Linear System Simulator

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Course: Control Engineering Laboratory
Code: ELP 225

Motivation

- Specifications for a control system design often involve certain requirement associated with the time response analysis of the system.
- For time domain analysis of control systems, we need to subject the system to various test inputs.
- Test input signals are used for analysing how well a system responds to these known set of inputs.
- The transient and steady state response of the system can be studied when the test inputs are applied to the system.
- Linear System Simulator provides such an experimental setup where time response of various configurations of linear system can be studied.

Objectives

- To study the time response of a variety of simulated linear systems and to correlate the studies with theoretical results
- Experiments to be done:

1. To determine the open loop transfer function of all the blocks viz. integrator, time constant, uncommitted amplifier and error detectors/adders experimentally
2. To determine the first order (type 0 & type1) open loop system response for various input signals like unit step, ramp, square wave etc.
3. To determine the closed loop response of first and second order systems.
4. To study disturbance rejection of closed loop system.

Experiment Layout

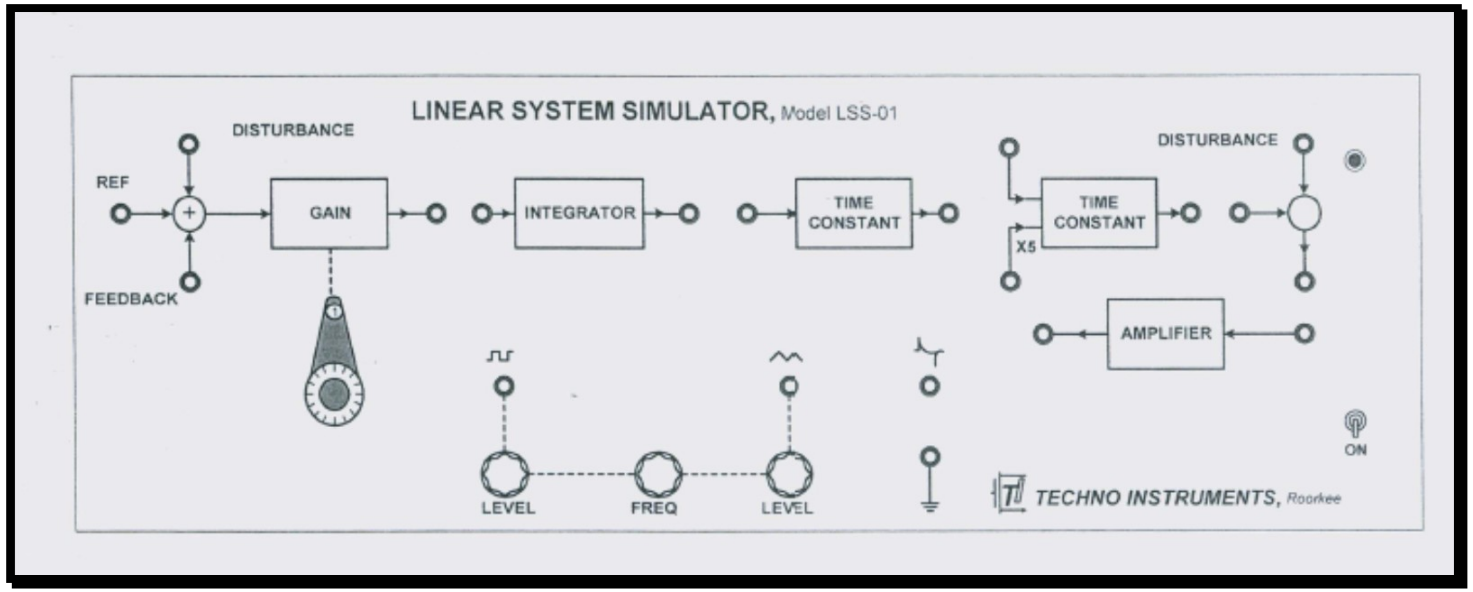


Fig 1: Panel Diagram of Linear System Simulator

- 3 built in sources: square wave, triangular wave and trigger
- Building blocks: error detector-cum-gain, integrator, time constant block, disturbance adder, uncommitted amplifier.

Block Diagrams (Open Loop System)

Reference In		Output
Y(t) 1	R(s) → + → K → $\frac{K_1}{s}$ → C(s); feedback -1	TYPE-1
r(t) 1	R(s) → + → K → $\frac{-K_3}{sT+1}$ → C(s); feedback -1	
	R(s) → + → K → $\frac{K_1}{s}$ → C(s); feedback -1	TYPE-1
	R(s) → + → K → $\frac{-K_3}{sT+1}$ → C(s); feedback -1	TYPE-0

Table 1: Time Response of First Order Open Loop Systems

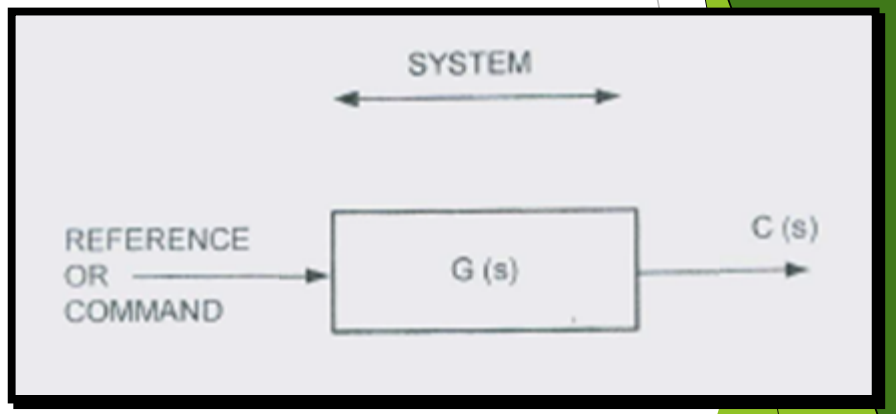


Fig 2: Open Loop System

Block Diagrams (Closed Loop System)

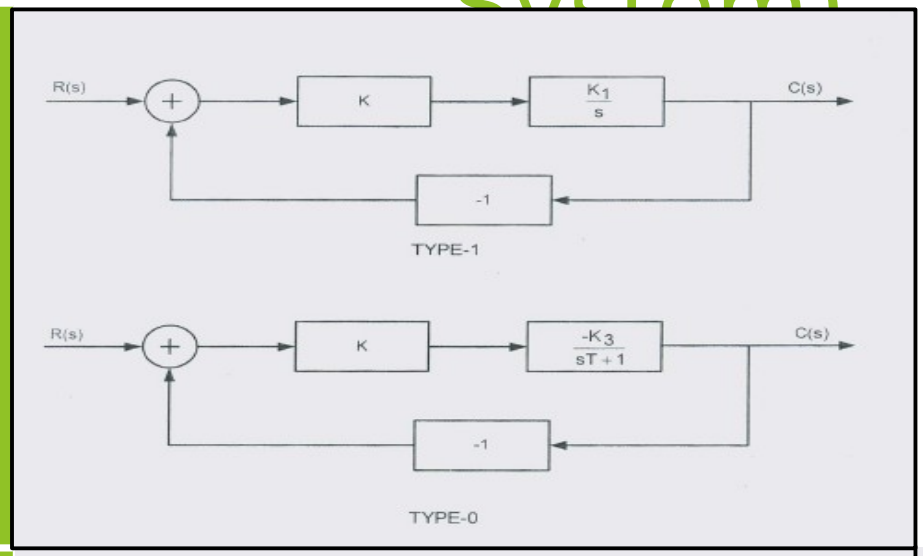
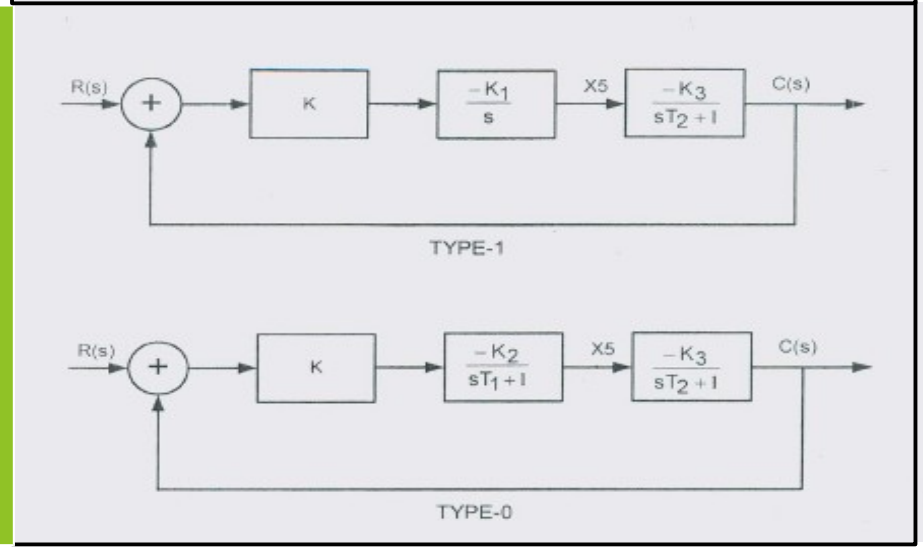
First Order Closed Loop System	
Second Order Closed Loop System	

Table 2: Block Diagram of First & Second Order Closed Loop System

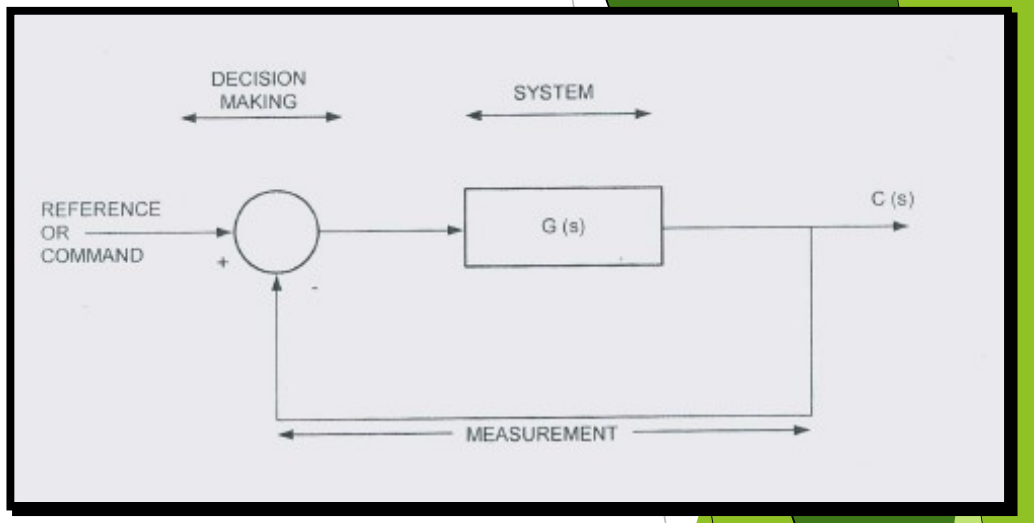


Fig 3: Closed Loop System

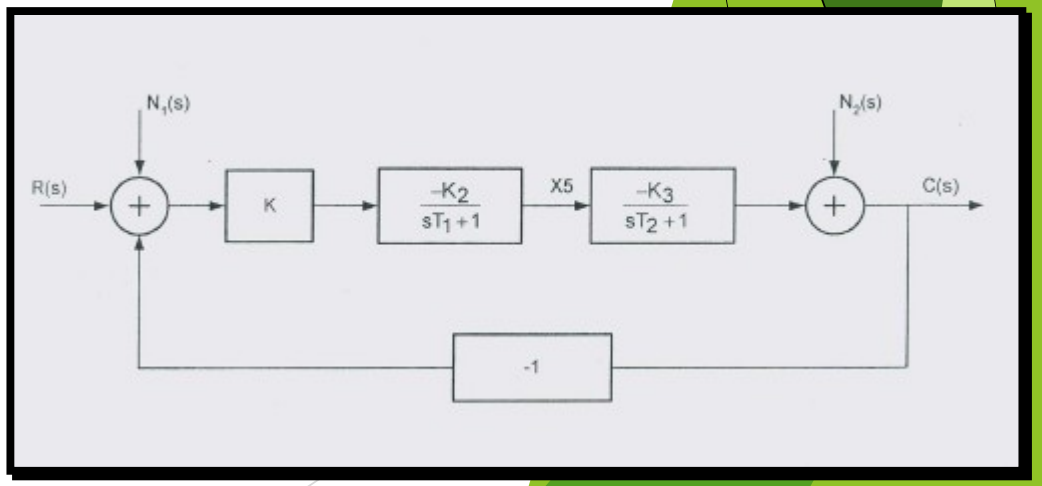


Fig 4: Block Diagram for Disturbance Rejection

Questions

- What is the difference between type and order of a system?
- What is a Lissajous pattern? In one of the experiments, a Lissajous pattern was obtained on the CRO. Why are we doing this experiment and what does the pattern tell?
- Differentiate between linear and non-linear systems. Which blocks on the setup are non-linear? Name the type of non-linearity.
- Why does the 3rd order system oscillate at very low value of K ?