International Journal of Aquatic Science
ISSN: 2008-8019
Vol 12, Issue 03 2021

Implementation And Analysis Of PIDE Auto-tune Automation Control Of Spherical Tank System Using Control Logix 5571

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Abstract. The challenge of handling process parameters such as flow, level, temperature, and pressure, which is regarded as the most significant problem in the process industry environment. In a spherical tank, the cross section area of the tank varies nonlinearly as the height of the tank changes, so shape of the level changes in a nonlinear manner. The nonlinear system is used by most of the process industries for storage purposes, like cement, sugar, paper & pulp, oil, and gas. The maintaining and controlling the process parameter liquid level of the spherical tank is critical for system stability, and the controller is designed for simplicity and improved performance. In this research work the control algorithms in the enhanced PID controller were selected. The Enhanced PID employs a velocity form of algorithms, and the resources on which the loop operates a change in errors to change the output. They are in charge of the system's stability as well as the proportional, integral, and derivative control values are then determined using the PIDE auto-tuning method. This is very effective for adaptive gains as well as multi-loop and cascade control. Conventional PID control systems used in controllers have positional form and work directly on errors not suitable for large systems. So, the Logix5571 controller is used to control spherical tank that communicates IO's remotely via Ethernet IP and Modbus master-slave connection.

Keywords: Autotune, Control Logix, Enhanced PID, Level, Spherical tank.

1. INTRODUCTION

Spherical tank system response are unpredictable and time-varying values, restrictions on independent variables, interaction among independent and measured variables, unmeasured dead time and regular disturbances on input, a nonlinear processes control challenge. Traditional control techniques are essential in most chemical process industries due to their inherent nonlinearity [3]. The majority of process industry chemical process systems are nonlinear state, such as the spherical tank system, continuous stirred tank reactor (CSTR), conical tank system, and biochemical reactor. Around the operating region, the nonlinear systems can be described as linear systems (steady or unsteady systems model with a time interval).In gas and oil plants, spherical tanks are commonly used. As their field of cross-section tends to vary with the height of the tank, they are non-linear structures [2]. A spherical is a structure that is very solid. The same distribution of stresses on the surfaces of the spherical tank suggests per unit length, they have a minimum surface range than most vessel nature. This means that for cylindrical or rectangular storage containers, the amount of heat transmitted from a colder environment to the liquid in the sphere would be smaller [11]. This results in less friction due to external heat. It is necessary to monitor a spherical tank, since the modification in form provides increase to nonlinearity. As a result of their non-linear dynamic behaviour, they suffer from a slew of challenges. Uncertainty and time-varying parameters must also be overcome, as well as limits on the manipulated variables, relations between the regulated variables and, manipulated unobserved and repeated disruptions, and dead time on input and quantities. In a variety of industries, spherical tanks are commonly employed. Because the non-linearity develops as the shape varies, regulating the level in a spherical tank design is challenging [8][7].

The first principle technique is utilised to find the control algorithm. Because level monitoring of the sensor's reading is critical in numerous industries, the control mechanism, auto tuning of an enhanced proportional-integral-derivative (PIDE) controller, is used. Control is a generally utilised control system for most industrial automation process since of its high efficiency, ease of employment, and wide applicability [1]. The main advantages of PID algorithms over other control systems are: (I) it comes in a range of arrangements, including parallel, series, and cascade. (II) Ensures that a range of operations run smoothly and reliably (III) allows for online/offline tuning and retuning established on the systems requirements (IV) it has a simple structure and can be implemented in either analogue or digital form [9]. A PID algorithms is then adapted to efficiently control linear model. The three controller parameters affecting the precision and performance of the PID controller are proportional gain (Kp), integral gain (Ki), and derivative gain (K). A sum of tuning rules for PID control have been projected in recent years to improve the performance of the controlled process. The PIDE outperforms the normal PID instruction in terms of functionality [13]. The velocity of PID algorithm is used in this instruction. The gain terms are applied to the change in the error or PV value, not the error or PV value itself. For more complex applications like adaptive gains or multiloop selection, the velocity method approach is significantly easier to use. As for reason, large distributed control systems have generally adopt a velocity form method. Similarly, the Logix systems series makes use of PIDE abilities such as ramp/soak temperature systems, flow totalization, valve powered motor control, and two or three-state control for systems like solenoid valves and pumps [19].These commands give you the pieces required to create common process control algorithms. Programmable automation controllers use a master-slave condition to control several functions in separate fields at the same time. The field interface analog and digital I\O’s, as well as system-interface circuitry, are provided by the master system control Logix and slave as Point I/O communication through the Ethernet cable I/O modules in this control [18]. The control mechanism has been implementation using by Studio5000 software design for the Allen Bradley programmable automation controller (PAC). The system control aims to maintain a proper gas, liquid and chemicals levels that is nearby mandatory in the spherical tank. The Studio 5000 programming software employs five main languages, functional block diagram used for this process. Panel View Human machine interface screen is used to dashboard complex data, programming and values are convert to useful graphical information for operators [17].

The control Logix 5571 PIDE Autotuner is an open-loop auto tuner that is incorporated into the PIDE tag in the Function Block Diagramming language. You may auto-tune from Panel Views or any other system interface, as well as Studio 5000, because PIDE Auto-tuning is embedded into the controller. The PIDE block is set up to use a second tag with a data structure that is exclusive to the Auto tuner [15]. Users can now construct autotune tags for only the loops they want to auto-tune. These tune tags can be accessible by all device allowing Panel Views and other devices to execute auto-tuning by set and analysis the relevant values in the controller's Auto tune data structure. If necessary, the user can share these tune tags among multiple PIDE tag to conserve memory. A suggested technique is tested in real time on a nonlinear spherical tank system using an upgraded PID auto tuning method, and the real-time results reveal that the PIDE autotune tag provides a smooth reaction for set point tracing [8].

2. MATERIALS AND METHOD

Control Logix 5571

The Control Logix 5571 manufactured by Allen-Bradley is a Programmable Automation Controller (PAC). A Control Logix system contains a single chassis with a stand-alone controller and I/O Logix modules. This controller is used to operate a non-linear system (spherical tank) in order to handle changes in the process variables more accurately and quickly. Control Logix is a high-performance control platform that may be used for a variety of applications. It creates a platform that integrates a variety of technologies, such as sequential, motion, driving, and process applications. Because the technology is modular, you can quickly design, build, and modify it while saving time and money on training and engineering [6].

Advanced configuration tools, memory organization, and symbolic programming that demands less programming and memory enhance engineering productivity, while features like flash-upgradable firmware protect your Control Logix investment the power supply module (230v to 24v dc), control logic CPU, I\O modules and communication modules. As your application grows, the Control Logix platform allows you to mix multiple processors, networks, and I/O modules without restriction. You can also use the NetLinx architecture for device control and configuration as well as data collection across Ethernet, ControlNet, DeviceNet, and Foundation Fieldbus networks [4].The Control Logix platform offers high-speed data transfers across the backplane, as well as a high-speed control platform with the Control Logix 5571 controller. Data is transferred between the processor and the remote I/O modules using Ethernet IP connectivity. Data transport is quicker and more precise. To maximise performance and make future network or system configuration changes easier, the controller's I/O is placed on an isolated network. Assign data transfer IP address for each Device 192.168.1.2 for controller and 192.168.1.3 for Point IO linx master (see Fig.1).Point IO link master connect the analog input DP transmitter and output controller control valve. If you're going to share I/O, make it's on a network that each controller can connect to switch.

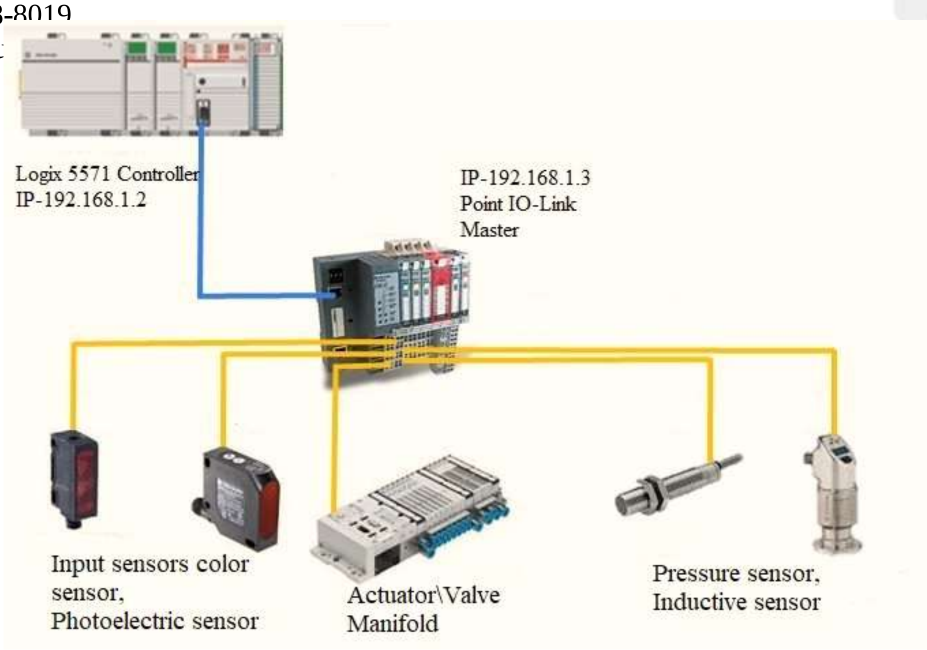


Fig. 1.Ethernet connection Control Logix and Point I\O

A logic function is mostly developed using the programmable controller ladder diagram and function block diagram. The Remote I/O Communication Module is used to connect the input sensors and output actuators, as well as EtherNet/IP communications contained within the standard ControlNet, DeviceNet and Profibus adapter TCP/UDP/IP protocol [12].

Spherical Tank Modelling

Spherical tanks are chosen for storing of high-pressure fluids. Spherical system is used for the storage of propane, butane, etc. as a high-pressure fuel, and spherical gas holder storage of city gas as a high-pressure gas. It is an effective and economic pressure vessel for the storage and transport of various fuels, liquids and liquefied gases. It is commonly used in the chemical, petroleum and oil refining, shipbuilding and urban gas industries [13]. Uniform force is its key advantage over cylindrical containers (Horizontal tank level, Vertical tank); the bearing capacity of the spherical tank is the maximum under the same wall thickness condition. The wall thickness needed by the spherical container under the same internal pressure condition is only 1/2 of that required for the cylindrical container with the same diameter and the same material (without considering the corrosion margin). The surface area of the spherical container is the smallest under the same volume condition, because of the wall thickness, limited surface area and other factors, it usually saves 30 percent ~ 40% of the steel than the cylindrical container [15] (see Fig.2).

Fig. 2. Structure of spherical System

A mathematical model of spherical system is important for controlling level of system. The first order differential equation is used for finding the mathematical model the system. The terminology used in this mathematical model is given
Fi – Inlet flow rate
Fo – Output flow rate
h – Height of liquid in the tank
R – Flow resistance
A – Area of cross-sectional area of tank

Volume of a sphere = $\frac{4}{3}\Pi h^3$ (1)

$$F_0 = \frac{h}{R} \quad (2)$$

$$\mathrm{AR}\frac{\mathrm{dh}}{\mathrm{dt}} + \mathrm{h} = \mathrm{RF_i} \quad (3)$$

$$\mathrm{AR}\frac{\mathrm{dh'}}{\mathrm{dt}} + \mathrm{h'} = \mathrm{RF'_i} \quad (4)$$

Where,

$\mathrm{h'} = \mathrm{h} - \mathrm{h_s}$

$\mathrm{F_i}' = \mathrm{F_i} - \mathrm{F_{ts}}$

$\tau_\mathrm{p} = \mathrm{AR}$

$\mathrm{K_p} = \mathrm{R}$

Transfer function

$$\mathrm{G(s)} = \frac{\mathrm{H(s)}}{\mathrm{Q(s)}} = \frac{\mathrm{R_t}}{\tau\mathrm{s}+1} \quad (5)$$

Where,

$$\mathrm{R_t} = \frac{2\mathrm{h_s}}{\mathrm{q_2}}$$

$$\tau = 4\Pi h_s R_t$$

Time Constant = Storage Capacity x Resistance to flow.

Finally the transfer function is find by substitute the height and resistance of flow in the equation

$$\mathrm{G(s)} = \frac{8.94\ \mathrm{e}^{-4.6s}}{35.65s+1} \quad (6)$$

Level Sensor

Due to the high-pressure in spherical tank and the hole cannot be opened during the production process, the contact level gauge, the radar level gauge, the servo liquid meter contact level gauge are not used at the time. So the differential pressure transmitter is used in this tank as a level sensor. The most common being level and flow. The diaphragm detects the head pressure produced by the height of the substance in the vessel in a DP Transmitter. To get the right degree calculation, this quantity is compounded by a density variable. Maintenance of the DP transmitter is simple since the isolation valve can be separated from the operation [11]. As the separator vessel undergoes a broad variety in composition in process materials, it is suitable and could be the only choice for complete level calculation in separator vessels. It may also be used on one side of the vessel for light slurries with expanded diaphragms, which suit flush. Speed calculation by DP Transmitters is more cost-effective than other sensors available. Differential pressure flow meters contain both primary and secondary elements. In general, the main component is intended to create a pressure difference as the flow rate increases [1]. The orifice plate, flow nozzle, venturi, and Pitot tube are some of the most prevalent forms of primary elements in differential pressure transmitter is the flow meter's secondary component. Its purpose is to properly measure the differential pressure created by the primary element. It is critical that variations in fluid pressure, temperature, or other variables such as ambient temperature have no effect on differential pressure measurement. An industrial DPT output signal is probable to be 4-20mA, but it could also incorporate digital communications like Fieldbus, Profibus, Modbus 485 RTU, HART, or any of a number of new protocols [3]. The Differential Pressure Transmitter generates a DC output current that is proportionate to the pressure range. The output current rating lower range is 4 mA, while the maximum range is 20 mA. Variations in load impedance and supply voltage have no effect on the regulated current output. It is easy to clean and maintain the tanks because the DPT is located away from the tank for level calculation. Differential Pressure Transmitters can detectwater collection at the tank's bottom (see Fig.3).

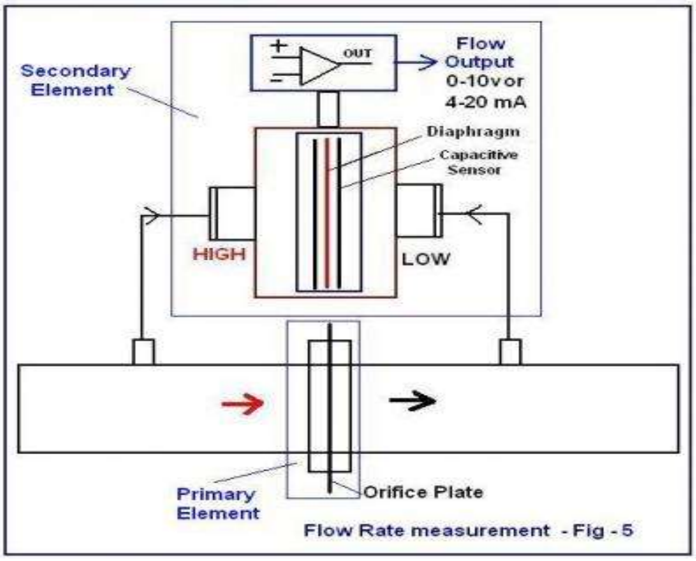


Fig. 3.Level measurement using Differential pressure transmitter

As the fluid density varies, the multivariable transmitter can appropriately compute the tank level. It can give the same precision in open or pressurised tanks and vessels. The technology behind this increased density compensated level transmitter is based on hydrostatic computation and advanced multivariable sensor technologies [14].

3. METHODS

Experimental setup for Spherical tank system

The Experimental setup of nonlinear system spherical model contains Control Logix PLC, 1734 Point I\O, Input Sensor Differential pressure transmitter (DPT), current to pressure convertor I\P, Output actuator Pneumatic Control valve, pump and Studio5000 software installed on the PC (see Fig.5).The Control Logix PLC controls the Pneumatic control valve and Differential pressure transmitter and point IO module link the input and output device through IO link interface [21].Rs linx software is used to interface the programming device and real time controllers and set different IP address panel view devices to act as master control 192.168.1.1 and control Logix 192.168.1.2 and Point I\O 192.168.1.3 are slave devices. This keeps the liquid level in the spherical tank stable. The transmitter completes this task by always sensing the level value in the tank and fine-tuning a control valve to improve increases or decrease level to tank. The real storage container level identified by the DP transmitter is feed back to the PLC controller. This feedback is associated with the preferred level. Now the logix5571 describes the control action and it is given to the I-P converter. The final control device is now measured by the final air pressure [12].once start button is pressed system runs continuously automatic maintain certain level in the tank. This, in turn, controls the inflow to the spherical tank and keeps the level, real time setup of nonlinear system as (see Fig.4).The principle of differential pressure level measurement is based on the change of pressure between a high and a low point. The tank level is zero, the DPT output is 4mA, the tank level is high, and the DPT output is 20mA. HMI represents the graphical value of nonlinear processes flow and parameter values [16].), the level transmitter output is given to PLC through analog input module and the PLC processes transmitter output using PIDE and generates output 4 to 20mA based on set value and controller parameters. PIDE output is rooted to the field via analog output module. Output from the PLC is given to current to pressure (I/P) converter, which converts 4 to 20mA in to 3 to 15 PSI (Pounds per square inch). The I/P converter output (3 to 15 PSI) is given control valve to control the flow rate which intern controls the level. The entry is in 0.01 second intervals. Generally enter a loop update time five to ten times faster than the natural period of the load.

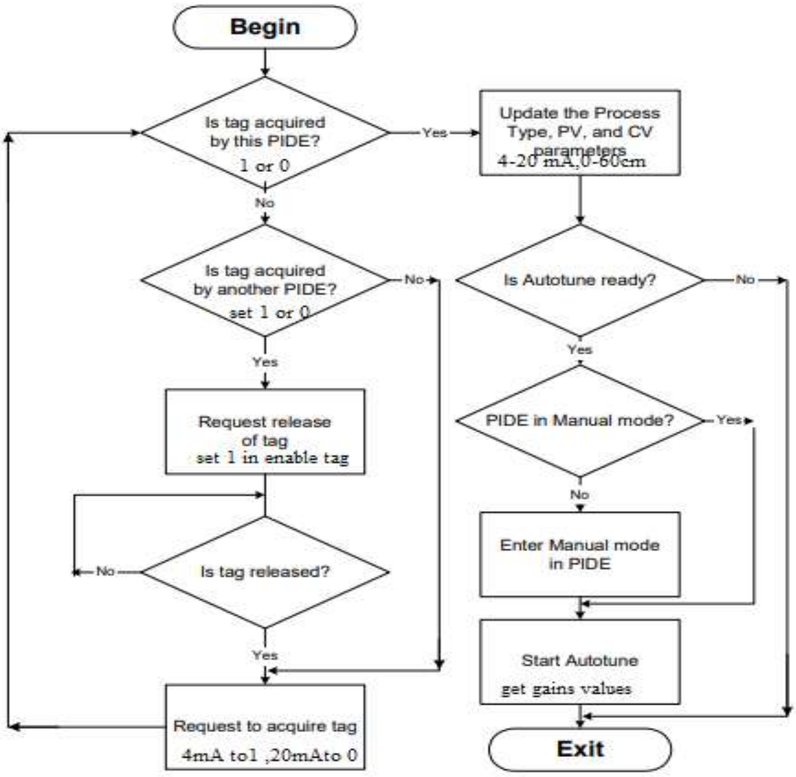


Fig.4. Real Time setup for Nonlinear System spherical tank

1.1 *EnhancedPID Controller*

In a broad variety of applications for process control, PID controllers are found. Around 95 percent of the industrial automation sectors closed loop operations use PID controllers. Proportional-Integral-Derivative stands for PID. These three controllers are coupled in such a manner that a control signal is generated. It provides the control output at optimal levels as a feedback controller [20].The analog electronic components were introduced for PID control before microprocessors were invented. But now the microprocessors process all PID controllers these are traditionally used in process control systems due to the simplicity and robustness of PID controllers. In this project, the term PIDE stands for Enhanced proportional integral derivative and is used to regulate the level of the spherical tank in industrial applications. To control all the process variables, a control loop feedback device is used in this controller. The PIDE instruction uses a Velocity form of the PID equation and closed loop system and steps in Autotune (see Fig.5) [11].

Fig.5.PIDE closed loop control system and steps in Autotune

Principally, this means that the loop works on change in error to change in output.

Traditional PID systems used in PLCs have used positional form algorithms.A positional form algorithm take on error directly. This is adequate for simple process, the velocity form algorithm is much easier to apply for innovative applications such as adaptive gains or multiple section. As a result, the velocity form technique has typically been applied in most Distributed Control Systems .similarly, the Logix controller family makes use of the velocity form algorithm's more advanced features. Realized that a velocity form and a positional form PID algorithms respond to a change in error in the same way. In reality, one form of the equation can be simply deduced from the other. Only as a function block is the PIDE available [7].

Positional form Algorithm PID

$$\mathrm{CV{=}K}\square\mathrm{E}+\sum K_{\mathrm{i}}E\mathit{\Delta} t + K_{\mathrm{D}}\frac{\Delta E}{\Delta t} \qquad (1)$$

Velocity form Algorithm PIDE

$$\mathrm{CV1}= \mathrm{CV1}^{-1} + \mathrm{K}\square\Delta\mathrm{E}+ K_{\mathrm{i}}E\mathit{\Delta} t + K_{\mathrm{D}}\frac{E\square-2E\square^{-1}+E\square^{-2}}{\Delta t} \qquad (2)$$

Where,
CV – Controlled Variable
E – Error
Δt – Update time in sec
Kp – proportional gain
Ki – Integral gain
K_D – Derivative gain

The major difference among two PID algorithms:

1. Proportional term is applied to the change in error (ΔE) in the velocity form as well as the Error (E) in the positional form.
2. Summation of integral in the positional form and the preceding output (CVn-1) in the velocity form algorithm both contain the accumulation of integral term. These are the two primary distinctions between the forms of the PID algorithms. The sections that follow will explain why this is so crucial. In addition, the PIDE instruction enables two types of velocity form algorithms Independent and dependent gains [21].

3.2.1 *Independent Gains Form*

Each of the algorithm’s terms, Proportional, Integral, Derivative, has its own result in this implementation. Changing one gain has no effect on any of the other terms.

$$\mathrm{CV}= \mathrm{CV1}^{-1} + \mathrm{K}_{\square}\Delta \mathrm{E}+ \frac{K_{\mathrm{i}}}{60} E\Delta t + 60K_{\mathrm{D}}\frac{E_{\square}-2E_{\square}^{-1}+E_{\square}^{-2}}{\Delta t} \qquad (3)$$

Where,
CV – Control Variable
E –Error in the % of span
Δt – Update loop time in sec
Kp – Proportional gain
Ki – Integral gain.
K_D – Derivative gain

3.2.*2* *Dependent Gains Form*

The proportional gain is well transformed to a PIDE gain in this variation of the method. You can adjust the effect of three gains proportional, integral, and derivative at the simultaneously by simply changing the controller's gain.

$$\mathrm{CV1}= \mathrm{CV1}_{-1} + \mathrm{Kc}\left(\Delta \mathrm{E}+\frac{1}{60T_{\mathrm{i}}} E\Delta t + 60T_{\mathrm{D}}\frac{E_{\square}-2E_{\square -1}+E_{\square -2}}{\Delta t}\right) \qquad (4)$$

Where:
Kc– Controller gain
T_D–Derivative time constant in minutes
Ti – Integral time constant in minutes per repeat.
Δt – Update loop time in sec
CV – Control Variable
E – Error in % of span

The integral term aspect Ti minutes to replicate the proportionate period action in react to a step output change in error. It's worth noting that a higher Ti value results in a slower integral response.

The control parameters PID Gains are used to signify Kp, Ki, and K_D after the Depend-Independ parameter is cleared when using PIDE instruction. The control parameters PID Gains are used to characterize Kc, Ti, and then T_D when Depend-Independ is specified. The algorithms employed by the PIDE instruction are represented by the PIDE equations above [10]. By modifying the parameters PVE Proportional and PVE Derivative the change in error limit by the change in PV (in % of span) for the proportional and derivative terms. The PIDE command, default, employs proportional values change in error and derivative values modification in PV.

4. RESULTS AND DISCUSSION

Configuration and programming

First Open and Create New Studio 5000 project software and Configure I\O configuration tree the PLC controller, panel view HMI and Remote Point I\O all devices configure through Ethernet IP Master Slave communication data transfer between the system bidirectional. Setting IP address to each device using Bootp-DHCP configuration tool and using Mac address of each device. Click new routine and add PIDE controller in process tab. The control valve allows a liquid, chemical or gas to be added to the spherical process to increase the parameter value and the differential pressure transmitter will send the feedback value to PIDE controller [12].Now configure parameters in PIDE tuning block like timing mode, Control action, Units scaling PV and CV, set point maximum and minimum limits and equation type etc.Finally configure auto tune tag (see Fig.6). Process variable PV system real input value scaled to 4-20mA and I to P controller the value 4-20mA convert to 3-15 psi to control valve. Create the Autotune program tag for the loops and select PIDE_AUTOTUNE as data type. Configure the autotune parameter while an Autotune is in progress, process variable reaches then adapt PV limit, it will be aborted the Autotune tag.

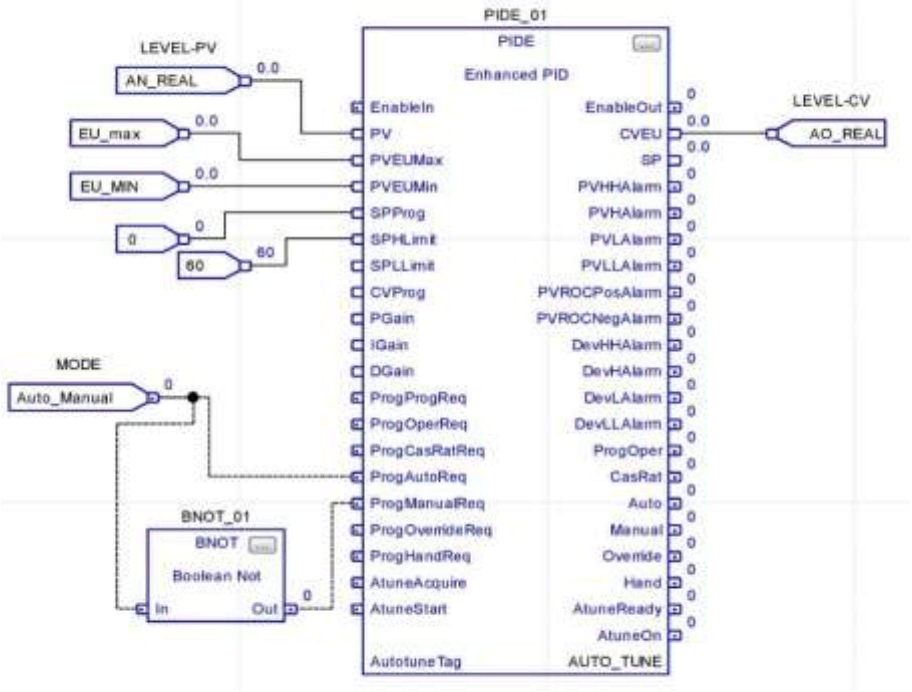


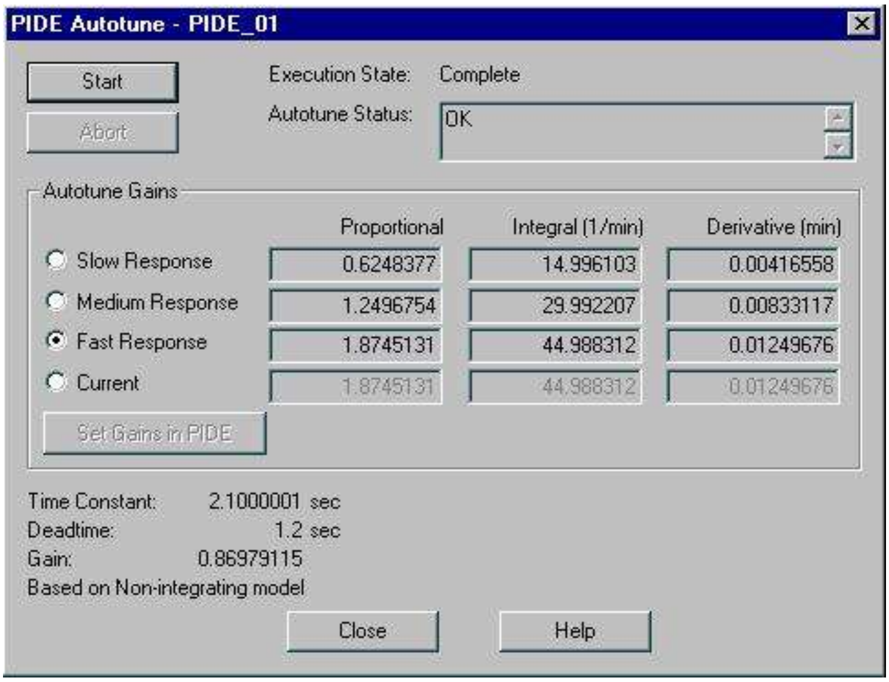
Fig.6.Function Block Diagram program for Non-linear process

Set Process Variable limit sufficient value maximum or minimum the existing PV scaling for autotuning to succeed, next step the Controlled variable step size does not source the PV to exceed the PV limit Adjustment (depending on how the process will respond to the CV Step). When autotuning begins, set the CV Step Size to the volume wish the step output. The auto-tuning control is finished, output step reset to its original size. The scope of the CV value varies change step up (+ve) or step down (–ve) [11].

Control tags and set point are configuring to panel view plus HMI the parameters valves in HMI screen. After development of program upload to Control Logix PLC. Once system is on DPT measure the level valve in spherical tank the measured process variable valve is less than set point control valve is open and tank level achieved at required level an output is based on the change in the error.Auto indicates that the PID is controlling the output. (Word 0, bit 1 is clear.) Manual indicates that the user is setting the output. (Word 0, bit 1 is set.).The transmitter output (4 to 20 mA) must be compatible to the processor (6553 (for 4 mA) to 32787 (for 20mA), since the processor resolution is 32768.Convert all PIDE inputs Process Variable, Set point in to 0 to 16383.Transmitter output is connected to analog input module and output from the AO module is connected to the actuators.

PIDE Autotune Analysis

The PIDE control is a closed loop Autotune based on non-integral, which means that systems control auto adjusted. Autotune output step by a specified volume, monitor the PV response, and then offer proportional, integral, and derivative gain settings for a quick, slow, or medium reaction (see Fig.8) and chose current autotune gains and set the gains in PIDE [3].



Execution State: Complete
Autotune Status: OK

	Proportional	Integral (1/min)	Derivative (min)
○ Slow Response	0.6248377	14.996103	0.00416558
○ Medium Response	1.2496754	29.992207	0.00833117
● Fast Response	1.8745131	44.988312	0.01249676
○ Current	1.8745131	44.988312	0.01249676

Time Constant: 2.1000001 sec
Deadtime: 1.2 sec
Gain: 0.86979115
Based on Non-integrating model

Fig. 7. Control Logix PIDE Autotune Tag

Autotune, in addition to the suggested tuning constants, also back to the systems model that was used to estimate the fine-tuning constant during an auto-tune test, it defines PV limit change, process type and CV step output that our specific non-linear process accept and get a concept of suitability of the proposed gains by comparing this process systems to the actual process. At this point, we'll realize the difference between a position-based and a velocity-based controller [18]. When we set the gain on a position-based controller to 2, we would expect the output to immediately jump to 20.When we change the gain of this velocity-based controller to 2, however, nothing happens. Because the error hasn't changed, the output remains at 10. Because we did not immediately "bump" the process, this is one advantage of a velocity-based controller. The overall output under position-based control would be 24%. Our output is 14% because this controller is based on velocity. This is because we started with 10% output and had a 2% change in error with a two percent controller gain [19].

This is equal to a 2% increase in errors multiplied by a proportional gain of 2. Because we started with a 10 % output, the controller added 4% as a result of the modification, and our output is now 14 %. To summarise, this PID is compelled to operate in programme control mode (in auto). To examine the change in the output presented in Figure 8, we just send it a set point and a process variable (feedback). This PIDE's scale ranges from 0 to 100%, and it's in "Independent Mode." This means it will do proportional, integral, and derivative calculations individually [17]. It can also be "reverse-acting" to simulate a heating process.Consider the Control Variable as the heating band's output. Feedback, also known as temperature, is a process variable.

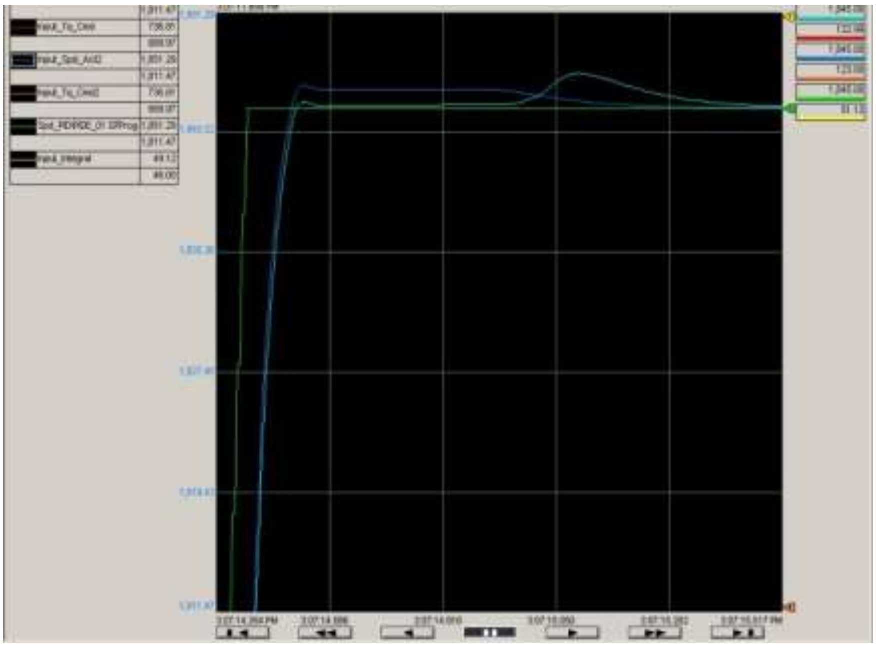
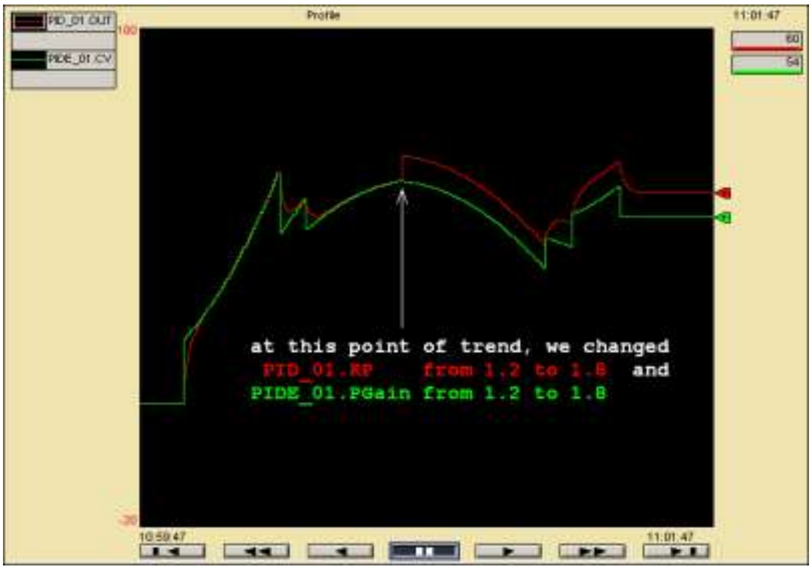


Fig. 8. Comparison of control effect by different correction factors

Real time controller effect on non-linear spherical tank level control process for PIDE Vs PID tuning methodology implemented in control Logix PLC. An experimental result shows that digital controller having good set point tracking proficiency [19]. PIDE velocity form algorithm this means that the control mechanism works on change in error to change the output and normal PID positional form works on error directly (see Fig.9).



at this point of trend, we changed
PID_01.KP from 1.2 to 1.8 and
PIDE_01.PGain from 1.2 to 1.8

Fig.9. PIDE autotuning VS PID tuning comparison

5. CONCLUSIONS

The auto tuning response of a nonlinear spherical tank system was automated using Control Logix 5571 controller and analysis various levels of tank set point were obtained at the respective transfer function. The PIDE auto tuning parameters for obtaining smooth response in three different modes gains slow, medium and fast modes. The performance of PIDE controller velocity type algorithm quick settling time and fast response to change in error compared with normal PID systems efficiency in nonlinear spherical tank control system. The HMI screen was developed and visualizes the process parameter values tank set point, CV, PV values and tank level value in graphical terms and operators easy to understand. In compared to a PID controller, the enhanced PID controller delivers a reasonable transient stability with minimal error indices of 14.12 % and high quality values of 10.26%. As a result, the PIDE controller improved the overall efficiency of the system by 56 % when compared to a standard PID controller. The PIDE algorithms differs from the commonly area of PLC based process control loop giving by many of the new capabilities that make it simple to setup a more complicated loop process without the time-consuming ladder language .The PIDE instruction is only one part of a Logix based process control it include the whole set of process control instructions, full-featured function blocks, redundancy control, a wide range of I/O configurations, including Fieldbus, and an interface with our RSView operator interface for multiloop process, ratio control,adpative gains and cascade systems.

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