https://www.youtube.com/watch?v=TYk97vWyHqc&t=8s

***Project. 2**

process control application in waste garbage

		Week 2	Week 3	Week 5	Week 8	Week 10	Week 12
Group 1.1	**waste garbage**	survey	analysis	design	Manufacturing	Assembly and control	Test
Group 1.2	**Food drying**	survey	analysis	design	Manufacturing	Assembly and control	Test

Projects

Tutorial

Course material

- http://52.174.38.133/login/index.php
- http://www.bu.edu.eg/staff/mustafaabdelmonem3-courses/13958

contacts

- Mustafa.elsayed@feng.bu.edu.eg