# Introduction to Control

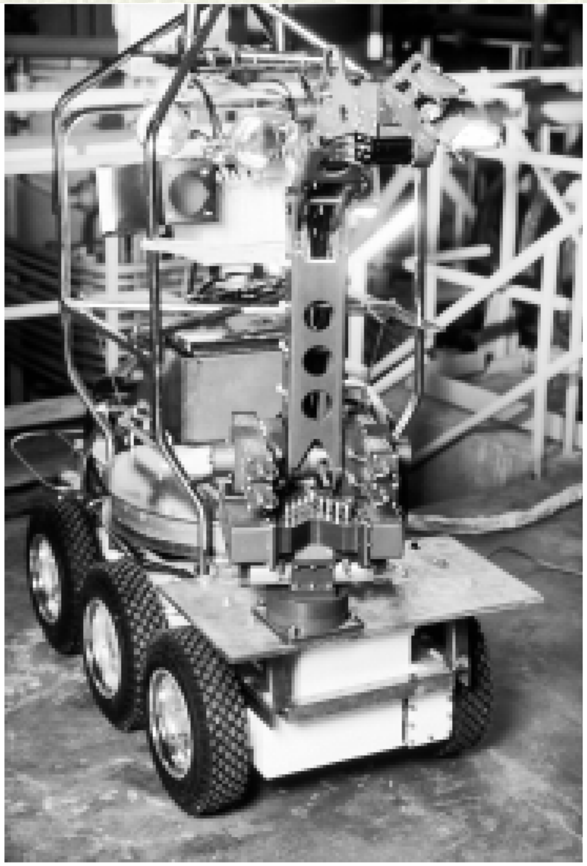
Instructor: Prof. Yi Guo

# Aims & Plan

- Why Control?
- What is a Control System?
- Feedback.
- What is the subject about?

# Why Control?

Rover was build to work in contaminated areas



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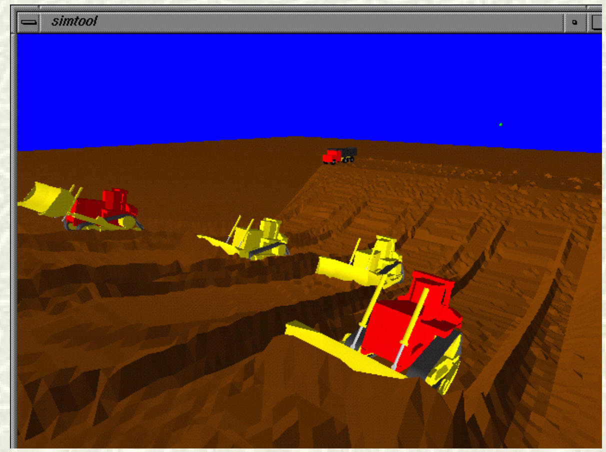
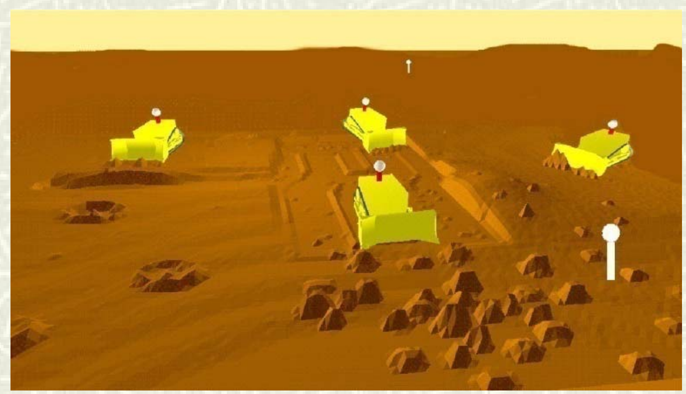


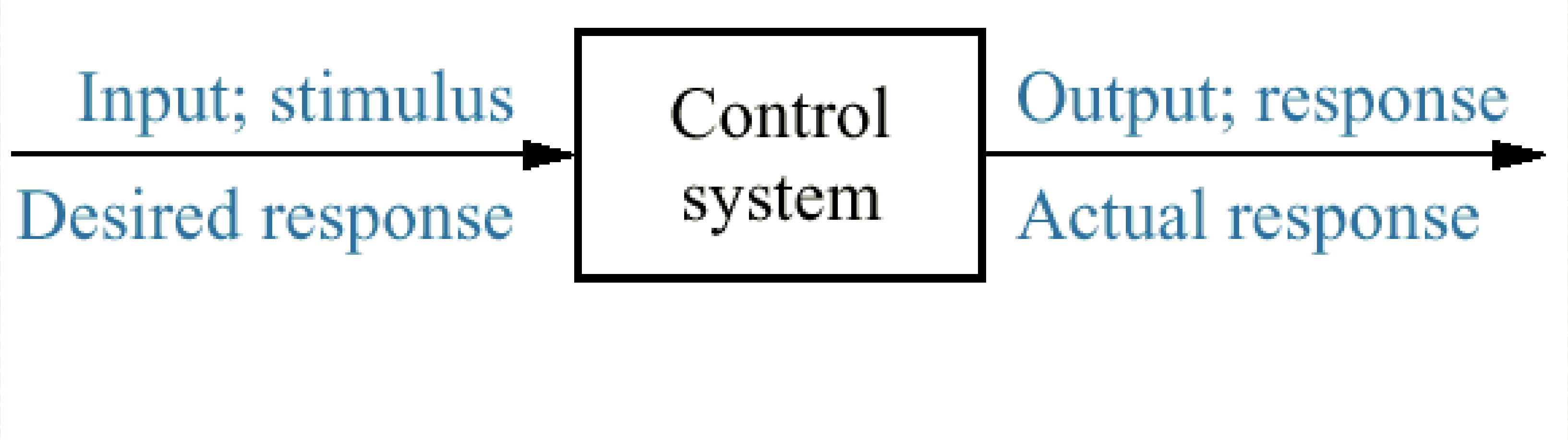

Robots used in surface mining, planetary exploration



# Why Control?

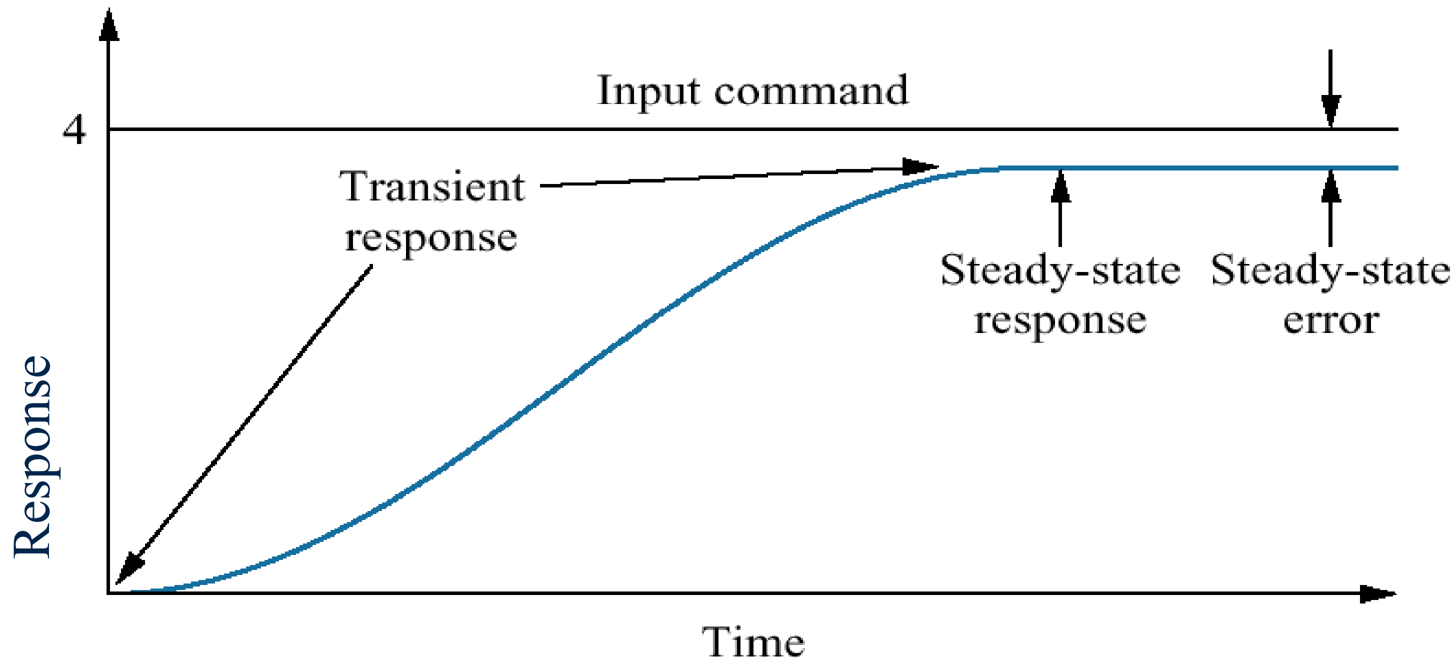
- Modern society have sophisticated control systems which are crucial to their successful operation.
- Reasons to build control systems:
  - Power amplification
  - Remote control
  - Convenience of input form
  - Compensation for disturbance

# What is a Control System?

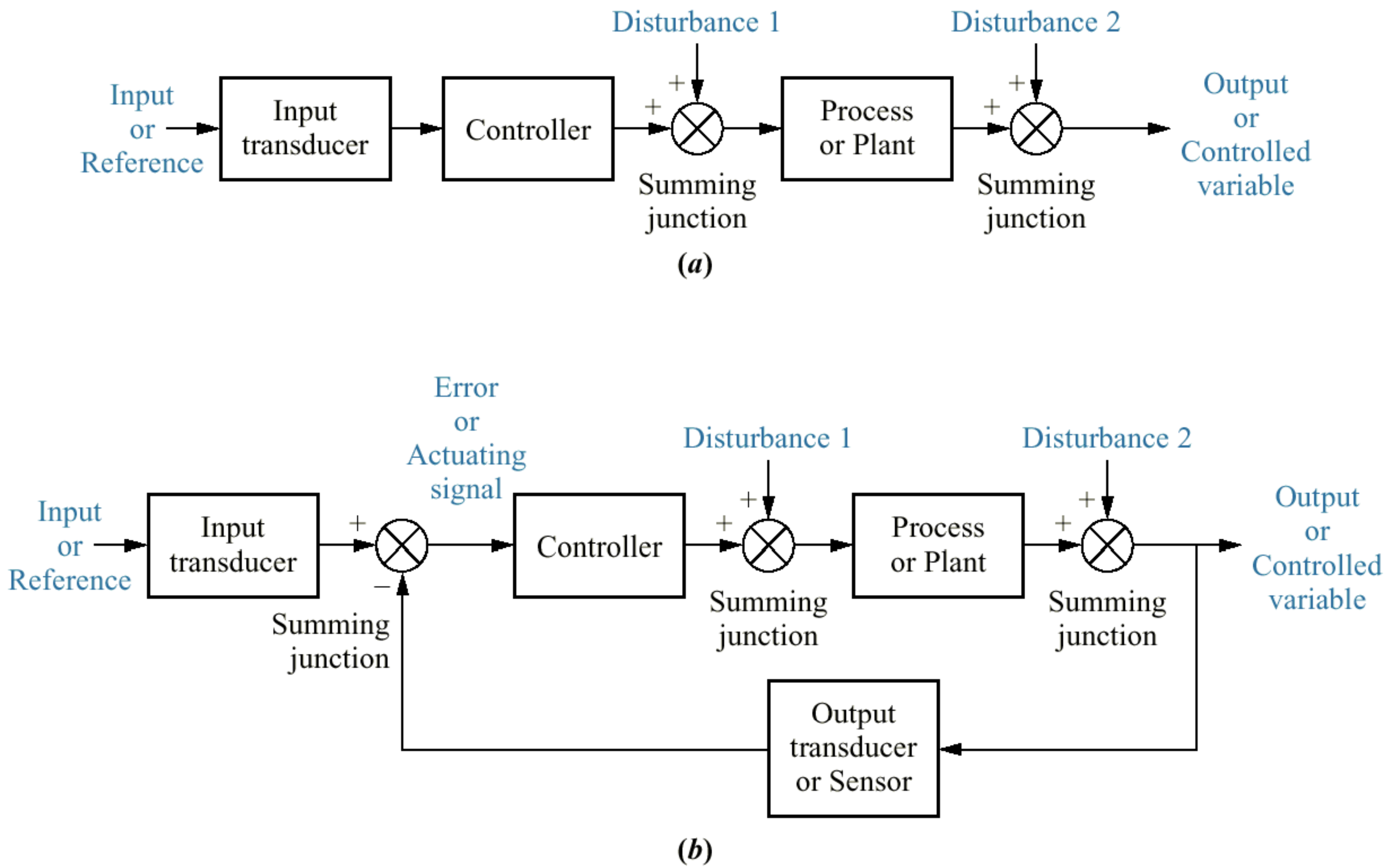



Simplified description of a control system

# Dynamic Response



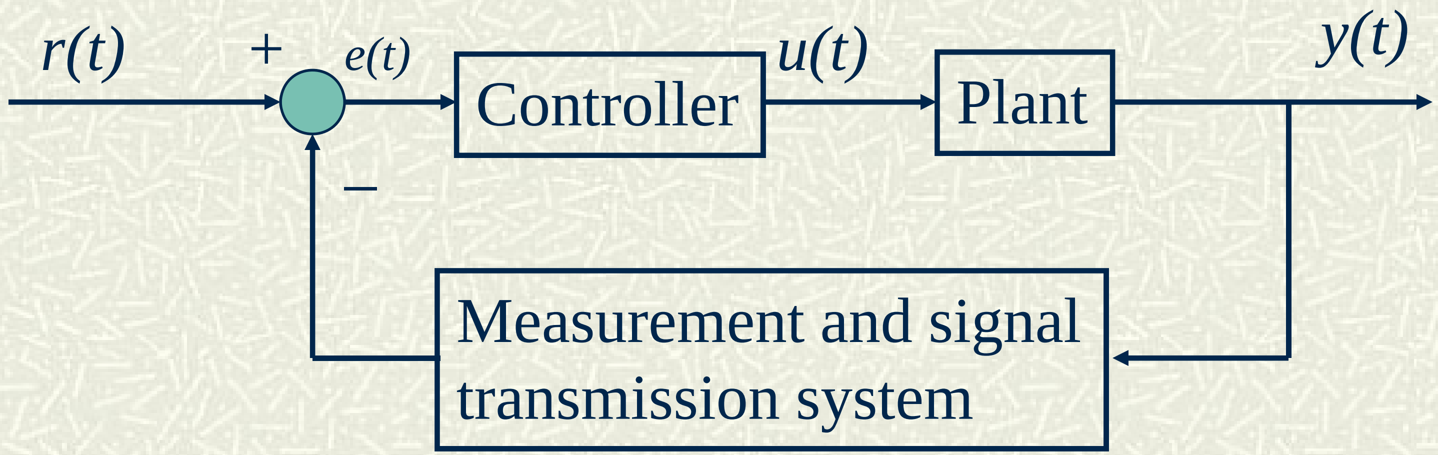
# Block diagrams of control systems:
**a.** open-loop system; **b.** closed-loop system



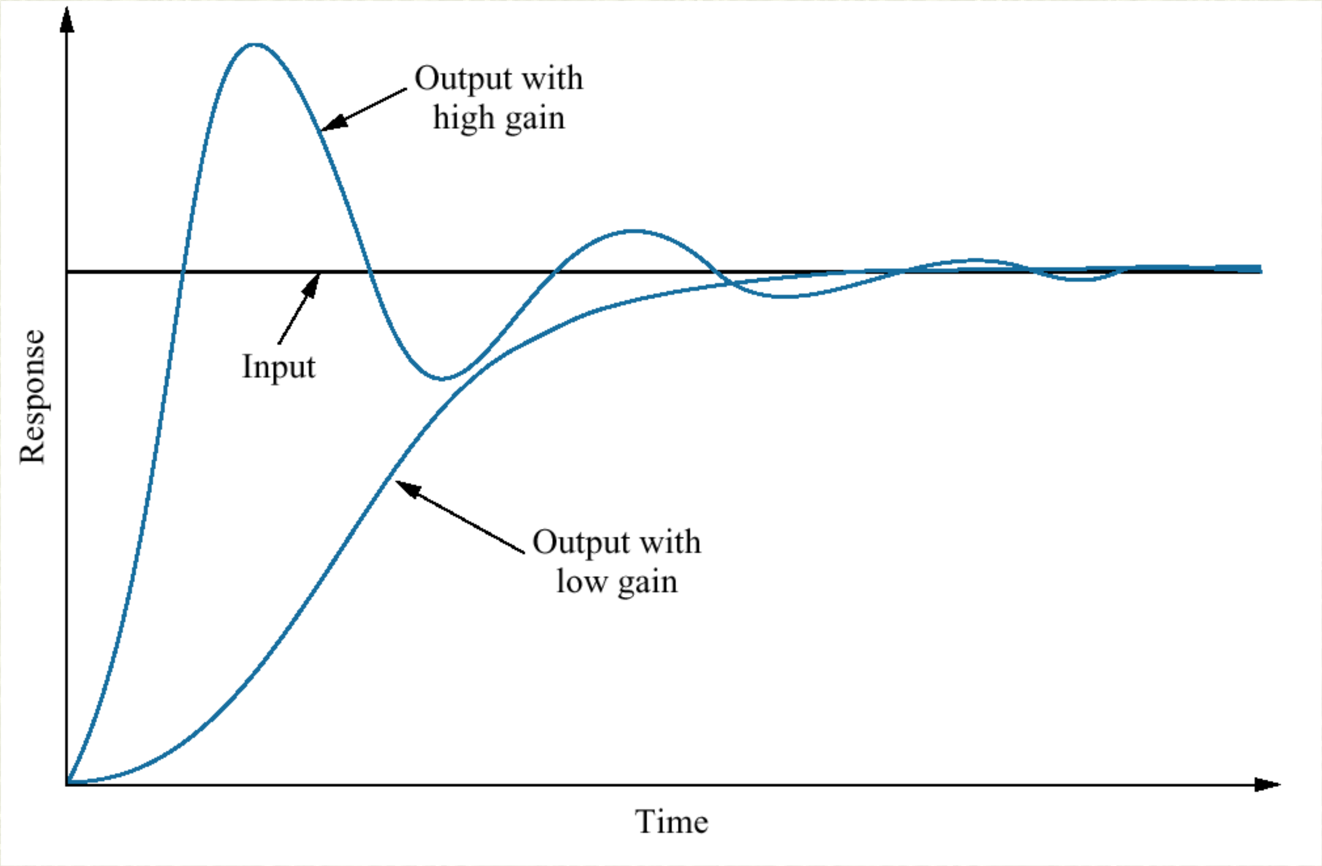
# Feedback

- Feedback is a key tool that can be used to modify the behavior of a system.
- This behavior altering effect of feedback is a key mechanism that control engineers exploit deliberately to achieve the objective of acting on a system to ensure that the desired performance specifications are achieved.

# Closed-loop control with sensor feedback



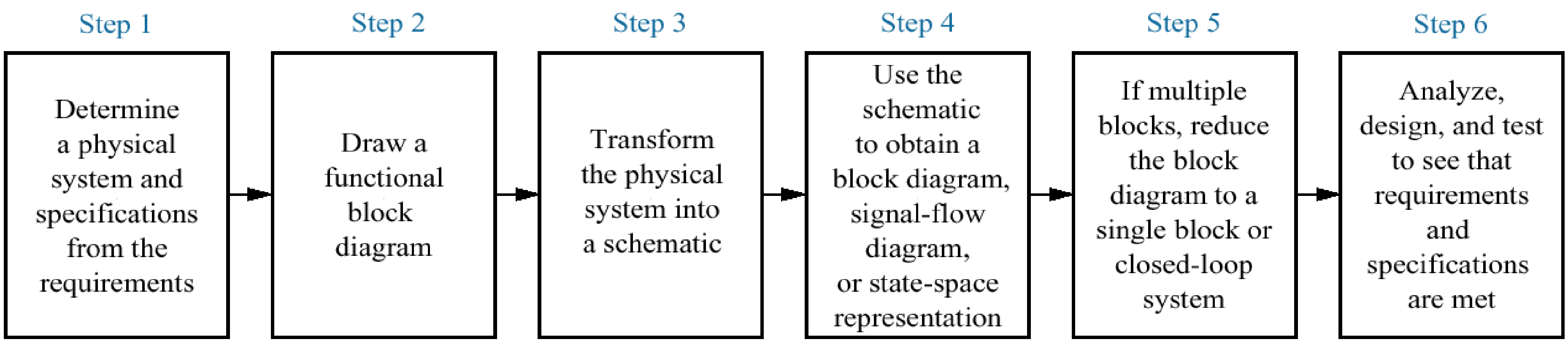
# Response of a position control system showing effect of high and low controller gain on the output response



# What is the Control System Engineer trying to achieve?

- First, understand the broader picture of the application to best apply a suitable control system.
- A good control system is a system that will
  - generate a response quickly and without oscillation (*good transient response*),
  - have low error once settled (*good steady-state response*),
  - and will not oscillate wildly or damage that system (*stability*).

# Control System Design Cycle



# Scope of the Subject

- Mathematical modeling of dynamic systems (transfer function, state space representation)
- Stability concepts
- Transient response for first and second order systems
- Root locus analysis
- Frequency response techniques: Nyquist criterion, Bode plots.

# At the end of the course…

- ***Modeling*** using transfer function, and state space
- Stability and transient response ***analysis***
- Simple compensator ***design***

**for**

*Linear time-invariant systems*

  - A linear system satisfies the principles of *superposition* and *homogeneity*
  - Ordinary differential equations that has *constant* coefficients

# Summary

We have introduced:

- Why do we need Control?
- What is a Control System?
- What are the main performance we care for a control system?
- Feedback is very important.
- What will this course cover?

# Summary

*The central problem in control is to find a technically feasible way to act on a given process so that the process behaves, as closely as possible, to some desired behavior. Furthermore, this approximate behavior should be achieved in the face of uncertainty of the process and in the presence of uncontrollable external disturbances acting on the process.*