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Unmanned Identification and Control of A Process System Using Labview

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Abstract : *This paper emphasis the idea of solving the disturbance caused in the process system without the human efforts by introducing the principle method of a new design of the experimental platform for the control and system identification based on LabVIEW. The main idea of this project is to make the Quadruple tank (non-interacting process) to be automated using LabVIEW .It includes the steps of system identification and tuning of the controllers. It reduces the complication in the tuning process for every change in the set point or any undesired disturbance. The final phase promotes the unmanned process and its corresponding control for the interfaced process of the system.*

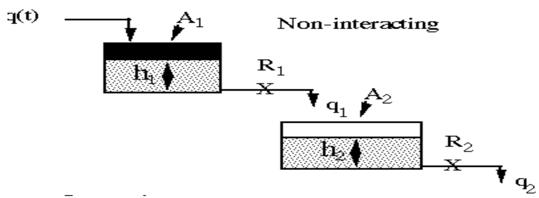
Keywords – *LabVIEW, non-interacting process, system identification, tuning methods, unmanned process*

I. INTRODUCTION

In the modern trend set the field of instrumental and industrial set up has a wide range of advancement in along with the evolution of control design. Controllers play the complete role in maintaining the process for the given/desired set point. This is shown along with the various control tuning techniques that are performed along with the system identification and model validation. This section is dealt with the level process by the QUADRAPULE TANK (multi-variable) system where the experimentation is done in non-interacting process. The main objective of this work is to enforce PID controller in a real time process and to find out the best and suitable controller which provides efficient control action.

II. NON-INTERACTING PROCESS

A physical system can be represented by several first-order processes connected in series in which two tanks are arranged so that the outlet flow from the first tank is the inlet flow to the second tank. In non interacting process *the* outlet flow from tank 1 discharges directly into the atmosphere before spilling into tank 2 and the flow through *R* 1 depends only on *h* 1 . The variation in *h* 2 in tank 2 does not affect the transient response occurring in tank 1. This type of system is referred to as a *non - interacting* system.



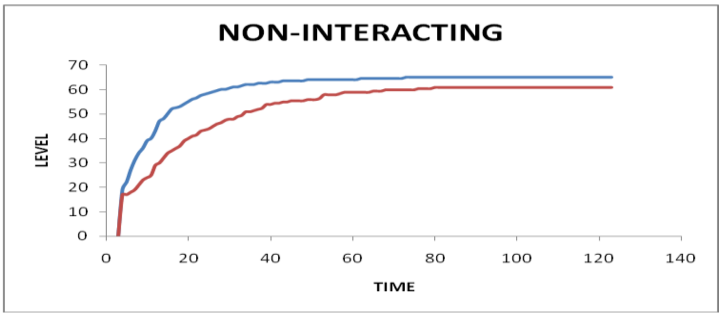
Having the transfer function for each tank, we can obtain the overall transfer function *H* 2 (*s*)/ *Q* (*s*) by multiplying the two separate transfer function of the tanks which is displayed as:

$$\frac{H2(s)}{Q(s)} = \frac{1}{\tau 2s+1}\frac{R2}{\tau 2s+1}$$

With the derived response of the non-interacting process the procedures of system identification and control tuning process is carried out in LabVIEW.

III. SYSTEM IDENTIFICATION AND CONTROL TUNING PROCESS

From the derived response of the non-interacting system in the MULTI-VARIABLE CONTROL TRAINER KIT,



The following system identification methods are carried out. This is done to obtain the optimum results of gain (K), delay time (td) and time constant (τ). The following are the various types of system identification techniques that we have proceeded, which also includes the model validation at the end as the result of this system identification process.

1.TANGENTIAL METHOD: From the list of readings, the transfer function parameters K (process gain), td (dead time) and τ_p (time constant) are determined.

The format of SOPTD transfer function is given as, G(s) = $\frac{2.2338}{4635s^2+148s+1}e^{-12s}$

2. SK METHOD: Sundaresan and Krishnaswamy use the normalized response $\frac{y}{KM}$ of the model to a step-forcing function**:** $U(s) = M/s$ at two different times, t_1 and t_2. These times are selected such that the normalized response reaches 35.3% at t_1 and 85.3% at t_2. The recipe gives the estimated values of the time constant and delay time by

td = 1.3 (t35.3) – 0.29 (t85.3)
τp = 0.67 (t85.3 – t35.3)

The transfer function identified through this method is as follows: G(s) = $\frac{2.2338}{4147.836s^2+135.34s+1}e^{-10.1s}$

3. TWO POINT METHOD: With the manipulated values of the response in terms of its 63.2% and 28.3% of its final values the delay time and the time constant is calculated which are as follows

t_d = t63.2 – t28.3
τ_p = 1.5 (t63.2 – t28.3)

The transfer function G(S) derived through this method is as follows: G(S)=

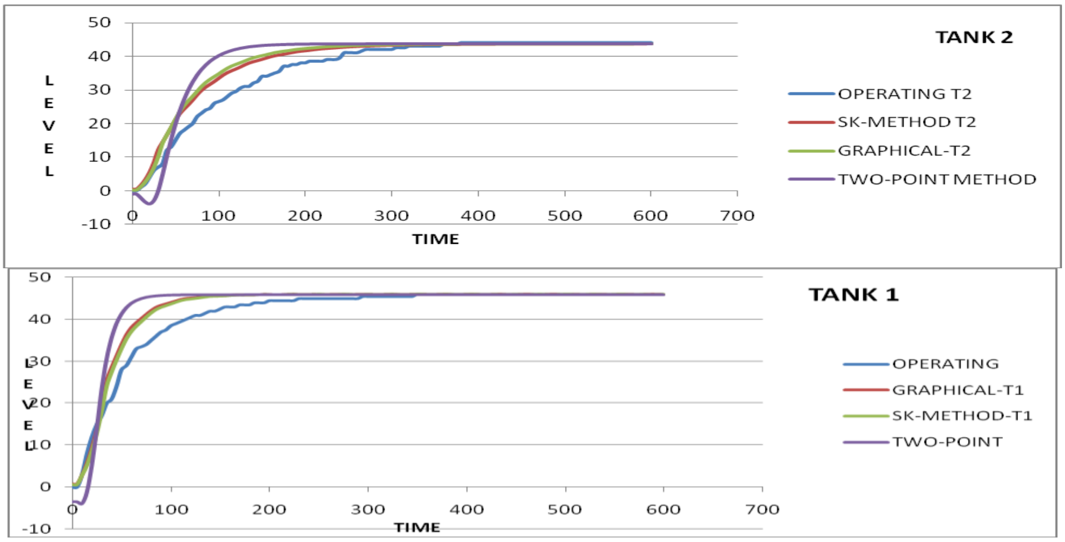
$$\frac{2.2338}{5049s^2+151.5s+1}e^{-101s}$$

The above system identification techniques provides the response which are displays above. They provide the values of gain (K), delay time (td) and time constant (τ) for each corresponding techniques respectively. They are tabulated which are as follows:

SYSTEM IDENTIFICATION METHOD	K_p	τ_1	τ_2	td
TANGENTIAL METHOD	2.2338	4635	148	12
SK METHOD	2.2338	4147.836	135.34	10.1
TWO POINT METHOD	2.2338	5049	151.5	101

Transfer Function Parameters

From the above tabulation, the modal validation is found to be recognized through SK (Sundaresan-Krishnaswamy) method. This is identified by comparing the response of the system along with the various system identification methods that are represented as follows:

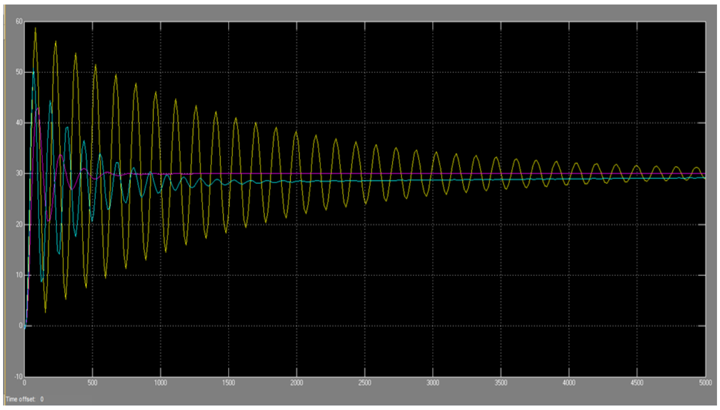


Comparison Of The Response Of System Identification Methods

The identified model is given in the form of the following **G(s)** = $\frac{2.2338}{4147.836s^2+135.34s+1}e^{-10.1s}$

For the manipulated transfer function, various tuning techniques like Ziegler Nichol's, Tyreus Luyben, IMC is used to find its PI values. They are tabulated along with its closed loop response in MATLAB, through which TYREUS LUYBEN METHOD suits the best through the derived response,

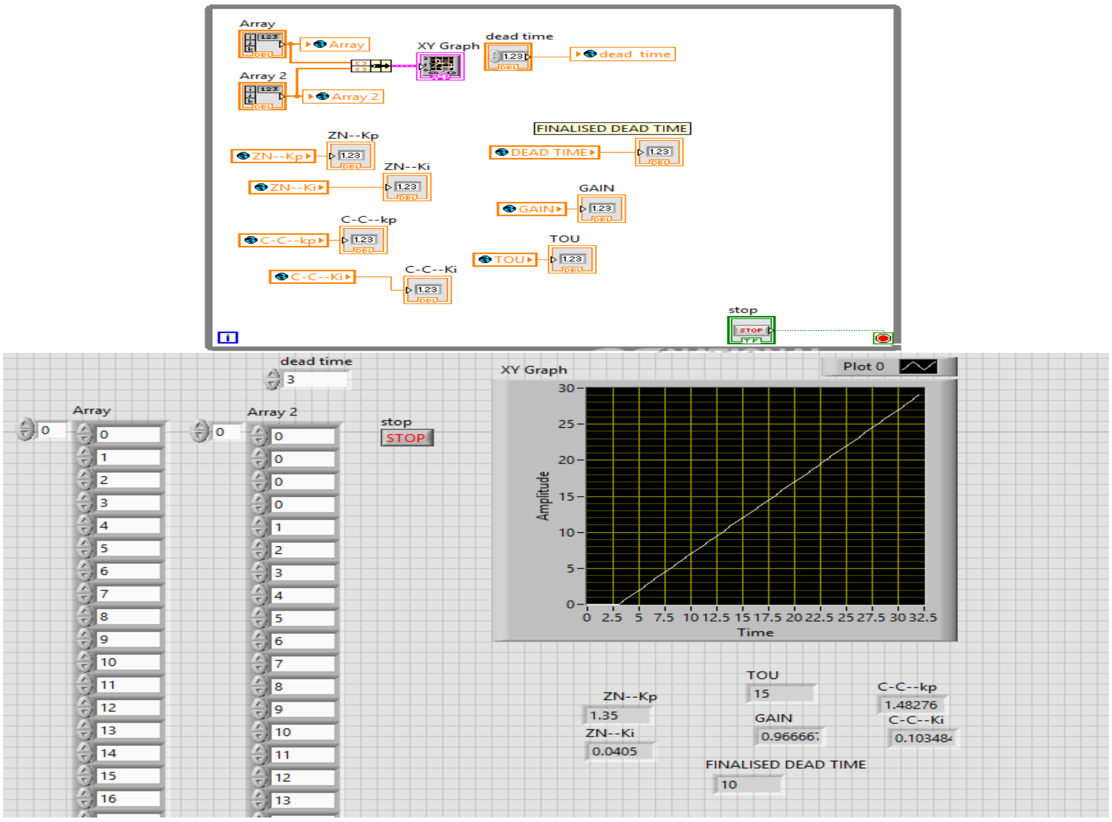
TUNING METHODS	KP	KI
ZIEGLER NICHOL'S	3.375	0.044
TYREUS- LUYBEN	2.593	0.0117
INTERNAL MODEL CONTROL	5.160	0.00120



TABULATION AND RESPONSEOF CONTROL VALUES

IV. SIMULATION IN LABVIEW

In LabVIEW, the non-interacting process is performed with the data logging strategies by embedding the values which are generated in the multivariable tank through its respective transmitters and interfacing techniques. The ultimate aim of the unmanned process to perform the control action for the identified disturbance is to perform the corrective measure by defining its tuning values which are done entirely without any human interference. The unmanned process front panel and block diagram is given which are as follows whose final control values will be interfaced with the NI-my RIO with the process that has to be interfaced and controlled without human interference.



FRONT PANEL AND BLOCK DIAGRAM OF UNMANNED PROCESS

V. CONCLUSION

Based on the attained graphs & readings, time domain specifications, error criteria and , for level (NON-INTERACTING) process controlling we have established that the modal validation deals best with the SK METHOD and TYREUS AND LUYBEN is suitable tuning methods that provide enhanced performance than any other tuning techniques for the non-interacting process. The second phase of this project also concludes that the non- interacting process is controlled in the unmanned environment where the entire manipulated on system identification and the identification of best controller has been calculated by itself . Thus this concludes with simulation of non-interacting process in LabVIEW which created the entire unmanned environment to control the non-interacting process.

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