《自动控制理论》
Automatic Control Theory

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Materials

- 1. 邹伯敏，自动控制理论，机械工业出版社
- 2. 吴麒，自动控制原理,清华大学出版社
- 3. 李友善，自动控制原理，国防工业出版社
- 4. 蔡尚峰，自动控制理论，机械工业出版社
- 5. 薛定宇，反馈控制系统分析与设计——MATLAB语言应用，清华大学出版社.
- 6. 胡松寿，自动控制原理，科学出版社
- 7. Katsuhiko Ogata著，卢伯英等译，现代控制工程（Modern Control Engineering）（第3版）
- 8. 自动控制理论习题集

Chapter 1: Introductions

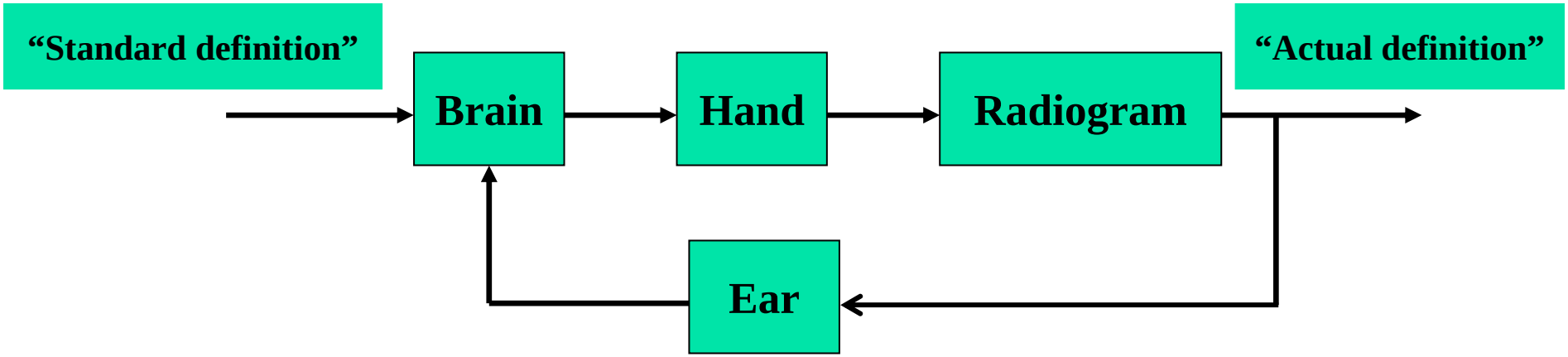
- 1 General concepts
- 2 History of automatic control theory
- 3 Open- and Closed-loop control systems
- 4 Classification of automatic control systems
- 5 Performance requirements of control system

Chapter 1: Introductions

Section 1: General concepts（*Automation* or *Automatization*）

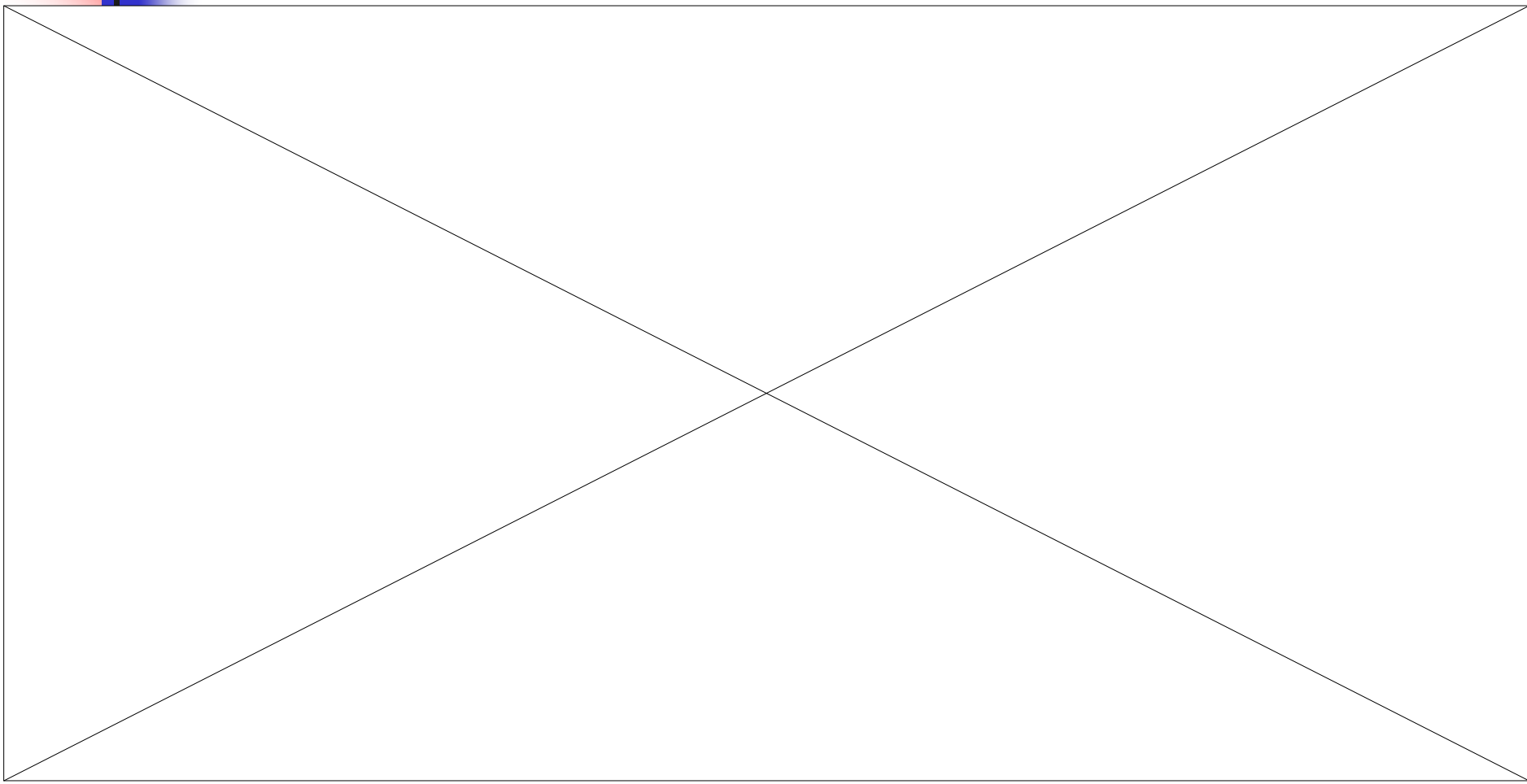
1.Control

An imposed process in order to achieve a desired purpose.



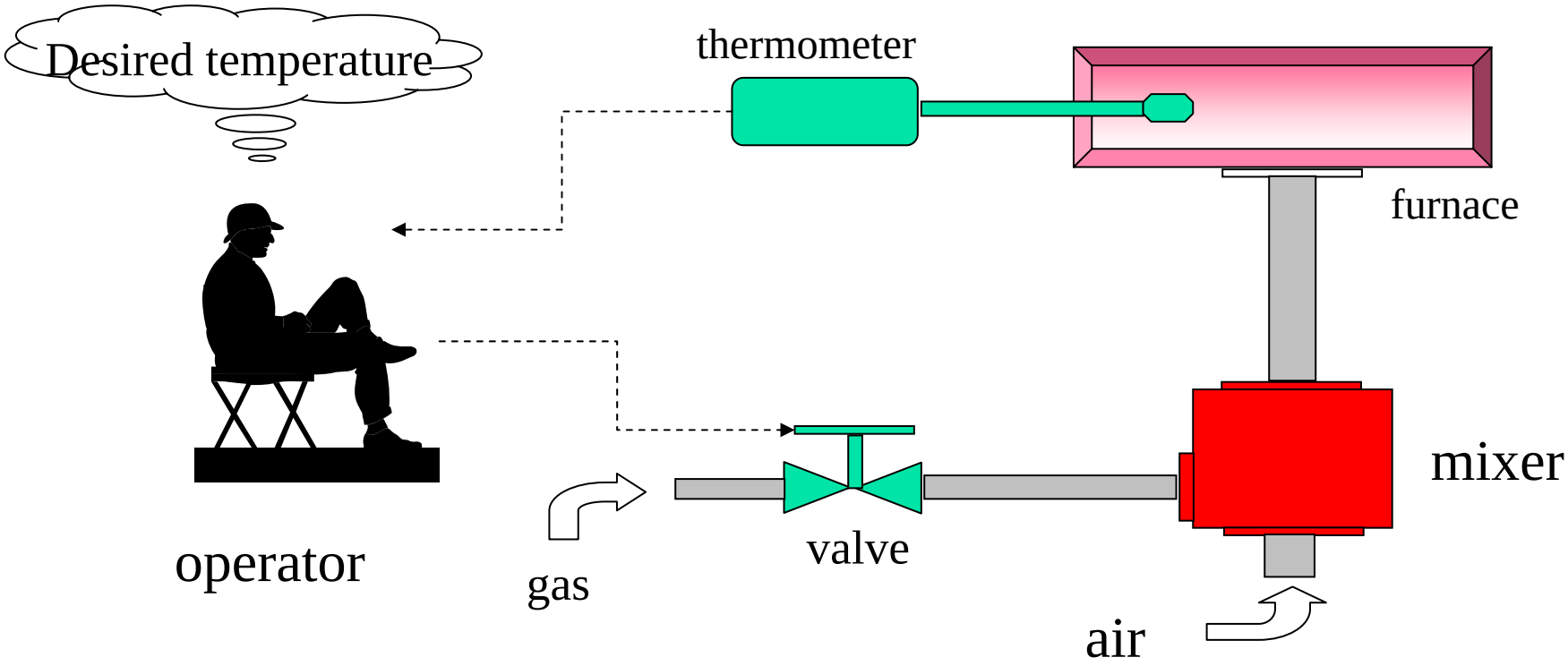
Control process of listening radiogram

Section 1: General concepts



A manual control system for regulating the level of fluid in a tank

Section 1: General concepts



Section 1: General concepts

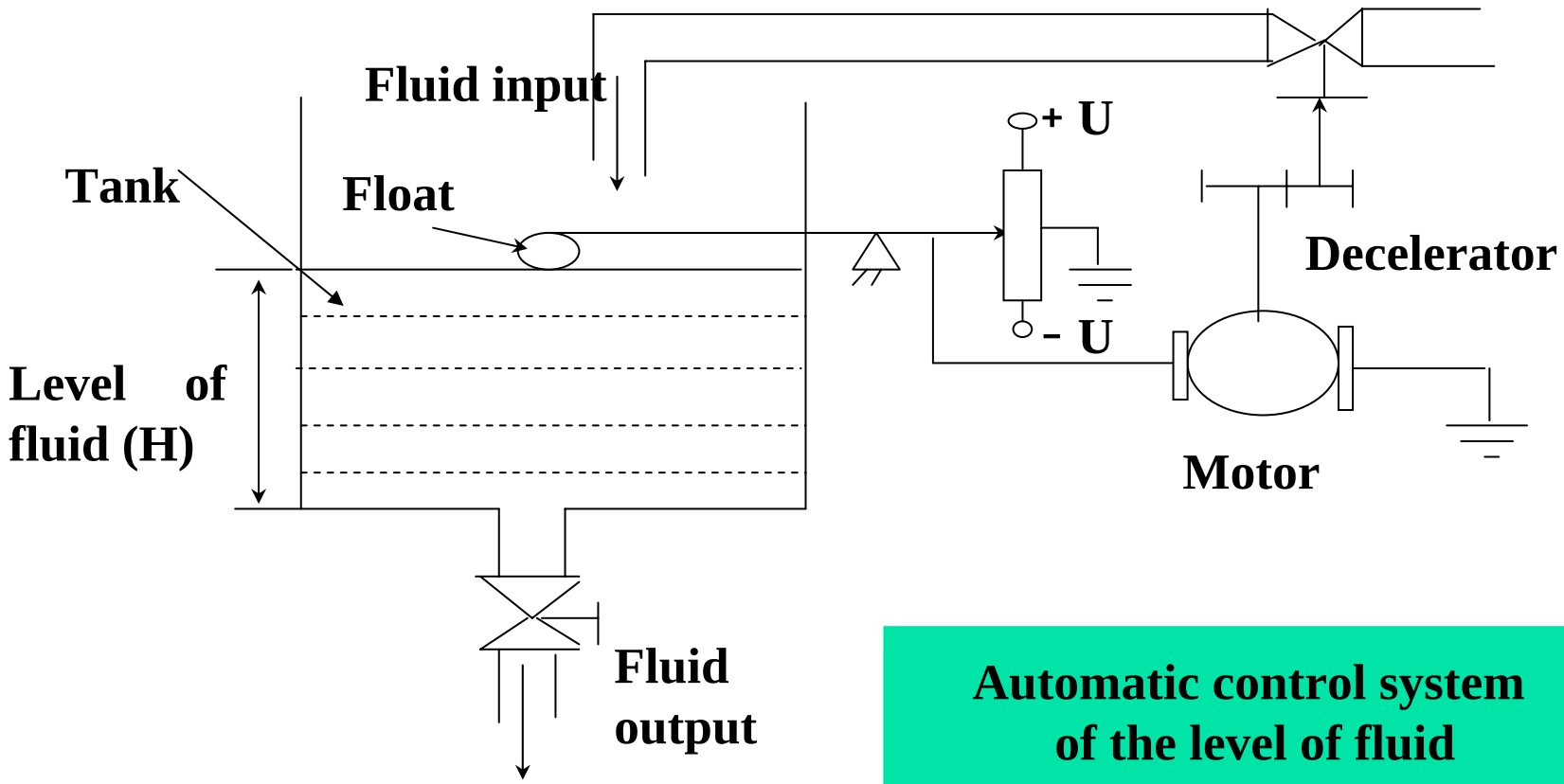
2.Automatic Control

Automatic control is using controllers to operate some physical quantities (such as: temperature, pressure, PH value) of a process without direct human interventions, and make these physical quantities changing in accordance with the law.

Section 1: General concepts

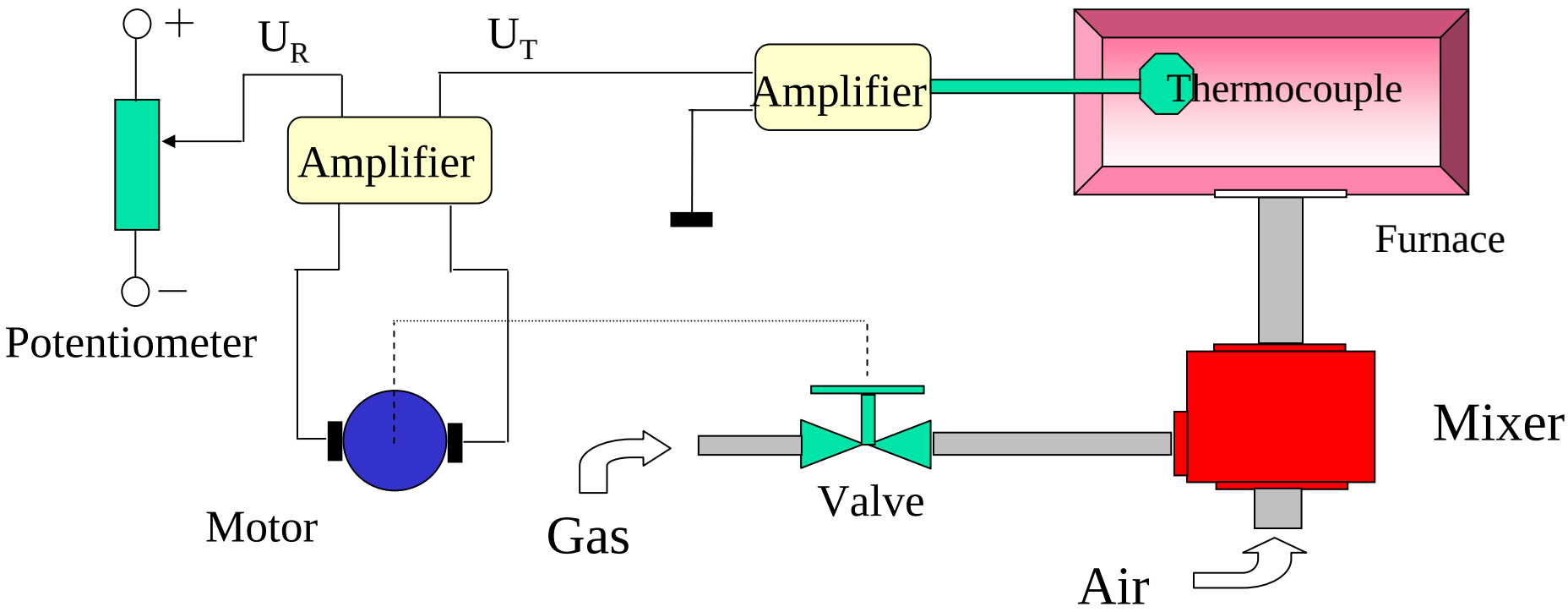
3. Automatic control system

A control system consisting of interconnected components is designed to achieve a desired purpose.



Automatic control system of the level of fluid

Section 1: General concepts



Section 2: History of automatic control theory

Automatic control is a technology science of researching control laws. It has a fascinating history. Form 1868, as J.C. Maxwell formulated a mathematical theory of automatic control, control theory could be divided into four stages:

1.Classical control theory

2. Modern control theory

3. Large scale system theory

4. Intelligent control theory

- Linear control system
- Nonlinear control system
- Sampling control system

Section 2: History of automatic control theory

1.Classical control theory

Research object: Single input single output control system (SISO)

Such as: regulate the voltage to change the motor speed, regulate steering to change direction of travel.

2. Modern control theory

Research object: Multiple input Multiple output control system (MIMO)

Such as: a auto could be consider as a two input (steering and throttle) and a two output (direction and speed) control system.

The progress of computer science promotes the development of control science .

3. Large scale system theory

Large scale system theory is a dynamic system engineering combining the process control and information processing. The research object is very complicated.

Such as our bodies. They could be considered as a Large scale system theory, including temperature control, emotion control, blood components control.

Large scale system theory is now in the development stage.

Section 2: History of automatic control theory

4.Intelligent control theory

It is new development control technology based on artificial intelligence. The guiding ideology is solve these complicated control problems like a human being, simulating their thinking and solution methods.

Schools: Structure and Function

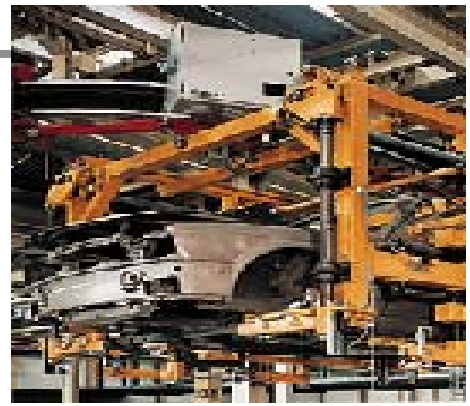
As a new control field, these are still some controversial issues. Now, it receives our great attentions for its remarkable capacity of solving complicated practical problems.

Applications of automatic control theory

Everywhere

Improve accuracy and reliability

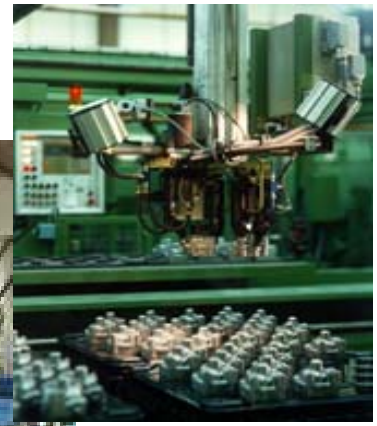
Improve output and reduce costs

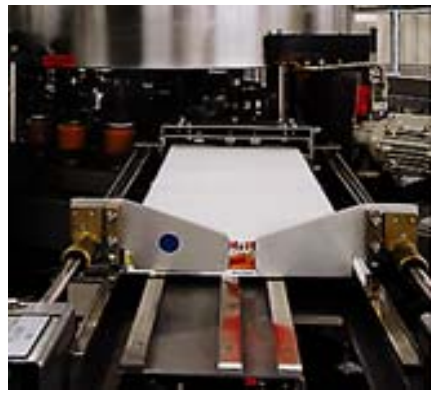


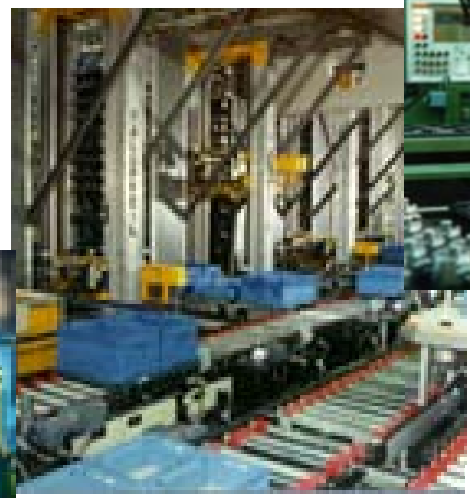
Aviation

Aerospace

Motion control







Process control

Our lives

Section 3: Open- and Closed-loop control systems

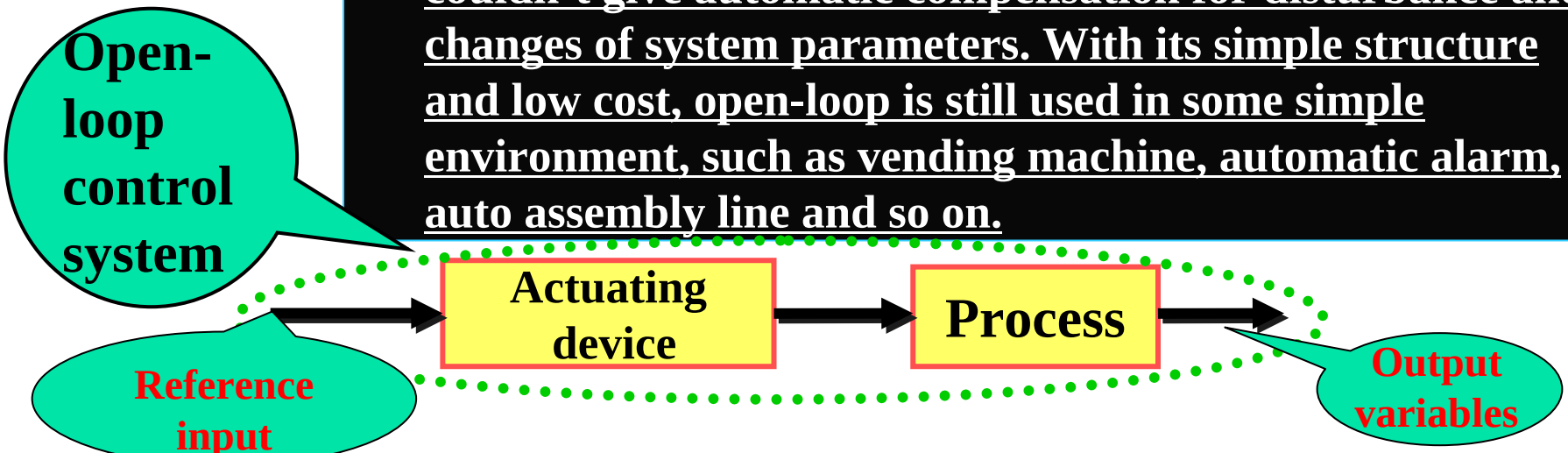
1.Open-loop control system: An Open-loop control system utilizes an actuating device to control the process directly without using feedback.

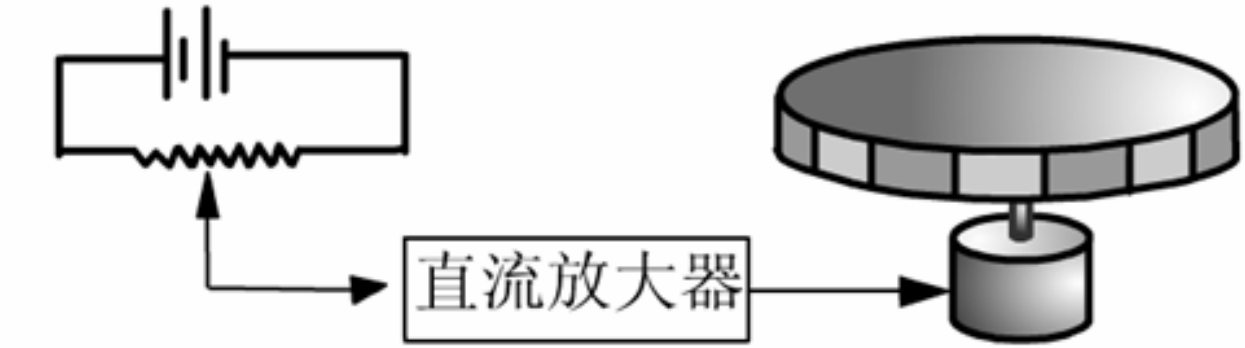
Features:

- The output of the open-loop system has no effect upon the input signal;
- The components needs high precision to improve the system precision;
- The stability is not the key problem.

Control method:

- An open-loop control system utilizes an actuating device to control the process directly without feedback. The system couldn't give automatic compensation for disturbance and changes of system parameters. With its simple structure and low cost, open-loop is still used in some simple environment, such as vending machine, automatic alarm, auto assembly line and so on.





Open-loop control system

Closed-loop control system

Section 3: Open- and Closed-loop control systems

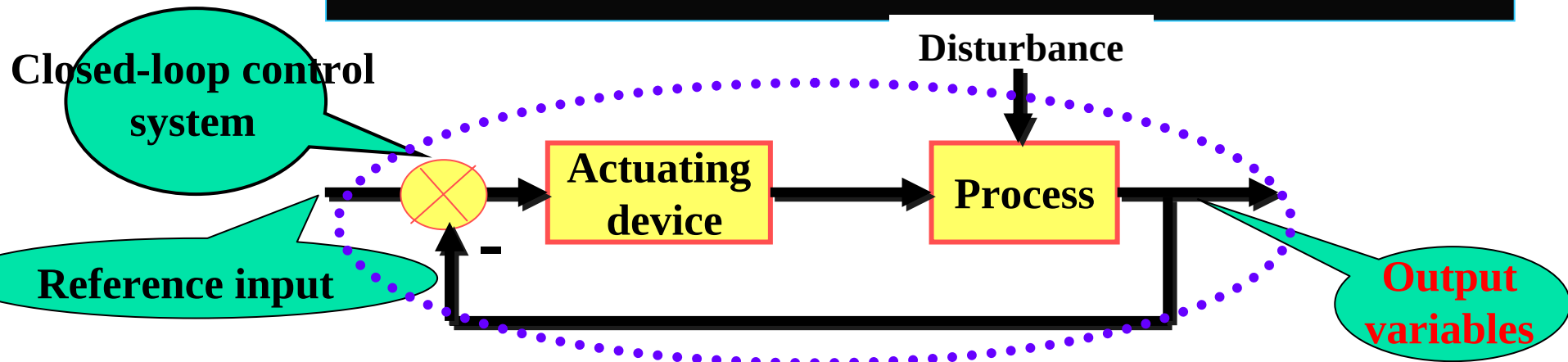
2.Closed-loop control system: a closed-loop control system uses a measurement of the output and feedback of this signal to compare it with the desired output.

Features:

- The output of the open-loop system affects the input signal;
- The precision of components are not strictly required;
- The stability is the key problem.

Control method:

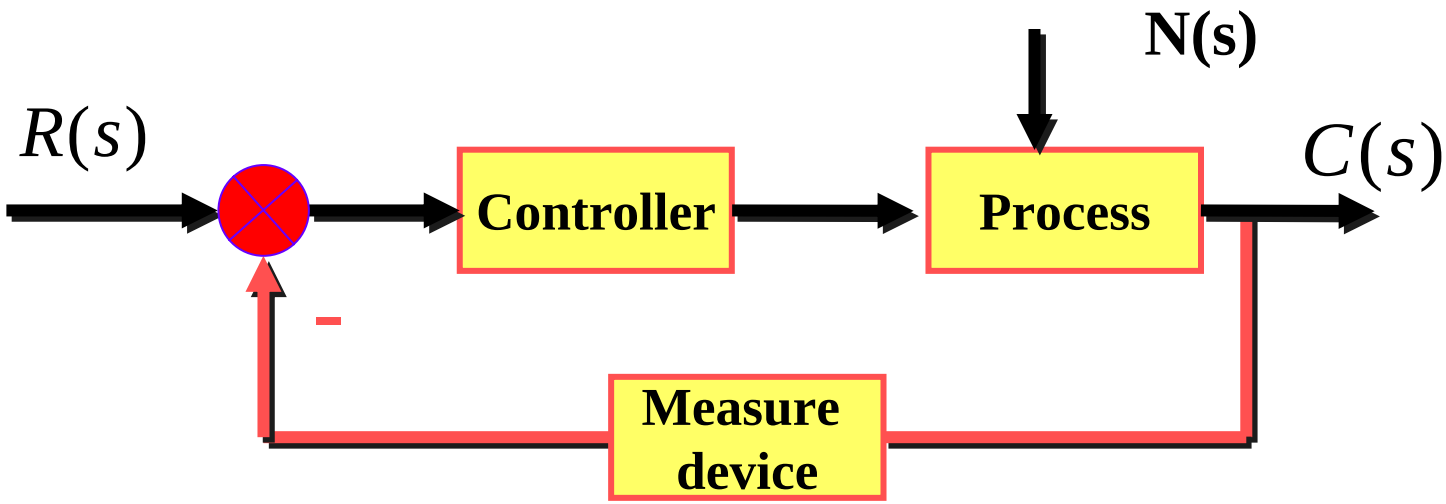
- Feedback control could be divided into two classed: positive feedback and negative feedback. Without special statement, feedback control means negative feedback.



Section 3: Open- and Closed-loop control systems

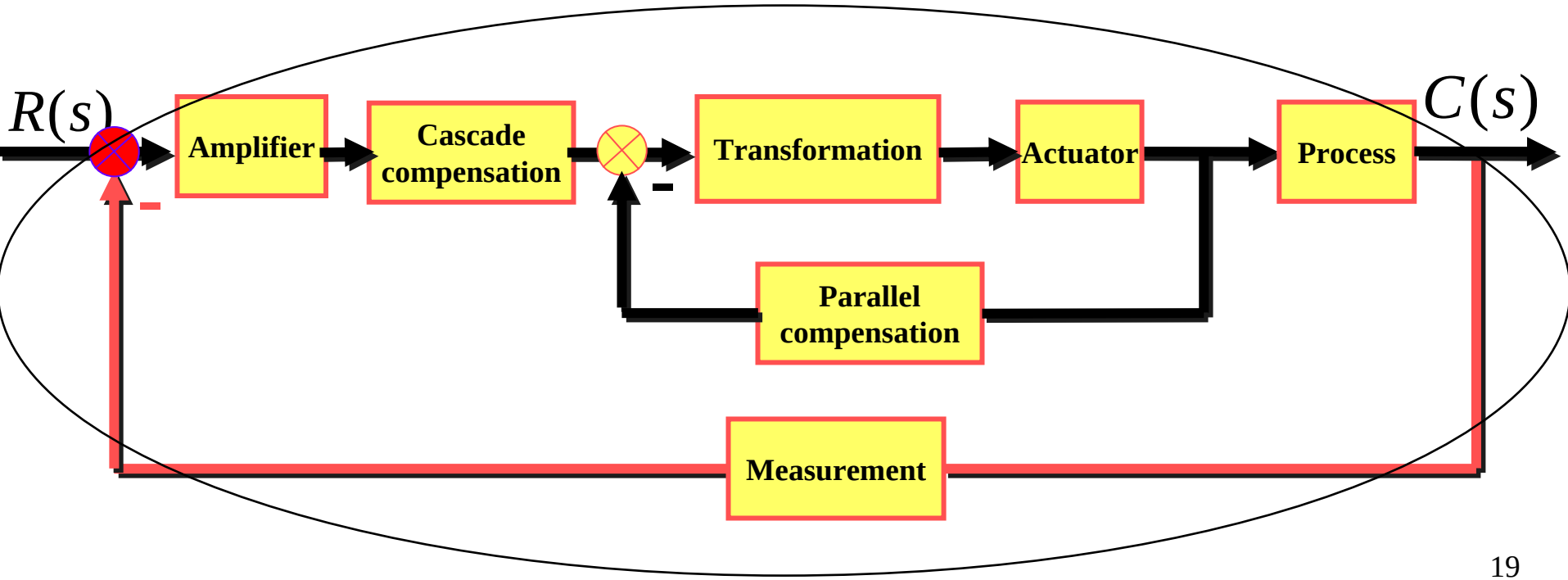
3. Components:

- **Controller:** The entire devices control the process.
- **Process:** The device, plant or system under control.
- **Output:** the physical quantities being automatic controlled .
- **Input:** the physical quantities imposed to realize some desired function or output.
- **Disturbance:** Any factor affects the output and input in regular control process



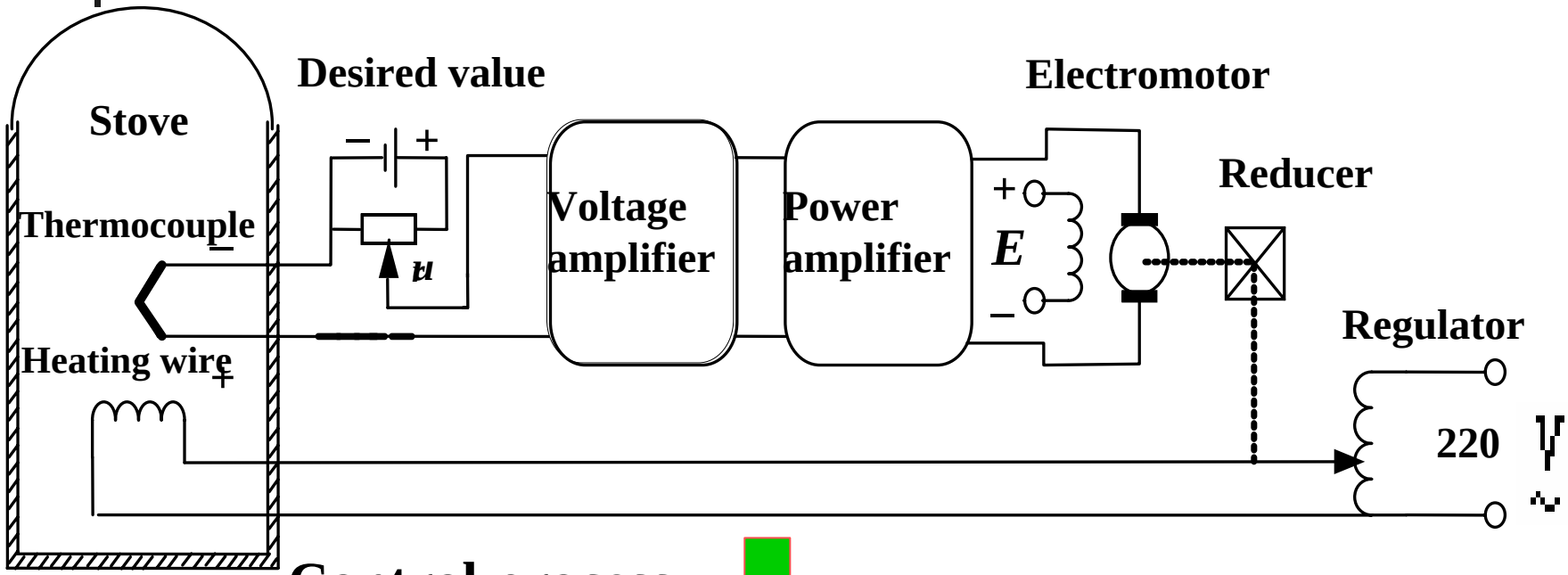
Section 3: Open- and Closed-loop control systems

The basic components of a closed-loop control system include:
(1)comparison; (2)amplifier; (3)actuator; (4)compensation; (5)process; (6)measurement.

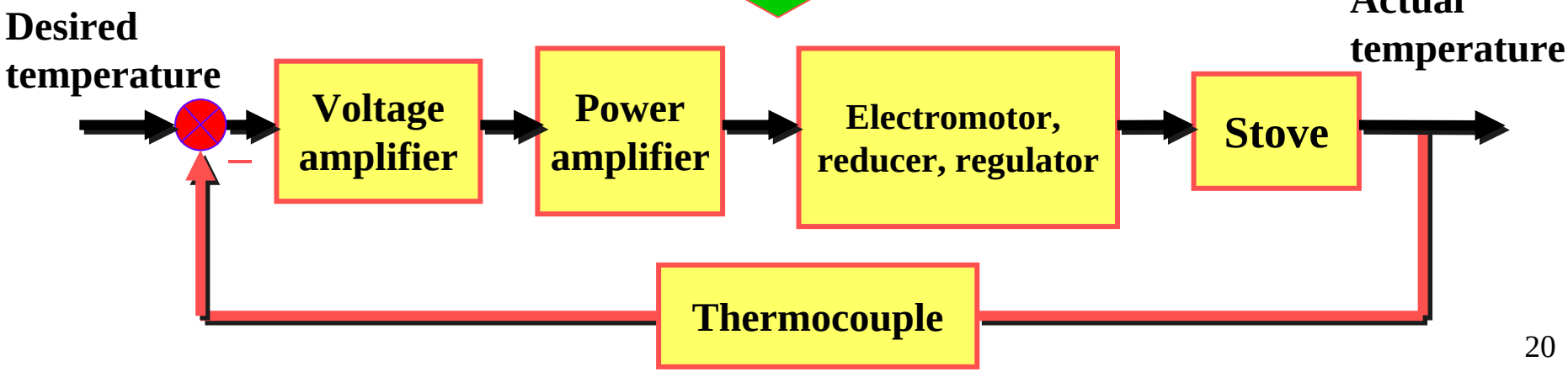


Example 1: Temperature control system: automatic control

Objective: the temperature of stove keeps on desired temperature



Control process



Example 2: Screwdown device of position control system —— automatic control

On blackboard

- **Homework： exercises 1-5, 1-6**

- **Thanks!**