1. Introduction to Control systems

Introduction

Control systems are an integral part of modern society. Numerous applications are all around us: Household appliances, temperature-control system, robotic systems , traffic control systems, chemical process systems. Control engineers are concerned with controlling segments of their environment, often called systems, to provide useful economic products for society.

Control engineering is based on foundations of feedback theory and linear system analysis, and it integrates the concepts of network theory and communication theory. It is equally applicable to electrical, aeronautical, chemical, mechanical, environmental, and civil engineering.

A control system is an interconnection of components forming a system configuration that will provide a desired system response.

- Each component is described by a cause-effect relation.

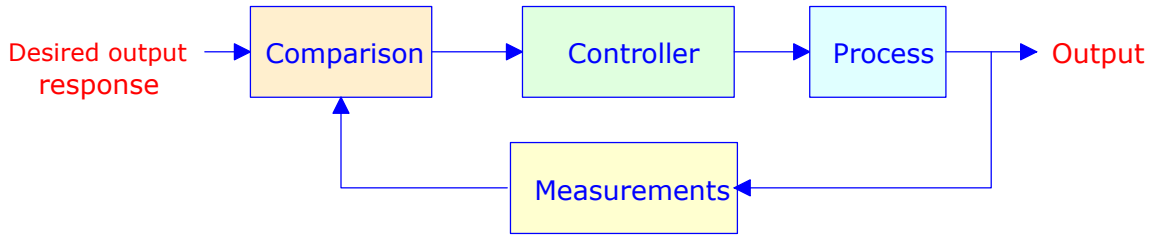
Therefore a component or process to be controlled can be represented by a block

- The input- output relation represents the cause-and-effect relationship of the process

Classification of Control systems

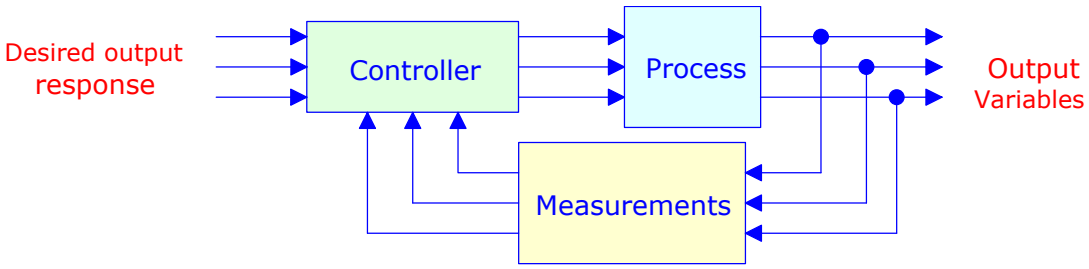
An open-loop control system utilizes an actuating device to control the process directly without feedback

A closed-loop control system uses a measurement of the out put and feedback of this signal to compare it with the desired output (reference or command)



Note that the above system has one input and one output. [**SISO**]

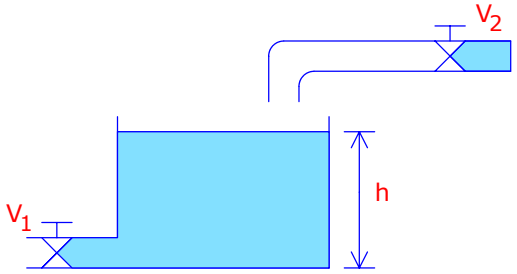
As the complexity of the systems under control increases, the interrelationship of many controlled variables must be considered in the control scheme. In this case we have a multivariable control system. [**MIMO**]



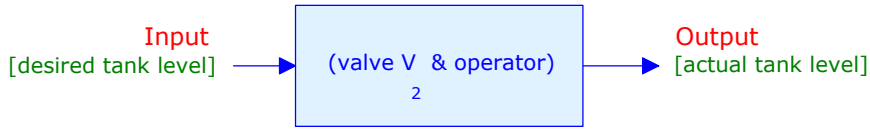
Example of an open-loop control system

- *Simple tank level control system*

-We wish to hold the tank level, h, within reasonable acceptable limits even though the outlet flow through valve V_1 is varied.
-This can be achieved by irregular manual adjustment of the inlet flow rate by valve V_2.
- This is not a precision system since it does not have the capability of accurately measuring the output flow rate through V_1, the input flow rate through valve V_2, or the tank level.

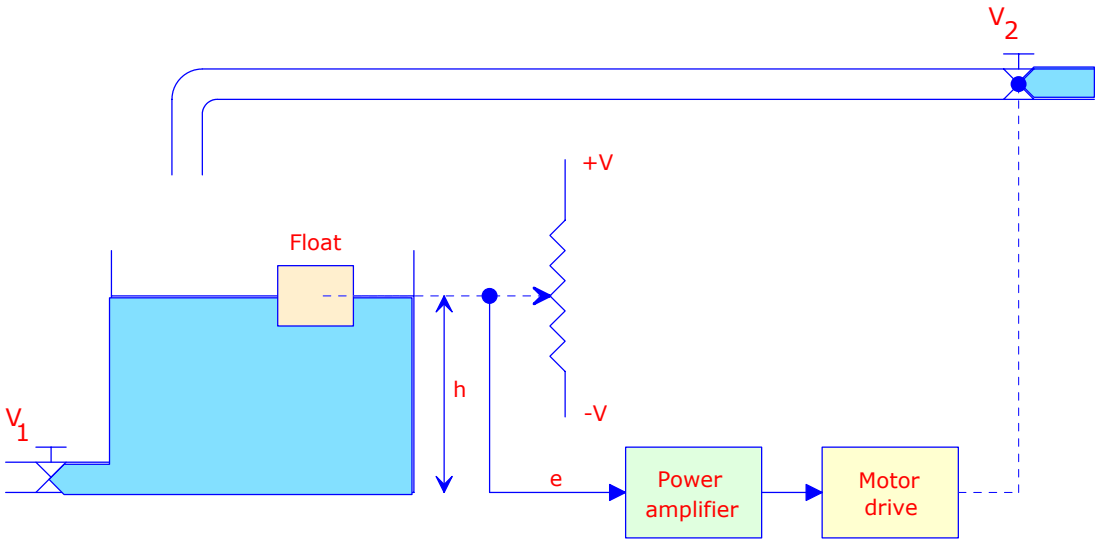


The simple relationship between the input (the desired tank level) and the output (the actual tank level) can be represented by a block diagram



Example of a closed-loop control system

- *Automatic tank level control system*



The above figure illustrates an automatic tank level control system. It can maintain the desired tank level *h* within quite accurate tolerances even though the output flow rate through valve V_1 is varied. If the tank level is not correct, an error voltage, *e* is developed. This is amplified and applied to a motor drive which adjusts valve V_2 in order to restore the desired tank level by adjusting the inlet flow rate. A block diagram of this system is shown.