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PERFORMANCE ANALYSIS OF STEADY STATE ERRORS USING SIMULATION

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ABSTRACT

In this paper I discussed Step and Ramp signals with and without feedback for different types of transfer functions in time response analysis. Calculated steady state error values for first order system and second order system which is the main objective of this paper. Secondary objective is to learn applications of some basic simulation commands and how to apply them in Control Systems.

Keywords - Transfer function, Open loop & Closed loop, Time response, Simulation

I. INTRODUCTION

Control engineering is based on the foundations of feedback theory linear system analysis, and it generates the concept of network theory and communication theory accordingly , Control engineering is not limited to any engineering discipline but is applicable to Aeronautical, Chemical, Mechanical, Environmental, Civil and Electrical engineering.

A Control System is an inter connection of components forming a system configuration that will provide a desired system response the basis for analysis of a system is the foundation provided by linear system which assumes a cause effect relationship for the components of a system. A component or process to be controlled can be represented by a block[1].

Main objective is a beginner can easily understand the concepts of control system with the help of simulation.

II. OPEN LOOP CONTROL SYSTEM

Figure 1:Block diagram of Open loop Control System

An open loop control system utilizes a controller or control actuator to obtain the desired response. The open loop control system utilizes on actuating device to control the process directly without using device[1]

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III. CLOSED LOOP CONTROL SYSTEM

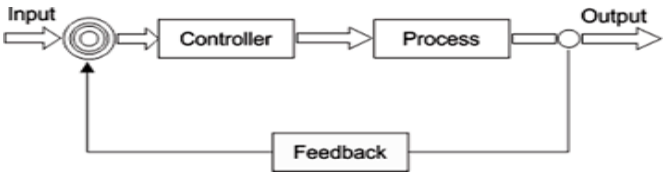

Figure 2 Block diagram of Closed loop Control System

Utilizes an additional measure of the actual output to compare the actual output with desired output response, the measure of the output is called the feedback signal. A feedback control system that tends to maintain relationship of one system variable to another by comparing functions of these variables and using the difference as a means of control[1].

When we study the analysis of the transient state and steady state response of control system know the some basic standard input signals.

IV. TIME RESPONSE ANALYSIS

A. Unit step function

One of the most common test inputs used is the **unit step** function, the **response** of a system (with all initial conditions equal to zero at t=0$^-$, i.e., a zero state **response**) to the **unit step** input is called the **unit step response**.

$$U(t)=1 \; ; \; t>0$$

$$=0; \; t<0$$

Laplace transform of $R(s)=1/s$

B. Ramp function

The ramp is a signal which starts at a value of a t=0 and increases linearly with time.

$$R(t) = At; \; t>0$$

$$= 0; \; t<0$$

$$R(s) = 1/s2$$

V. RESULT ANALYSIS

5.1 Unit Step Response for First Order System

A. Without Feed Back

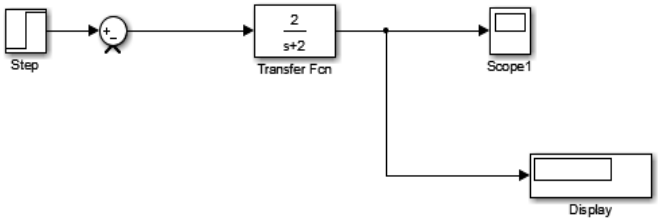

Figure 3:Simulink model for first order without feed back

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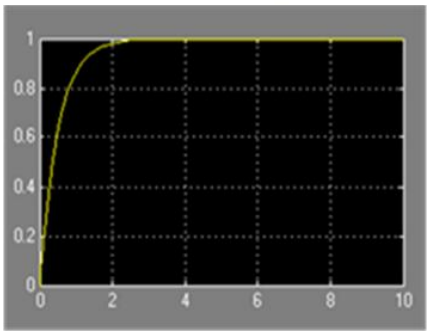

Figure 4 Unit Step first Order System without Feedback

B. With Feed Back

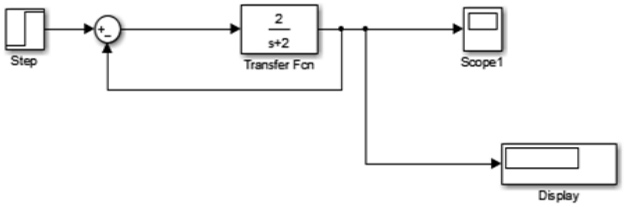

Figure 5:Simulink model for first order with feed back

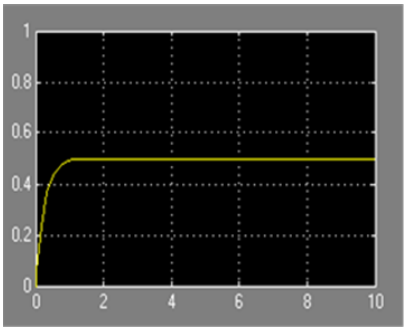

Figure 6 Unit Step Order Systemwith Feedback

5.2 Unit Step Response for Second Order System

A. Without Feed Back

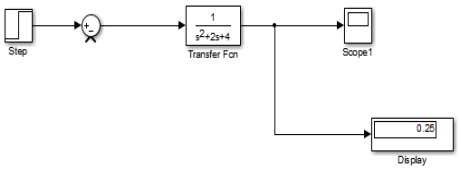

Figure7:Simulink model for second order without feed back

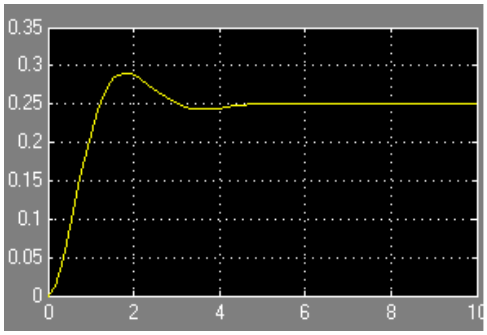

Figure 8 Unit Step second Order System without Feedback

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B.With Feed Back

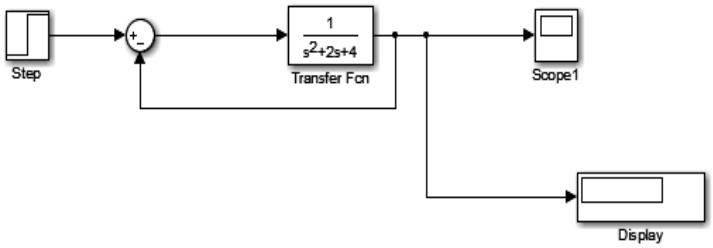

Figure 9:Simulink model forSecondOrder with feed back

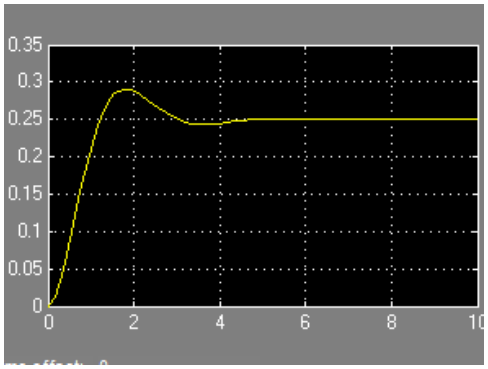

Figure 10. Unit Step second Order System without Feedback

5.3 RampResponse for First Order System

A. Without Feed Back

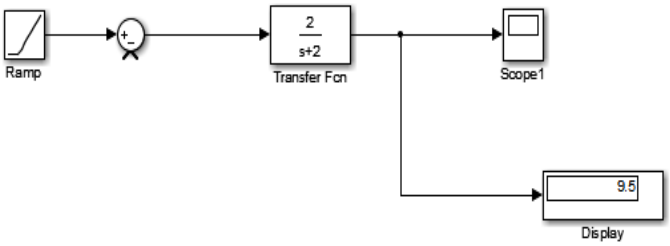

Figure11:Simulink model for Ramp first order without feed back

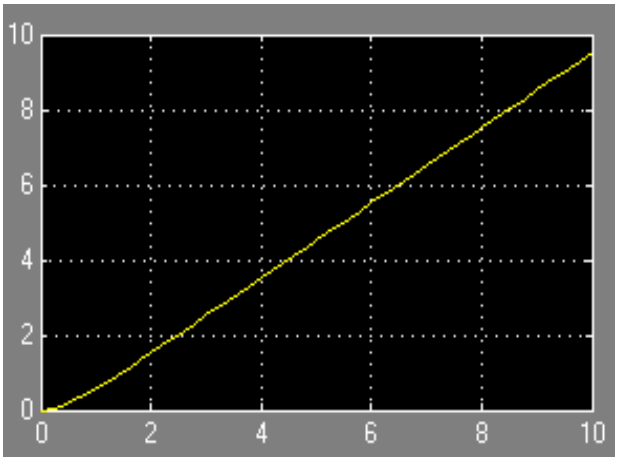

Figure 12 Unit Step Ramp first Order System without Feedback

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B. With Feed Back

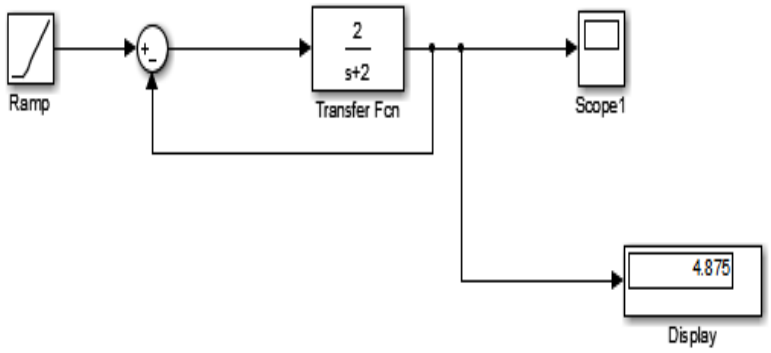

Figure13:Simulink model for Ramp first order with feed back

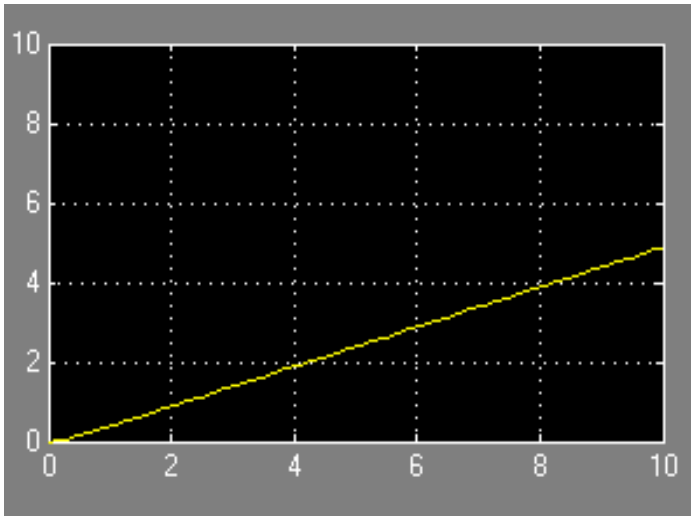

Figure 14.Unit Step Ramp first Order System with Feedback

5.3 Ramp Response for Second Order System

A. Without Feed Back

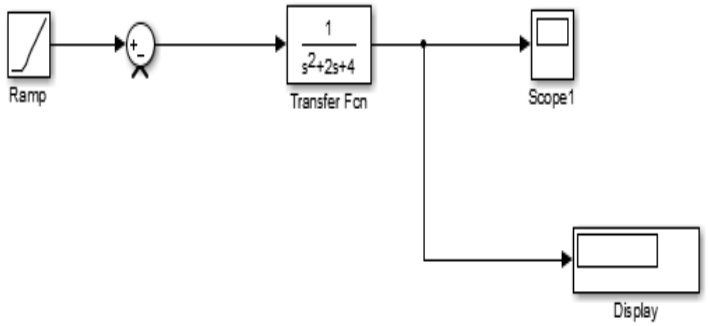

Figure15:Simulink model for Ramp Second order without feed back

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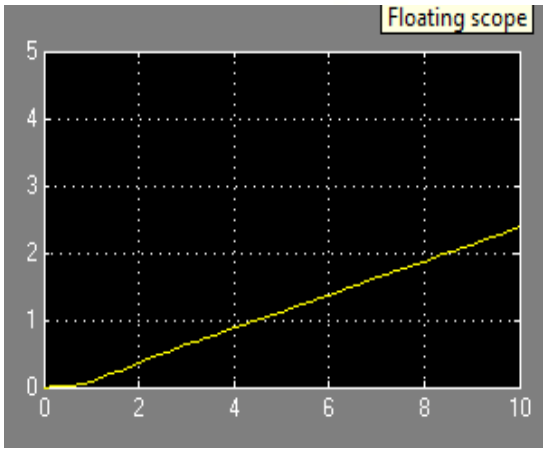

Figure16Unit Step Ramp second Order System with outFeedback

B. With Feed Back

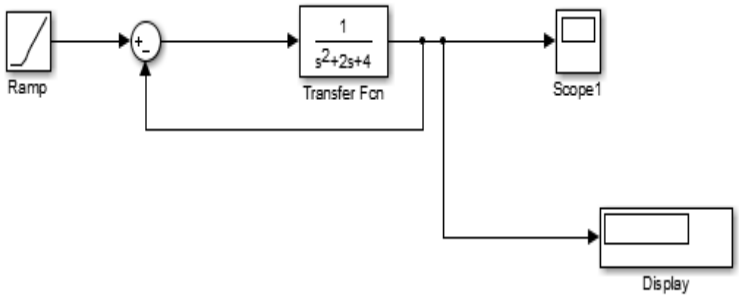

Figure 17:Simulink model for Ramp second order with feed back

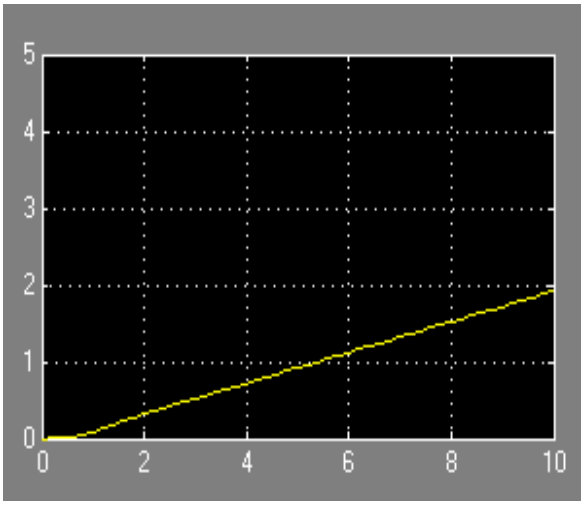

Figure18 Unit Step Ramp second Order System with Feedback

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VI. COMPARISON OF STEADY STATE ANALYSIS

A. First Order System

Input	Transfer Function	With Feedback Steady State Error	Without Feed back Steady State Error
STEP	1/(S2+2S+4)	0.2	0.25
RAMP	1/(S2+2S+4	1.92	2.375

Table 1: Comparison of first order systems

B. Second order system

Input	Transfer function	With feedback steady state error	Without feedback steady state error
STEP	2/S+2	0.5	1
RAMP	2/S+2	4.875	9.5

Table2: Comparison of Second Order Systems

VII. CONCLUSION

Calculated steady state error values in time response of first order and second order system. Step input gives better response performance than Ramp input. Increasing type of the system, more steady state errors are eliminated and speed response of system increased.

VIII. FUTURE WORK

In this paper discussed steady state error in time domain analysis. By using gain values with feedback calculate the steady state error and also try for different types of controller P, PI, PID, frequency domain analysis different types of transfer function for higher order system.

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[2] V.K.Singh, "MATLAB Simulation for Control System", International Journal Of Innovative Research In Electrical, Electronics, Instrumentation And Control Engineering, Vol. 2, Issue 1, January 2014.