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Optimized tuning of Internal Model Control for Level Process

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Abstract - *The analysis study has been done for a liquid level process control system which is controlled by tuning (IMC) using MATLAB software .The study has been done for IMC method to design the controller for the level tank system. The conventional PID controller gives corrective action only after error has developed but not in advance but IMC provides corrective action in advance. The internal model control is able to compensate for disturbances and model uncertainty while open loop control is not Internal model control is also detuned to assure stability even if there is model uncertainty The Pade's approximation for time delay has been used with the delayed system. The objective of this study is to investigate the IMC strategy, analyze and compare the control effects with conventional control strategy in maintaining a water level system.*

Key Words: PID, IMC, Matlab, liquid level control system

1.INTRODUCTION

In industrial application liquid level control is very important as in dairy, filtration , effluent treatment , nuclear power generation plants and water purification systems in all the industries . The level control is a type of control method common in process system. It must be controlled by using proper controller .The conventional proportional controller (PID) is commonly utilized in controlling the level [1].The selection of a controller type (P,PI,PID) and its parameters (K_C,τ_I ,τ_D) is intimately related to the model of the process to be controlled. The adjustment to achieve satisfactory control is called tuning, A typical criterion for good control is the response of the system to a step change in set point or load have minimum overshoot , minimum rise time and minimum settling time[2].Controller design is the most essential and important part of the control applications. There are many types of controllers are architectures which are available in control system The designed controller has to give optimal control result irrespective of every situation like plant and equipment.

The mathematical modelling of the process requires experimentally plant data and then equivalent mathematical modelling of the control scheme is made .Different kinds of controller can be designed to meet the con troll scheme .The controller is actually establishing the parameters and set point as per the requirement of process. The internal model control (IMC) algorithm is based on the fact that an accurate model of process can lead to the design of a robust controller both in terms of stability and performance[5].The first predictive control algorithm is referred to the publication of Richalet et al. titled" model predictive Heuristic control"[6].However in 1979, Cutler and Ramaker by shell™ developed their own MPC algorithm named Dynamic Matrix control [8] .Since, then, a great variety of algorithms based on the MPC principle has been also developed. The basic IMC structure is shown in fig(1).

To meet the control scheme of the process there are following types of controller can be implemented.

i. Feedback controller
ii. Feedback plus feed forward controller

2. Process Description:

In the present work, we discuss about the single tank system in which supply tank, pump, rotameter and transparent tanks with graduated scales are available.

FIG 2 : Experimental set up

2.1 **Internal Model Control controller**

The internal model control is based on the principle of the internal control .In process control applications; model based control systems are often used to track set points and reject low disturbances .The internal model philosophy relie on the internal model principle which states that if any control system contain within it implicity or explicity ,some representation of the process to be controlled then a perfect control is easily achieved. Generally control scheme has been developed based on the exact model of the process then perfect control is theoretically possible Although the IMC design procedure, the implementation of IMC result in feedback system The perfect control on the process can be achieved by having the complete knowledge of the process The internal model control (IMC) algorithm is based on the fact that an accurate model of. The basic IMC structure is shown in fig(2.1).

$G_P(s)$ is the process transfer function

$G_P(s)$ is the process model

d(s) is the disturbance

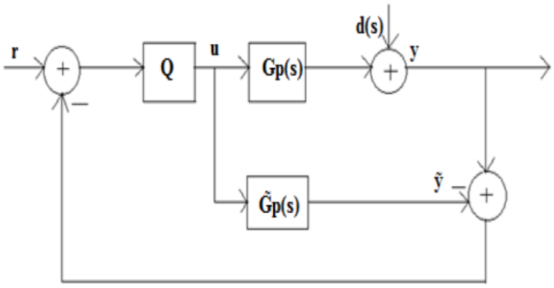


Figure 2.1: IMC modified structure

3. Result and discussion:

3.1. Simulation of IMC based first order process with time delay plus first order disturbances.

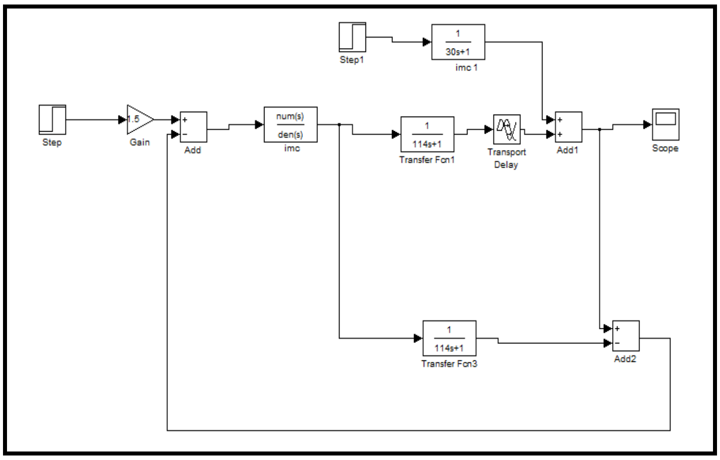
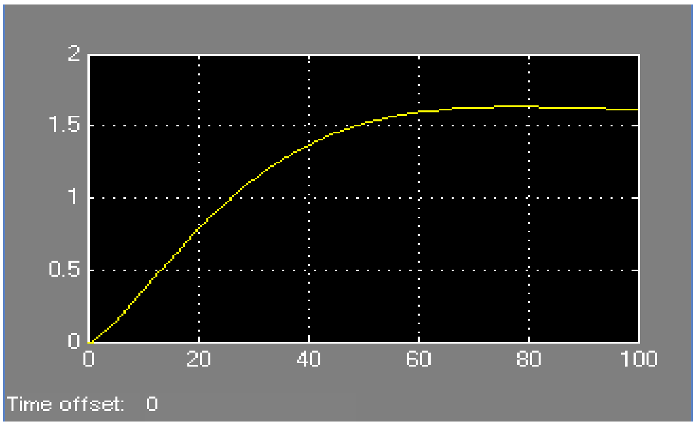


Fig: 3.1 Simulink block diagram for IMC based first order process with first order disturbances.



3.2. Simulation of IMC based first order process with time delay plus second order disturbances.

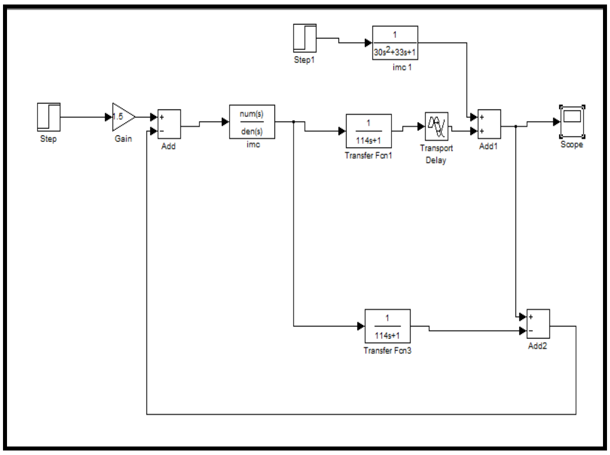
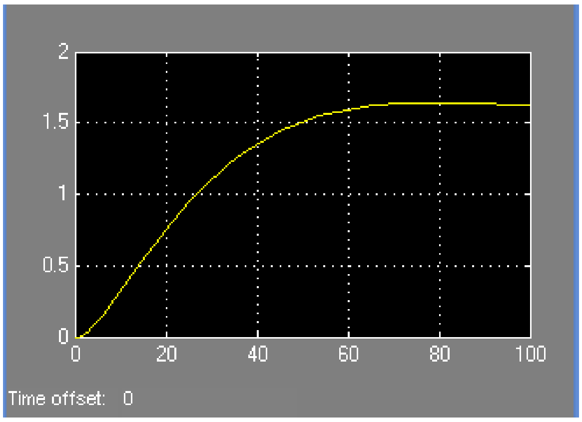


Fig: 3.2 Simulink block diagram for IMC based first order process with second order disturbances.



3. CONCLUSIONS

The internal model controller provides a transparent framework for control system design and tuning .It is also called advanced tuning method to predict the error before process is completed.

It is generally used to handle the model uncertainties and disturbances .There is time delay in system which affects the output of a system .so pade's approximation used. So generally it is used to compensate the disturbances and model uncertainty while open loop control is not. Internal model controller is also detuned to assure stability even if there is model uncertainty. So in this paper we try to reduce disturbances and uncertainty by tuning our liquid level system with Internal Model Control

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