Advanced Automatic Control

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

Staff boarder

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Instructor

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Advanced Automatic Control
MDP 444

- 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	19-9	Introduction Syllable/Course specs Control system classifications System Modeling			Ref-01	
2	26-9	Mathematical Modeling (mechanical-hydraulic)		DC-Motor control		
3	03-10	Modeling (motors and combined systems) and block diagram				5/3 quizes
4	10-10	Transfer function and State space Time Response (2nd order)		Electrical-mechanical analogy		
5	17-10	steady state Error, Stability analysis				5/3 quizes
6	24-10	Frequency Response Bode Plot		Filters		
7	31-10	Midterm				15

Course plan

week	Date	Contents	Requirements	Laboratory	References	Marks
8	07-11	Design Controller and system compensation				
9	14-11	PID / Design	Reports (Quadcopter)	DC- motor Kit	Ref-01	5
10	21-11	Optimal and LQR control	Quiz	Operational amplifier circuits		5/3 quizes
11	28-11	Fuzzy Logic Control			Ref-02	
12	05-12	Neural Network (Case study)				
13	12-12	Corrective exam and Receive project				10 for exam 20 for project

Evaluation rules

Report Contents

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

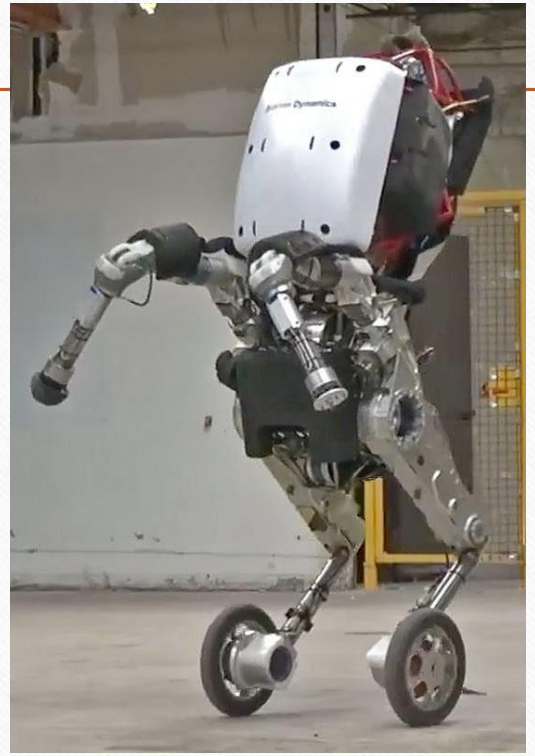
Marks distribution

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

Projects

Underwater ROV robot (Proj-01)

EndoWrist Robot Da-vinci (Proj-03)



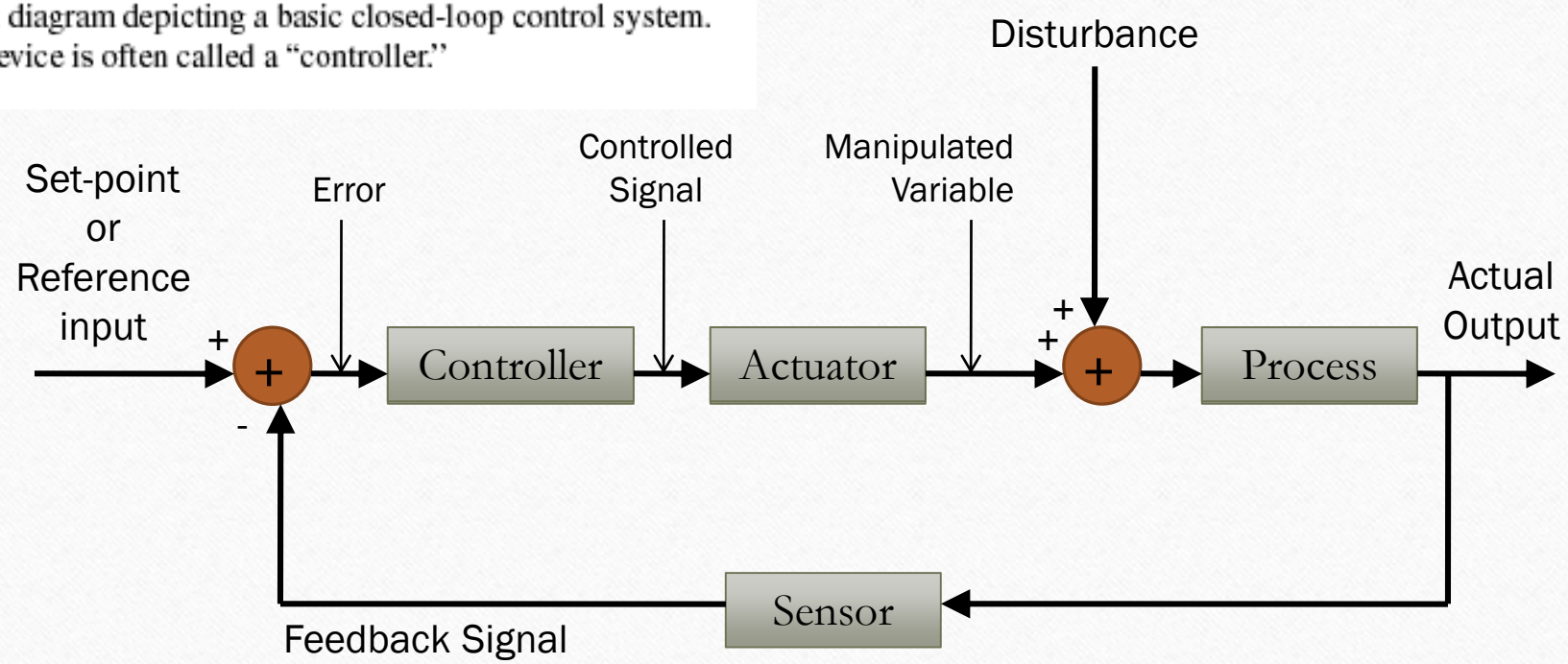
Seg-way dynamic robot (Proj-02)

Legged Robot littleDog (Proj-04)

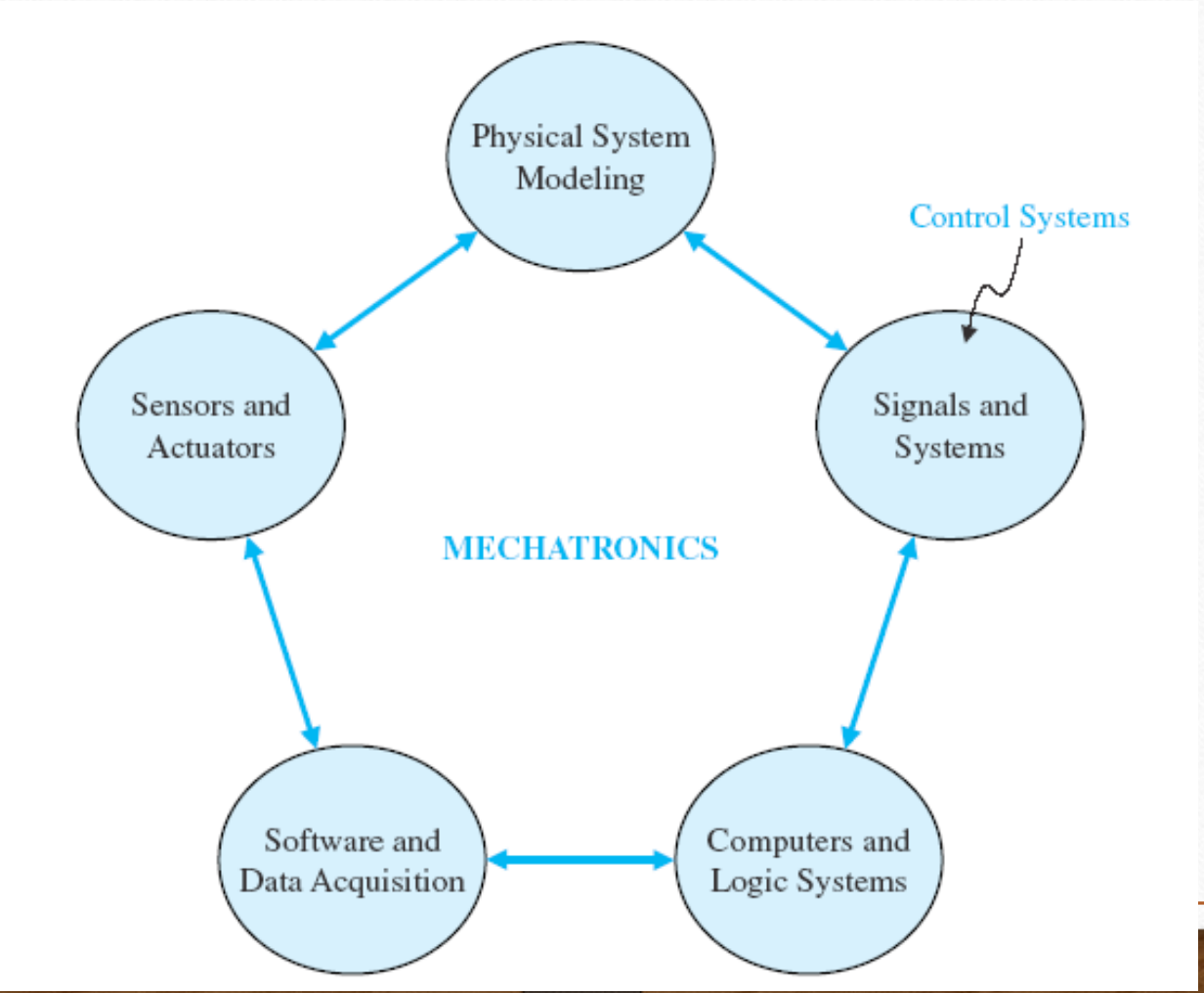
https://youtu.be/-7xvqQeoA8c

Automatic control system

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

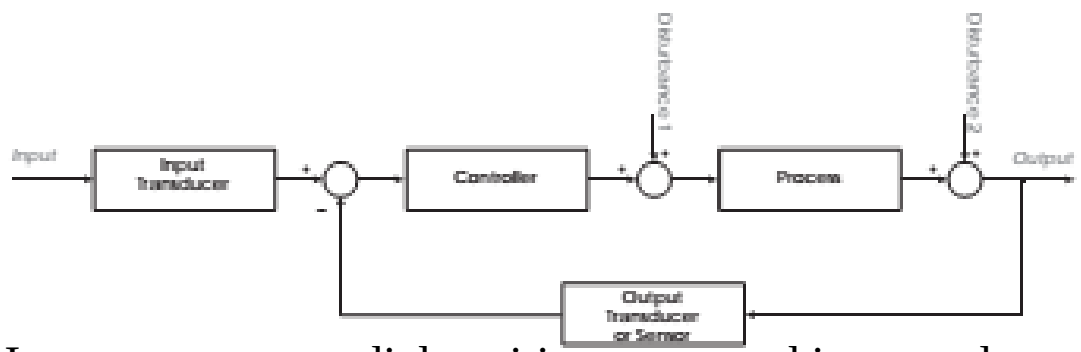


Automatic control system



Automatic control system

Closed-Loop Control System

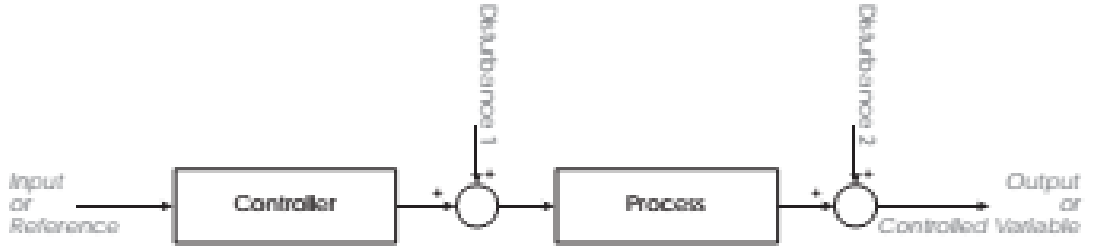


Input temperature dial position converted into a voltage by a potentiometer.

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.

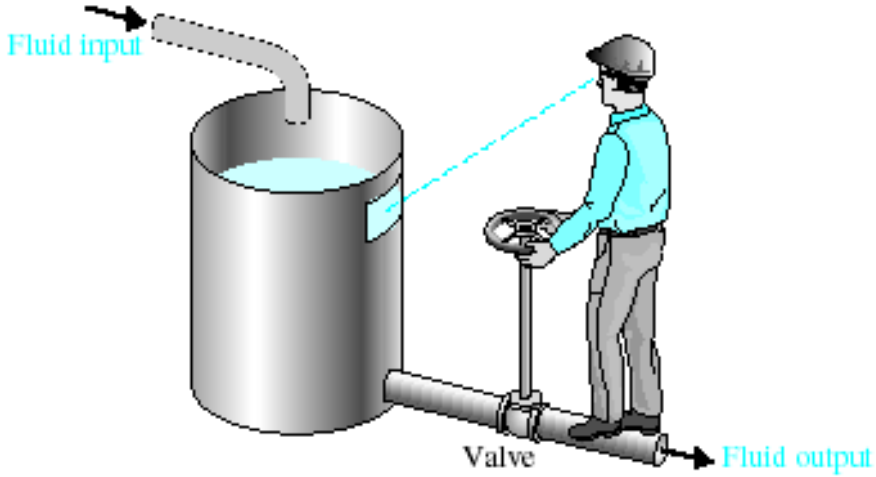
Controller is electronics, valves, etc. that control fuel flow into furnace.

Input is thermostat position

Automatic control system

Examples of Modern Control Systems

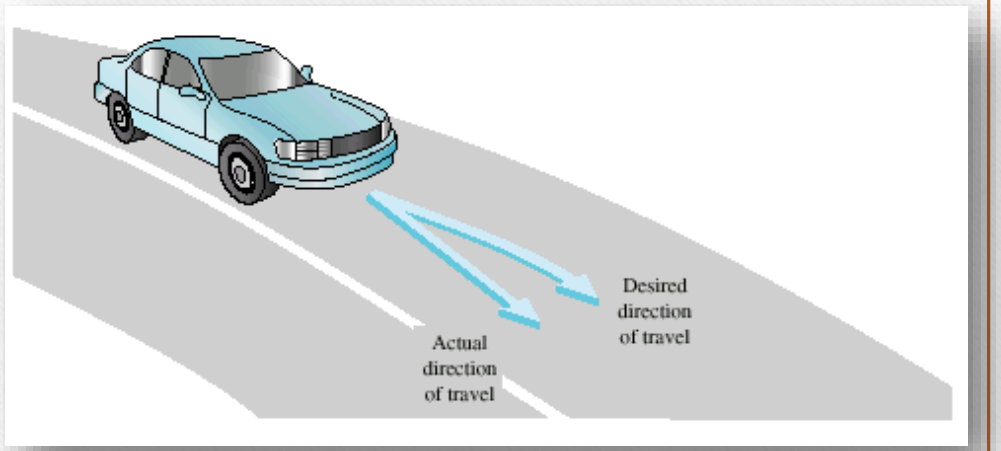
A manual control system for regulating the level of fluid in a tank by adjusting the output valve. The operator views the level of fluid through a port in the side of the tank.



Automatic control system

Transportation

Car and Driver

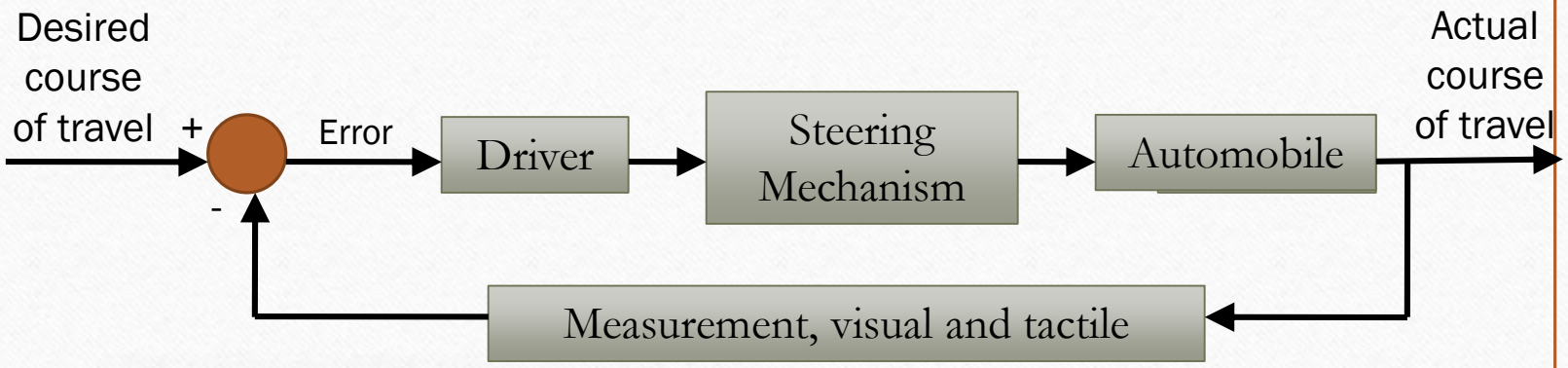


- Objective: To control direction and speed of car
- Outputs: Actual direction and speed of car
- Control inputs: Road markings and speed signs
- Disturbances: Road surface and grade, wind, obstacles
- Possible subsystems: The car alone, power steering system, breaking system

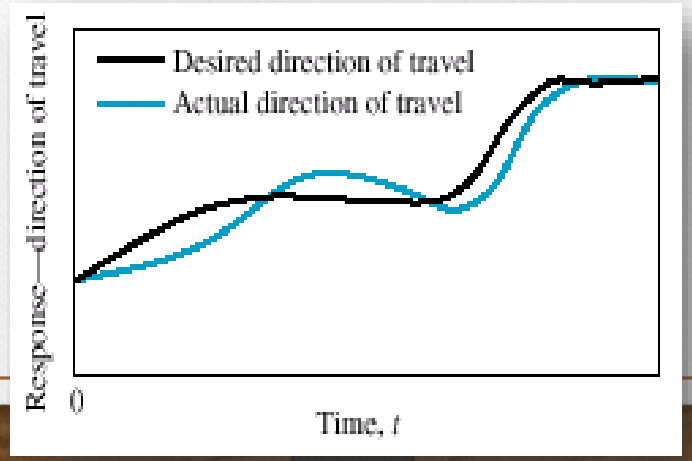
Automatic control system

Transportation

- Functional block diagram:



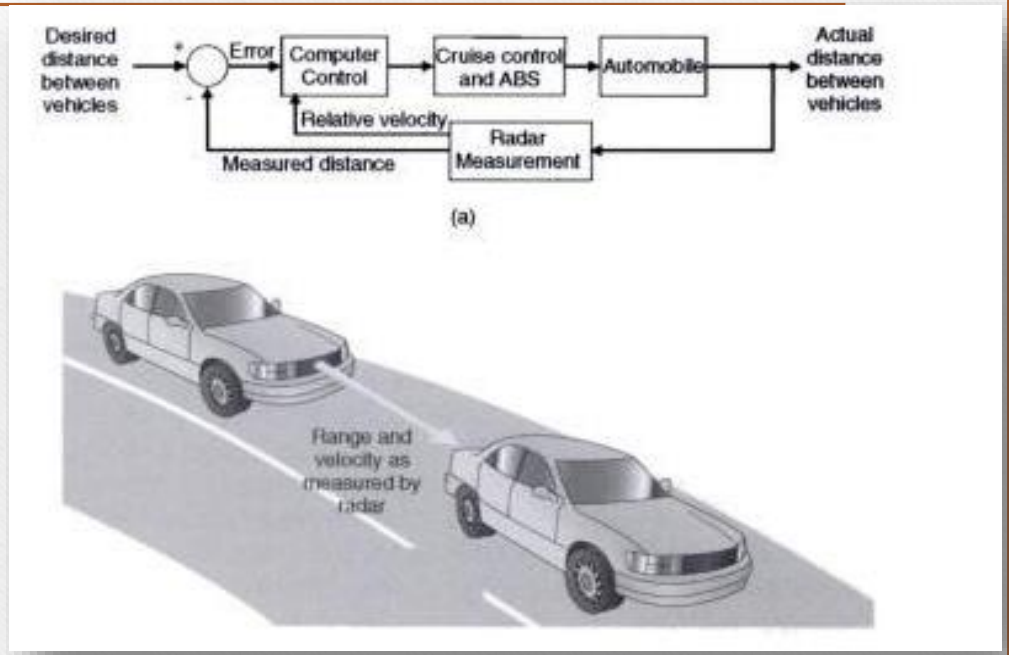
- Time response:



Automatic control system

Transportation

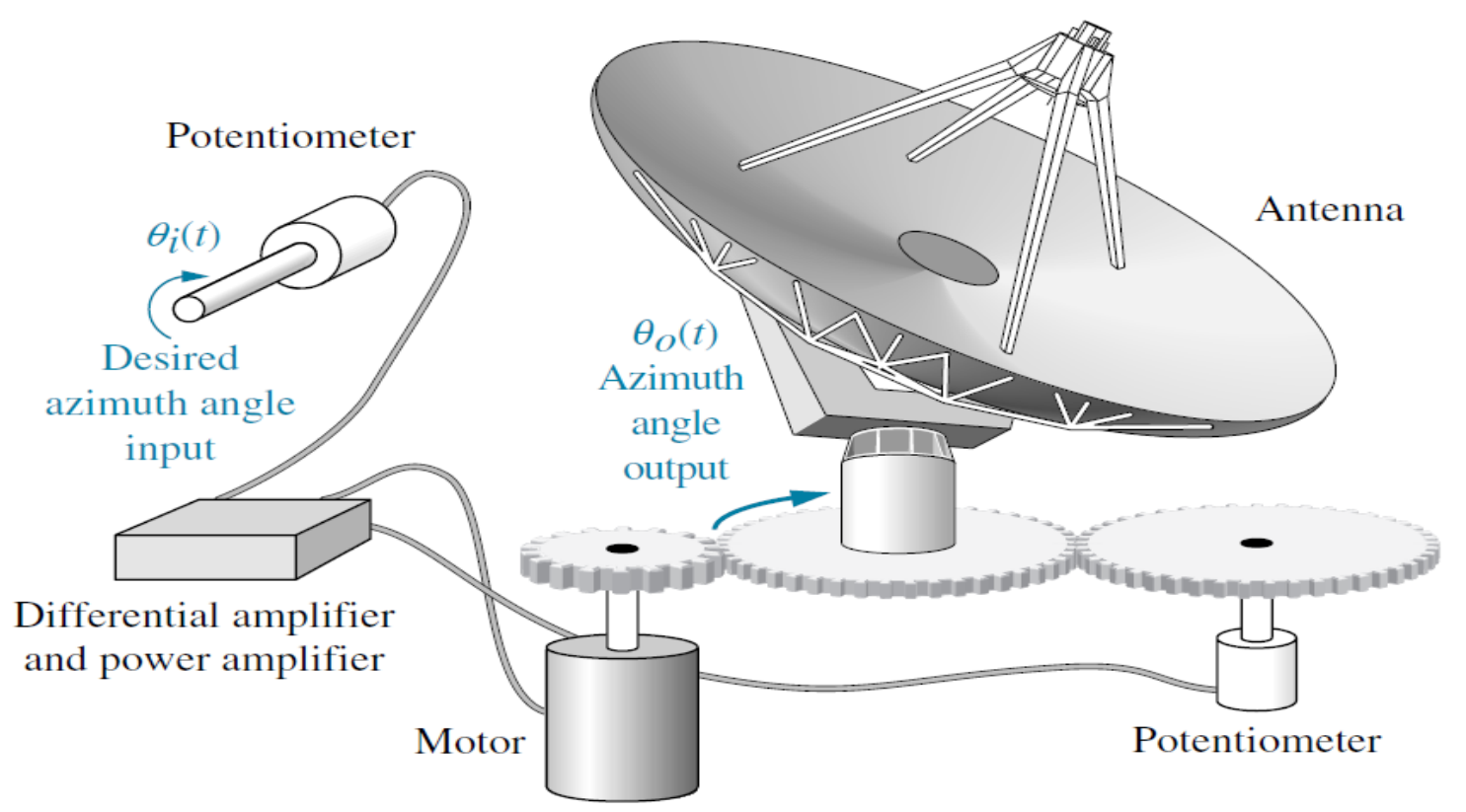
- Consider using a radar to measure distance and velocity to autonomously maintain distance between vehicles.



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

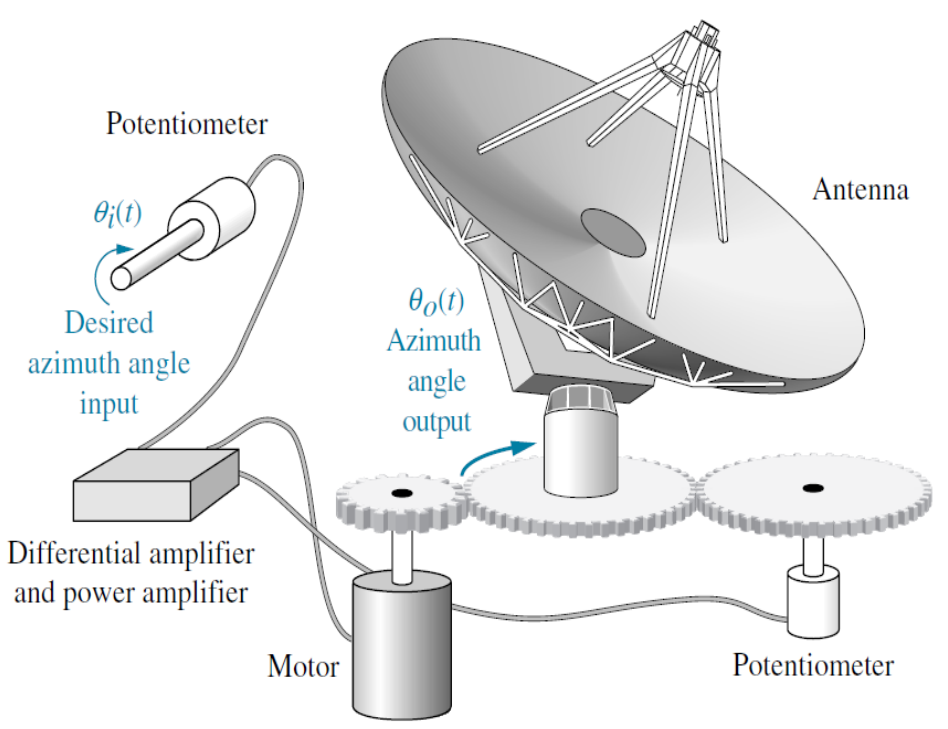
Automatic control system

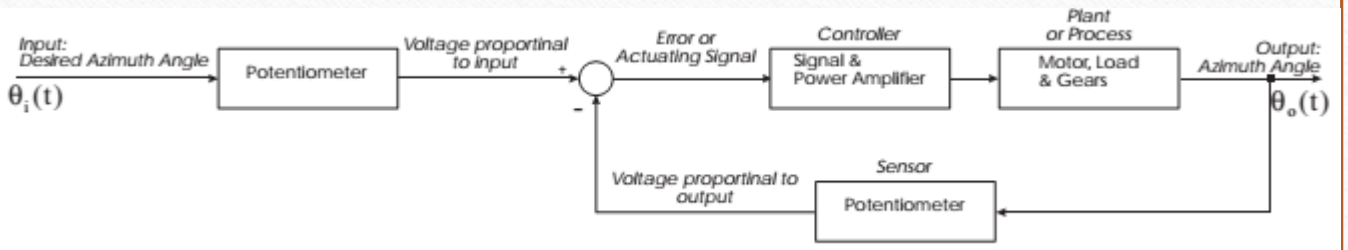
- Azimuth Position Control System Example



Automatic control system

Azimuth Position Control System Example

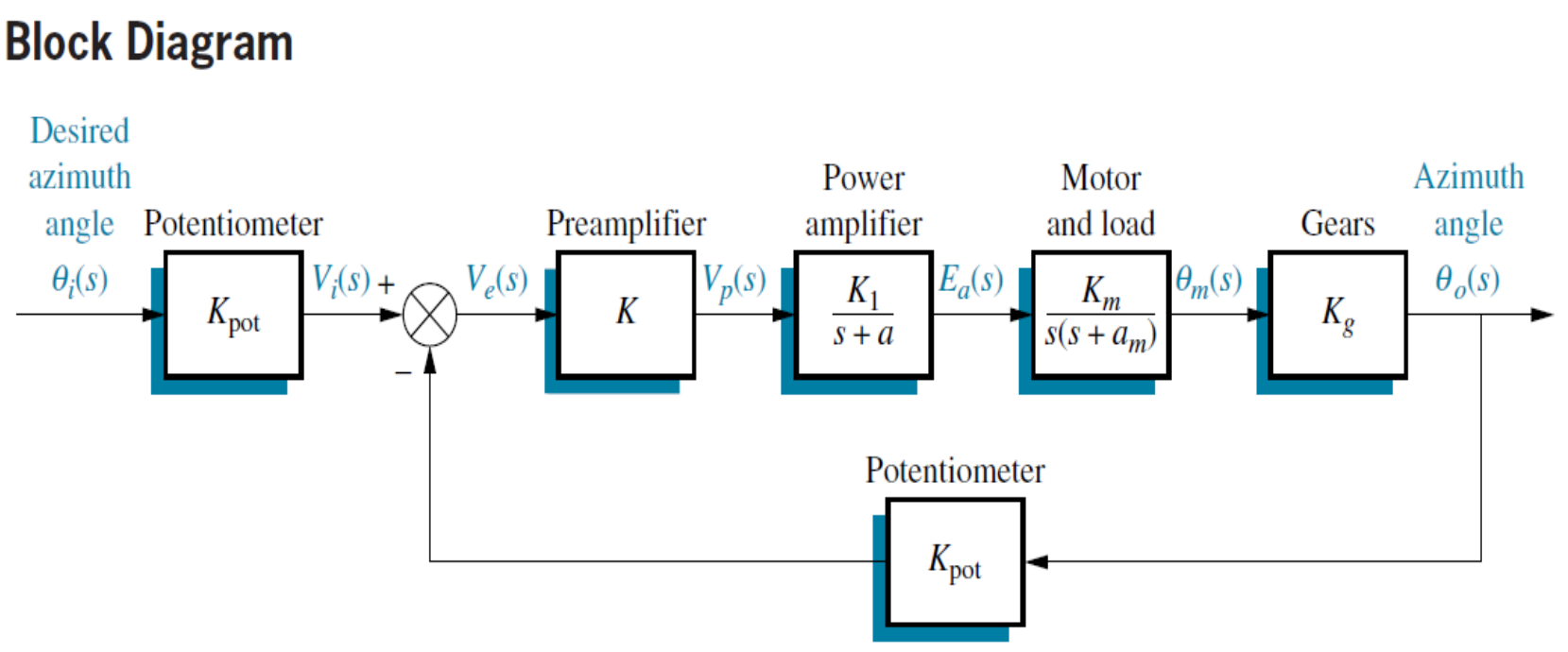




Block Schematic Diagram

Automatic control system

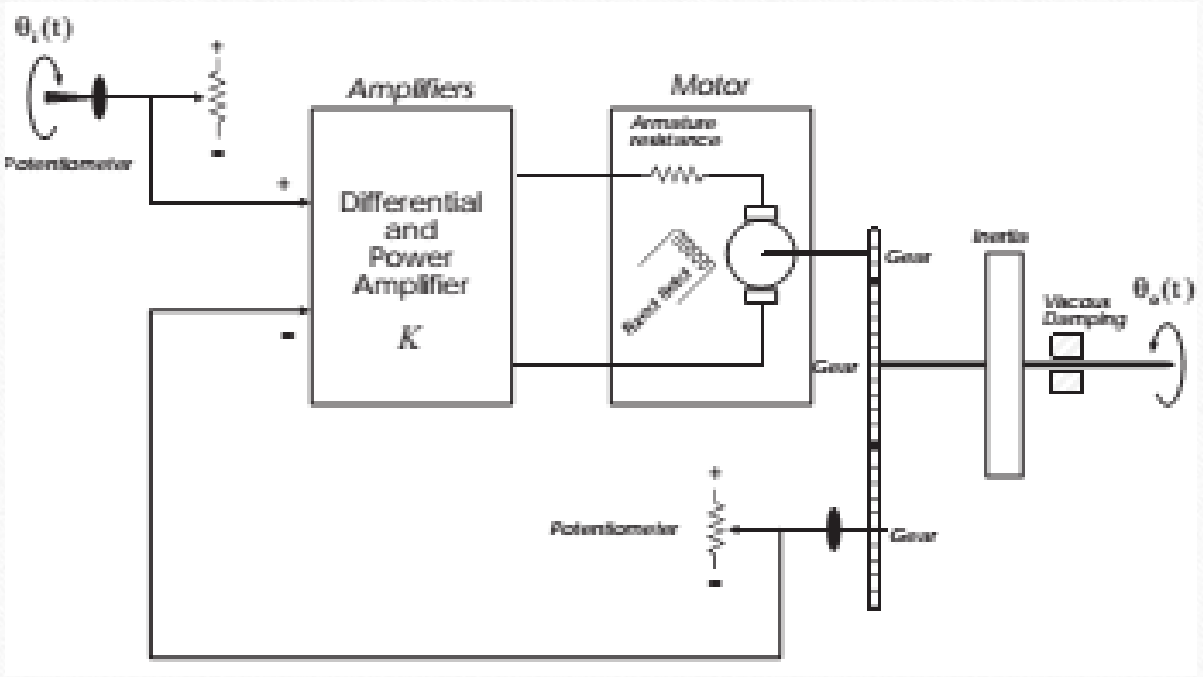
- Azimuth Position Control System Example



Automatic control system

Transform the Physical System into a Schematic

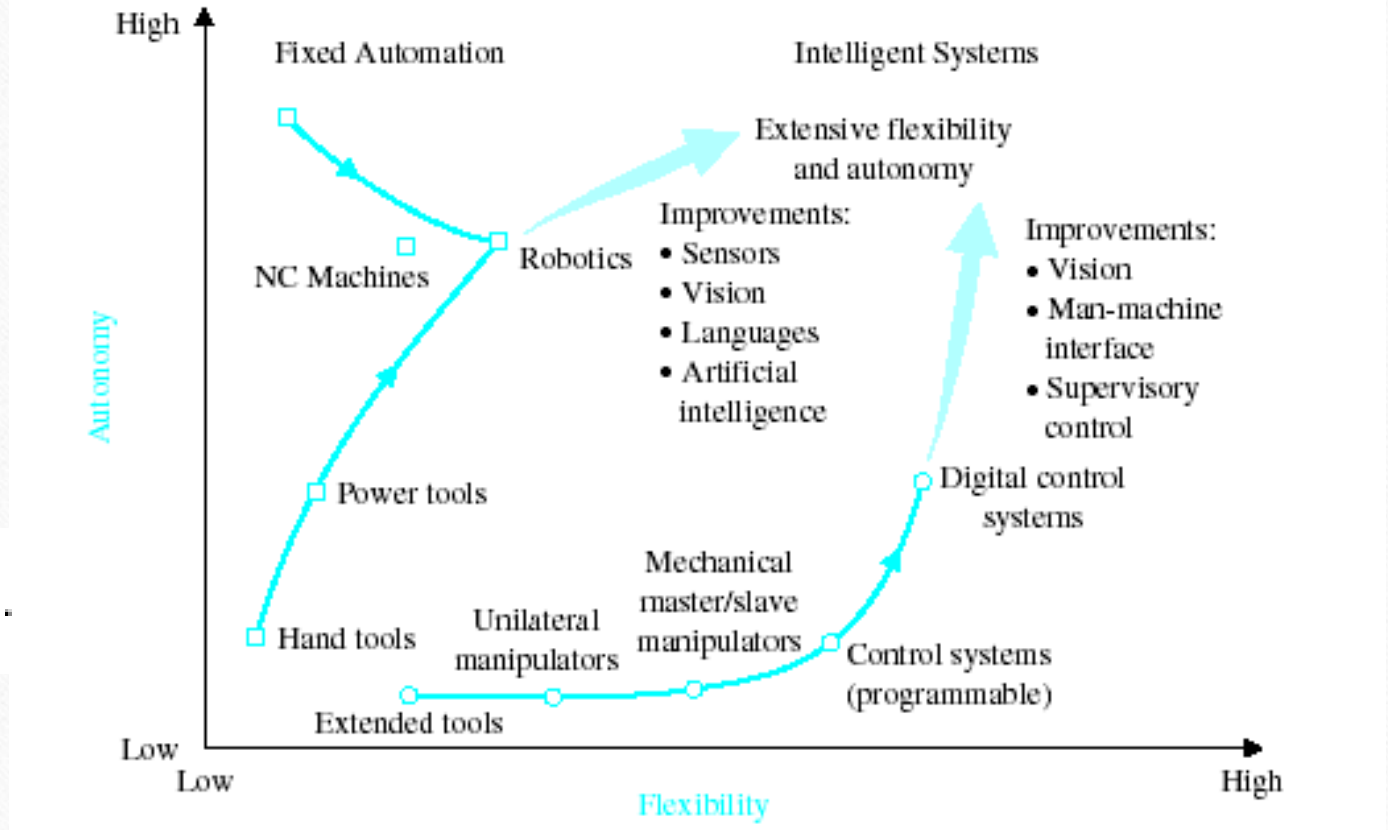
- **Makes relationships more concrete**
- **Enables decisions to be made about what can be neglected in formulating the mathematical model.**
- **Assumptions made can be easily reviewed and schematic and/or model adjusted as necessary.**
- **Should be kept as simple as possible:**
  - **Checked by analysis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



Block Schematic Diagram

Automatic control system

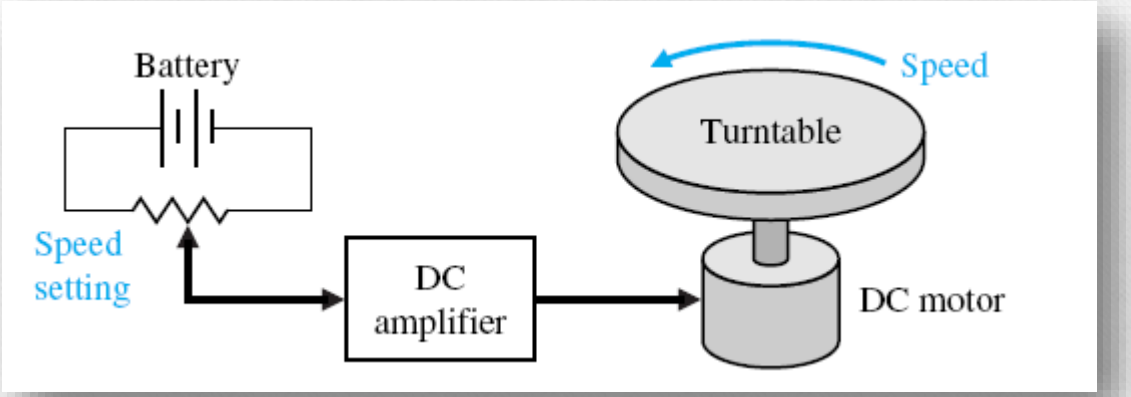
The Future of Control Systems



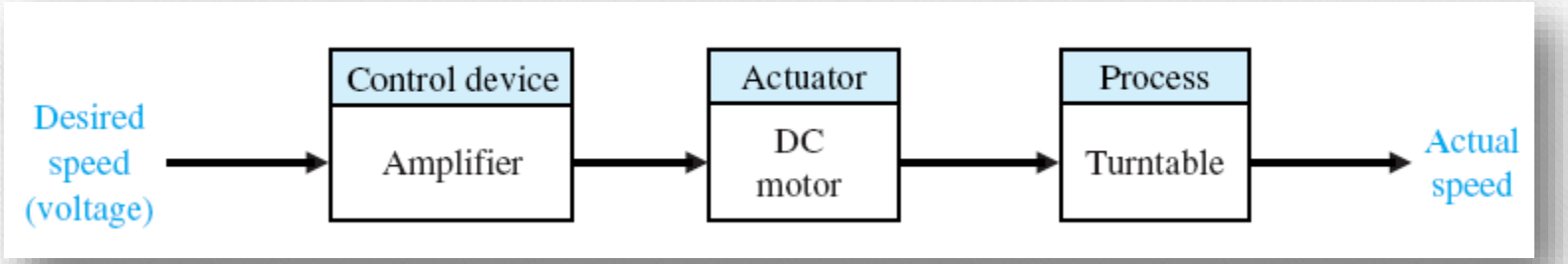
Future evolution of control systems and robotics.

Turntable Speed Control

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

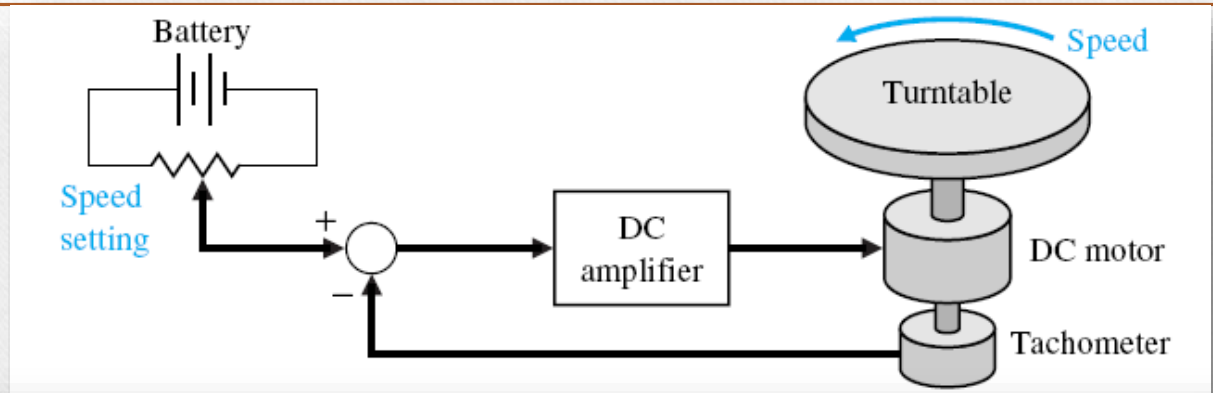


- Block diagram representation:

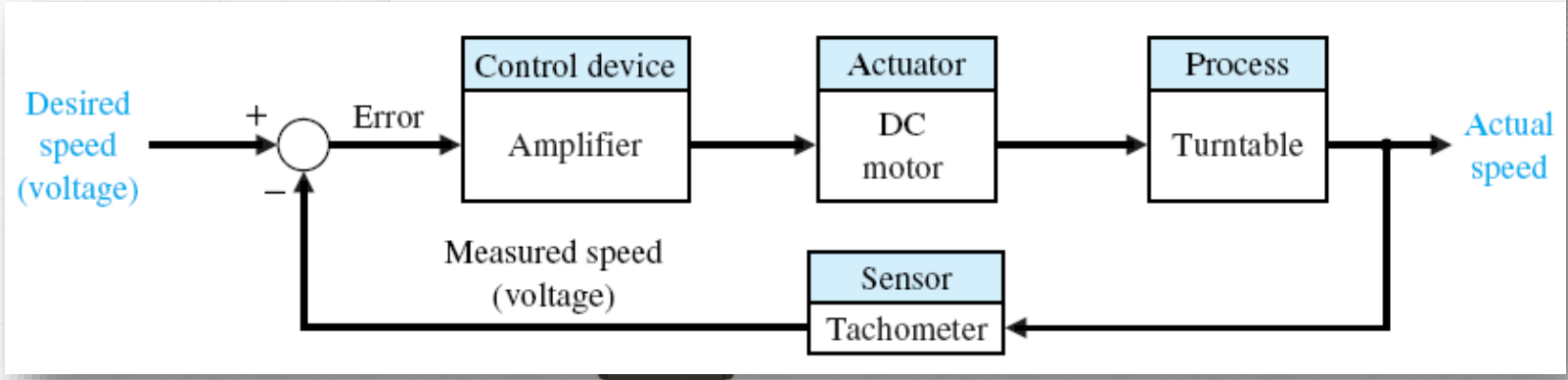


Turntable Speed Control

- Closed-loop control system:

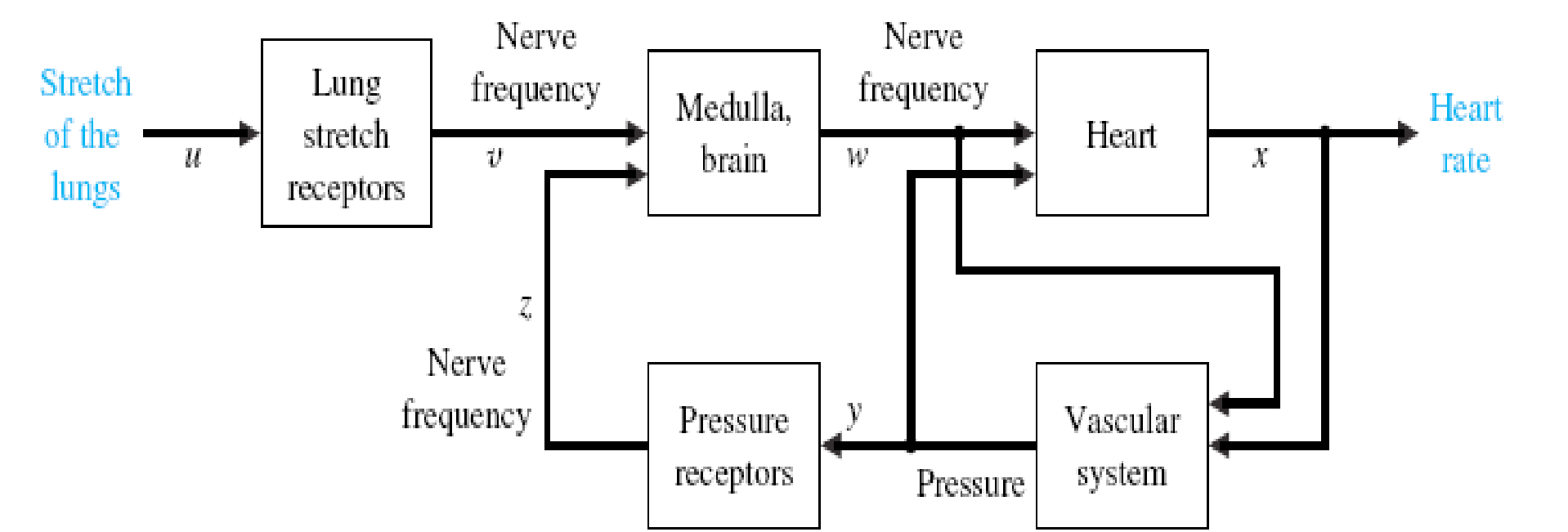


- Block diagram representation:



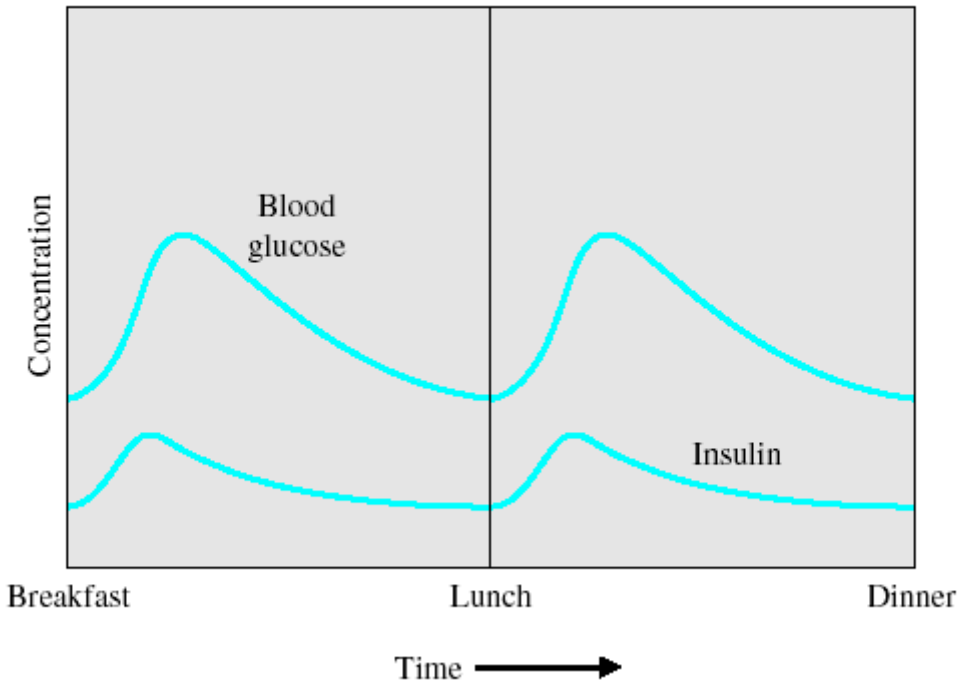
Automatic control system

Design Example



Automatic control system

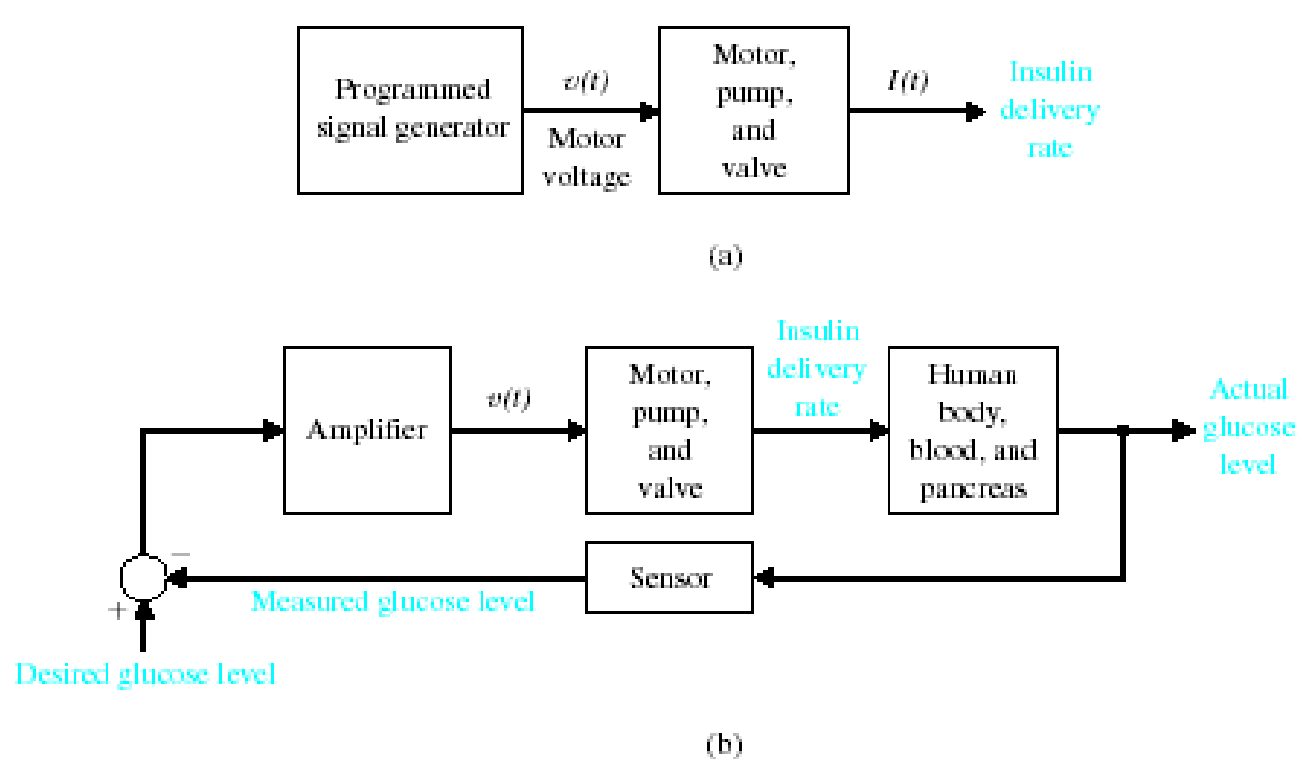
Design Example



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.

Tutorial

Peeling a Grape using the
da Vinci® Surgical System

1006245 rA

Tutorial


Learning Locomotion
with LittleDog
http://www-clmc.usc.edu
Mrinal Kalakrishnan, Jonas Buchli,
Peter Pastor, Michael Mistry, and
Stefan Schaal

Tutorial

Course material

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

contacts

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