

Dr. Norbert Cheung's Lecture Series

Level 2z Topic no: 01

Introduction to Feedback Control System

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Reference:

Feedback and Control Systems – Schaum's Outline Series – 3rd edition

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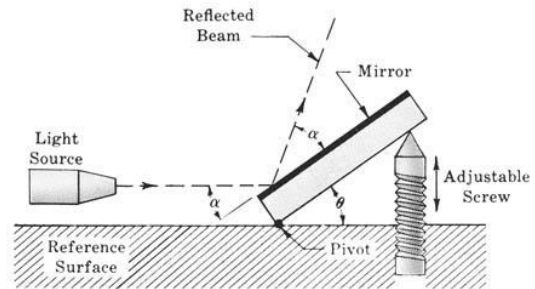
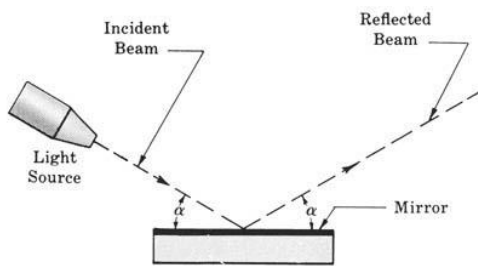
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1. What is a Control System?

A system is an arrangement of physical components connected or related in such a manner as to form and/or act as an entire unit.

A control system is an arrangement of physical components connected in such a manner as to command, or regulate itself.



The input is the command applied to a control system, typically from an external source.

The output is the actual response obtained from a control system. It may or may not be equal to the specified response implied by the input.

An open-loop control system is one in which the control action is independent of the output.

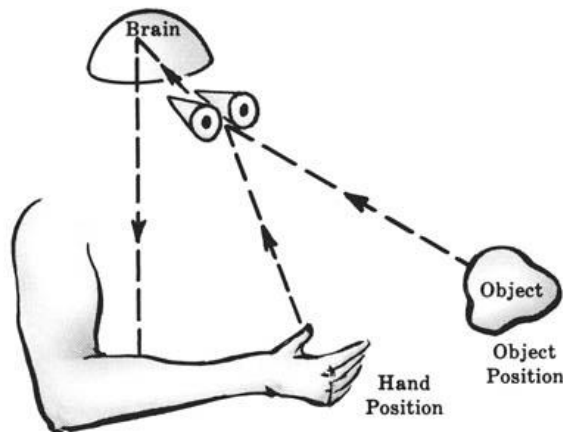
A closed-loop control system is one in which the control action is somehow dependent on the output.

Feedback is that property of a closed-loop system which permits the output to be compared with the input to the system so that the appropriate control action may be formed as some function of the output and input.

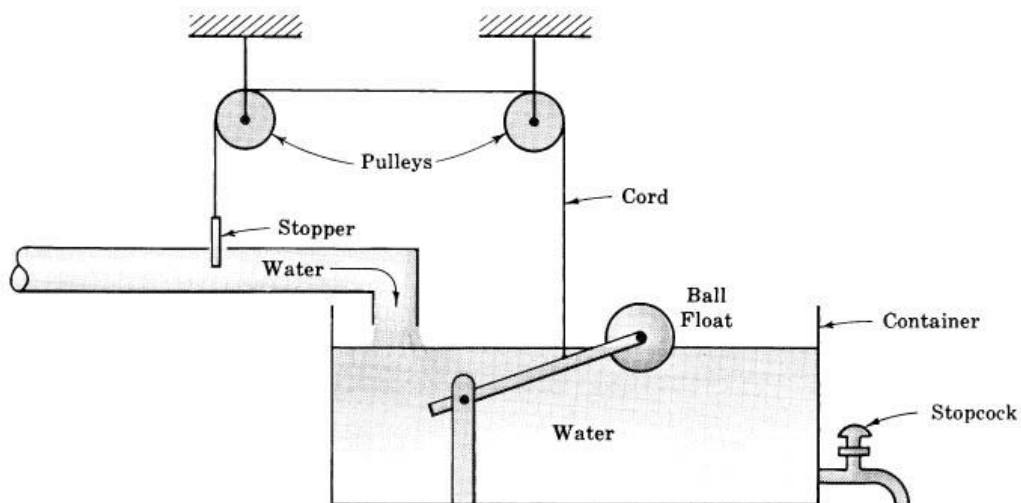
Properties of feedback control system:

1. Increased accuracy. For example, the ability to faithfully reproduce the input.
2. Tendency toward oscillation or instability.
3. Reduced sensitivity of the ratio of output to input to variations in system parameters.
4. Reduced nonlinearities effects
5. Reduced effects of external disturbances or noise

The objective of the control system is to reduce the distance between hand position and object position to zero. Below is a schematic diagram. The dashed lines and arrows represent the direction of information flow.

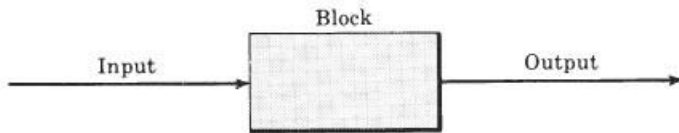


The simplified schematic diagram Below illustrates the principle of the ordinary toilet tank filling system.

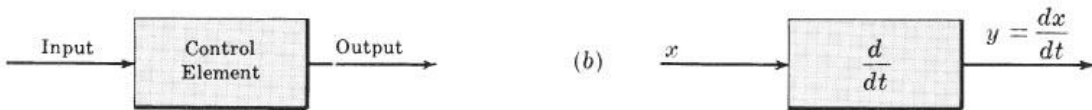


2. Block Diagram Fundamentals

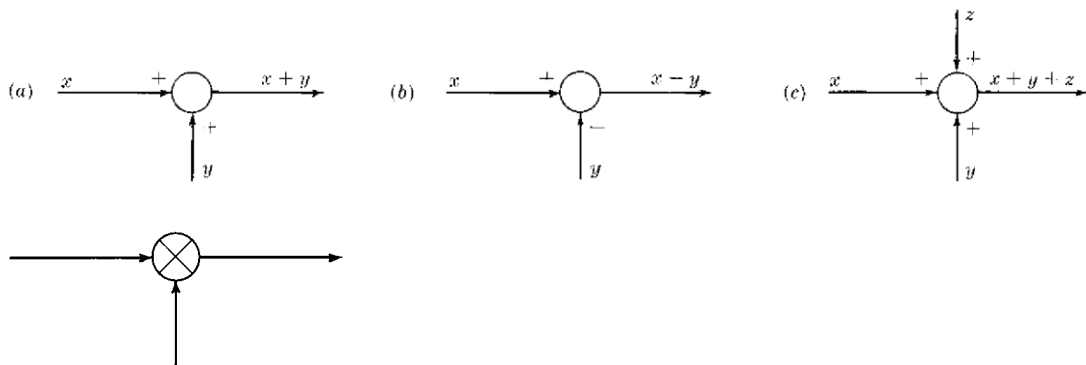
A block diagram is a shorthand, pictorial representation of the cause-and-effect relationship between the input and output of a physical system.



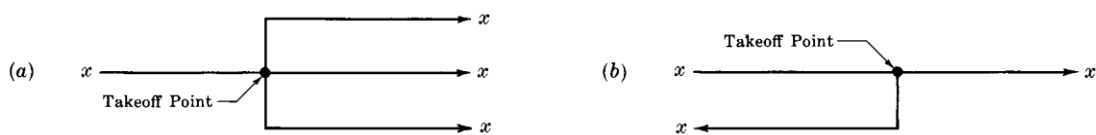
Examples:



The operations of addition and subtraction represents by a small circle, called a summing point, with the appropriate plus or minus sign associated with the arrows entering the circle. The output is the algebraic sum of the inputs. Any number of inputs may enter a summing point.

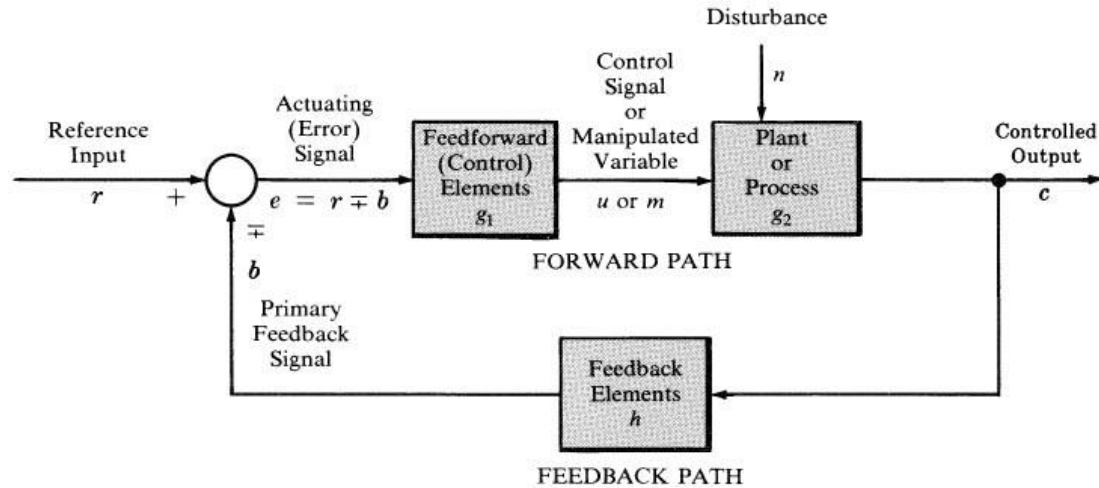


In order to have the same signal to be an input to more than one block, a takeoff point is used. This permits the signal to proceed to several destinations.



4. A Closed Loop SISO Control System

The basic configuration of a simple closed-loop (feedback) control system with a single input and a single output (abbreviated SISO) for a system with continuous (analogue) signals only.



3. Glossary

The plant g_2 is the system, subsystem, process, or object controlled by the feedback control system.

The controlled output c is the output variable of the plant, under the control of the feedback control system.

The forward path is the transmission path from the summing point to the controlled output c .

The feedforward (control) elements g_1 are the components of the forward path that generate the control signal u or m applied to the plant.

The control signal u (or manipulated variable m) is the output signal of the feedforward elements g_1 applied as input to the plant g_2 .

The feedback path is the transmission path from the controlled output c back to the summing point.

The feedback elements h establishes the functional relationship between the controlled output c and the primary feedback signal b .

The reference input r is an external signal applied to the feedback control system, usually at the first summing point, in order to command a specified action of the plant.

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Glossary – English/Chinese Translation

English	Chinese
feedback control system	反馈控制系统
block diagram	方框图
open loop control	开环控制
closed loop control	闭环控制
feedback	反馈
feedforward	前馈
accuracy	准确性
oscillation	振荡
instability	不稳定
sensitivity	敏感性
nonlinear effects	非线性效应
external disturbance	外部干扰
schematic diagram	原理图
cause and effect relationship	因果关系
summing point	总和点
takeoff point	起飞点
destination	目的地
plant or process	工厂或工序
error signal	错误信号
reference input	参考输入
manipulated variable	操纵变量

Your Notes: