

Advanced Control Strategies for MIMO System

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Abstract – This paper introduces a Web-based control laboratory for experimentation on a nonlinear multiple-input-multiple-output (MIMO) system: the three-tank plant. Using this application, automation technician students can learn in a practical way many fundamental aspects of control processes. The client-side of the virtual laboratory has been developed using the programming support provided by labview, the lab has been integrated in the collaborative Web-based experimentation environment which provides more flexibility for the students performing the laboratory experiments. Index Terms—Collaborative learning, distance learning, interactive systems, laboratory education, virtual laboratory, web-based laboratory experiment.

1. INTRODUCTION

We all know that upto now, the nonlinear multiple-input-multiple-output(MIMO) system: the three-tank plant has been interfacing more overly through the MatLAB. For a better understanding purpose and stimulation and to reduce the complexity we uses the labview software to stimulate the three tank system.

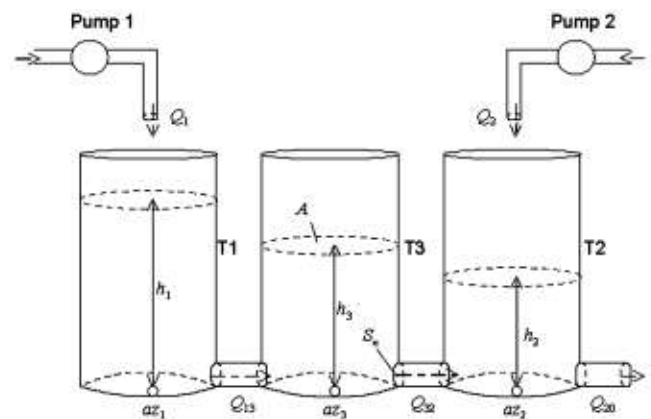
Till now only the coupled tank has been stimulated by the labview in which the interface can be done only to two tank system. Automation technicians do acquire basic understanding and knowledge of automation and control systems in the initial vocational training courses in automation. However, specialized and ongoing training and practice, in addition to basic education, need to be documented. This situation may also be a result of the organizational characteristics of many companies.

The specific aim of the project is to develop and disseminate a set of new and innovative software packages for vocational training in automation and control. These tools would not only be of interest to the automation technicians but also to faculty teaching who want to extend their work to the production and application of educational deliveries for non university education. The training packages will improve quality and increase motivation in vocational training. Each of these packages will consist of different types of Web-based learning resources: theory, exercises, interactive simulations, and virtual and remote laboratories. As a result of this project, automation technicians will acquire knowledge and practical experience

in the design, tuning, and troubleshooting of industrial control systems.

2. THE THREE-TANK SYSTEM

The three-tank plant consists of three cylinders T1, T2, and T3 with the same cross Section A. These cylinders are connected serially to each other by pipes of cross section. The tank on the left is T1; the tank in the middle is T3; and the tank on the right is T2. The figure below show you full structure of the plant.



On the right side of tank T2 is the outflow valve, a circular cross section. The outflowing liquid from the system is collected in a reservoir located under the three tanks. This reservoir supplies pumps 1 and 2 with liquid which returns to the system. Pumps 1 and 2 represent the input flows of tanks T1 and T2. The plant is a closed system, where the liquid that enters the reservoir from the tanks returns to the tanks via the pumps. However, these pumps will be switched off automatically when the liquid level of T1 or T2 exceeds a given upper limit. Besides the outflow valve on T2, the system includes five additional valves. Two of them are used to connect each pair of neighboring tanks (one for the T1-T3 connection and the other for the T3-T2 connection), and can be manually adjusted to close the connection between the two consecutive tanks. The other three valves are at the bottom of each tank. These leak valves can be used to manually drain each tank

In the global system, the pump flow rates correspond to the process input signals and the levels of tanks T1 and T2 are the output signals. All of them can be used for control purposes.

3. Labview

LabVIEW, short for *Laboratory Virtual Instrument Engineering Workbench*, is a programming environment in which you create programs using a graphical notation (connecting functional nodes via wires through which data flows); in this regard, it differs from traditional programming languages like C, C++, or Java, in which you program with text. However, LabVIEW is much more than a programming language. It is an interactive program development and execution system designed for people, like scientists and engineers, who need to program as part of their jobs. The LabVIEW development environment works on computers running Windows, Mac OS X, or Linux. LabVIEW can create programs that run on those platforms, as well as Microsoft Pocket PC, Microsoft Windows CE, Palm OS, and a variety of embedded platforms, including Field Programmable Gate Arrays (FPGAs), Digital Signal Processors (DSPs), and microprocessors.

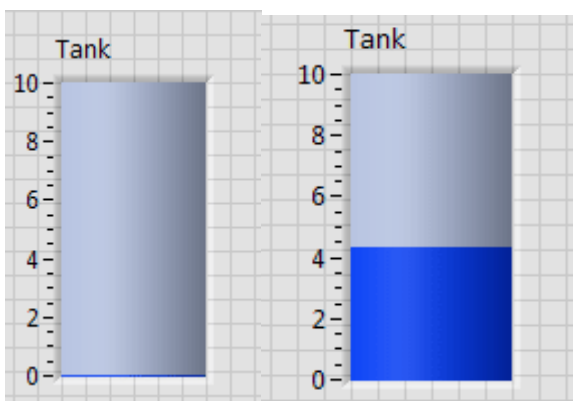
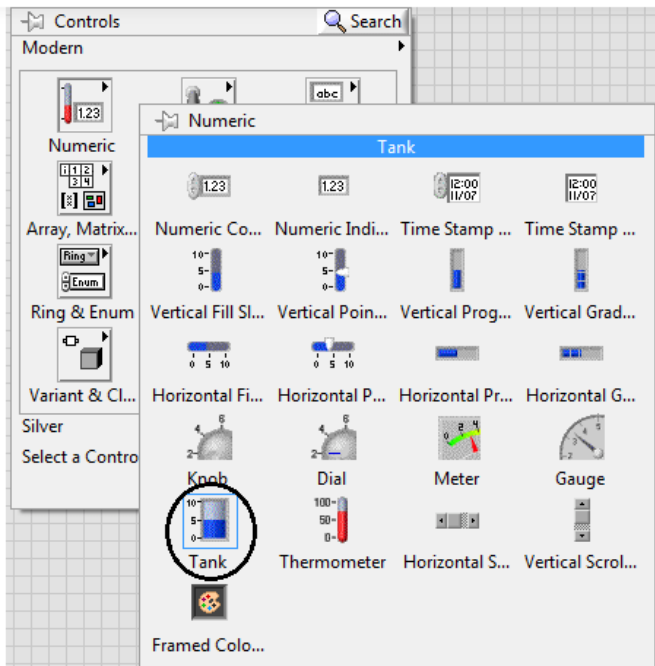


Fig-1: Basic function of tank system in labview

4. PC Computer

The PC controller monitors and modifies the feedback signal from the pressure sensor and sends a control signal to the differential amplifier in the actuator controller. It displays the tank liquid level, provides for the selection of three different modes of operation and allows for the input of PID values, liquid level set point and sample time. The controller input is the voltage from the bubbler pressure sensor, which represents the head or water level in the tank. The three modes of controller operation are PID or automatic, on/off and manual control. These three modes allow the operator or student to compare the performance of the system between methods of control. The purpose of the controller is to provide an output that will cause the water level in the tank to approach the set point. This water level will change due to the random water flow into the tank from the random liquid inlet system, which acts as a disturbance to the system.

FUNCTIONAL BLOCK DIAGRAM

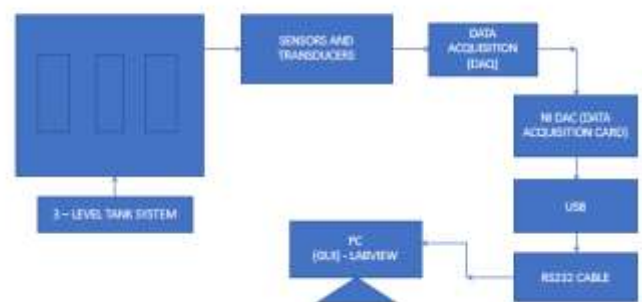


Fig -2: functional block diagram

5. Proposed System

Tank level control systems are used frequently in different processes. The three tank system is a widely used laboratory system in control theory. Liquid level's most representative didactical equipment is a three tank system. The system under consideration consists of two control valves controlling the flow to tank 1 and tank 3 respectively. A pump which is discharging the water from reservoir and supplies to process tanks through the Rotameter and control valve. The differential pressure transmitter is used to transmit the level of the process tank to control room.

The analog signal is fed to Data acquisition system which has the ADC/DAC, and it is interfaced with PC using RS232. The error is the difference between the user defined set point and digital form of level transmitter output, fed as input to a PID controller. The controller output is analog signal which controls the control valve to control inlet flow rate. For maintaining the level, the level is measured and pid controller takes correcting action to maintain the setpoint. The desired result of the system can be graphically represented by LABVIEW

6. CONCLUSION

Proposed system is developed based on 3 level tank system using LabVIEW. In this point, LabVIEW has proved to be a very worthy solution to improve the learning in control engineering. However there is some further technical work to be done regarding the creation of remote labs. The capabilities of LabVIEW have still to be improved to ease the programming of the connections with the server-side more intuitively, specially, if NI LabVIEW is chosen as software tool to create the server-side.

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