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EVALUATION OF MANAGEMENT PERFORMANCE PID CONTROLLER IN WIRELESS INDUSTRIAL NETWORKS

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ABSTRACT
Within the framework of the research will be designed an experiment that will relate to the evaluation of management performance PID controller in wireless industrial networks, which are the main goals of security and reliability of communication. Then will be presents the results which were obtained by the method of the experiment which will be proved to the wireless industrial network modified PID control algorithm provides the same handling characteristics as the standard control algorithm.
Keywords: Wireless devices, Industrial network, PID controller

1. INTRODUCTION
The research in this paper consists of three scenarios in which the computer is connected to the real laboratory model shown in Figure 1. and using AMS Device Manager and DeltaV software by management processing equipment in real time.

Figure 1. The system of two reservoirs

Meaning of colors chart in the DeltaV software are as follows:
- The yellow color represents the managed variable, ie. the water level in the secondary tank.
- The blue color represents the control variable, ie. openness of the control valve.
- The white color represents the reference value controlled variable.

2. THE FIRST SCENARIO

In the first scenario, the research includes analysis of the wired network implemented within a laboratory model using standard PID algorithm as shown in Figure 2. [1], [2], [3], [4].

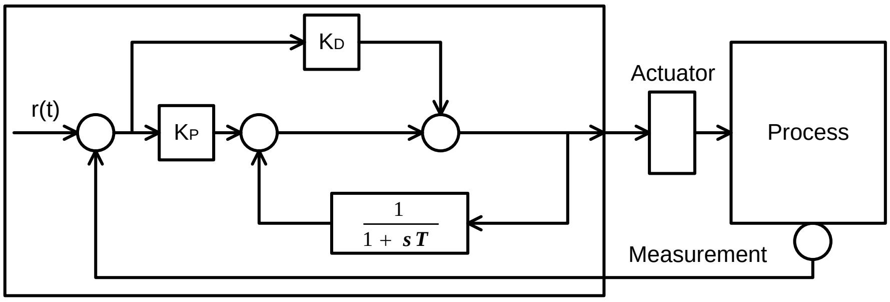

Figure 2. Conventional PID algorithm

The desired law of management DeltaV controller realized on the basis of the error signal e(t) or the difference between the reference value r(t) and the controlled variable c(t). In the realized laboratory model of controlled variable is the level of water in the middle tank. The results in Figure 3. show that the standard PID algorithm correctly monitor the management of wired communication networks.

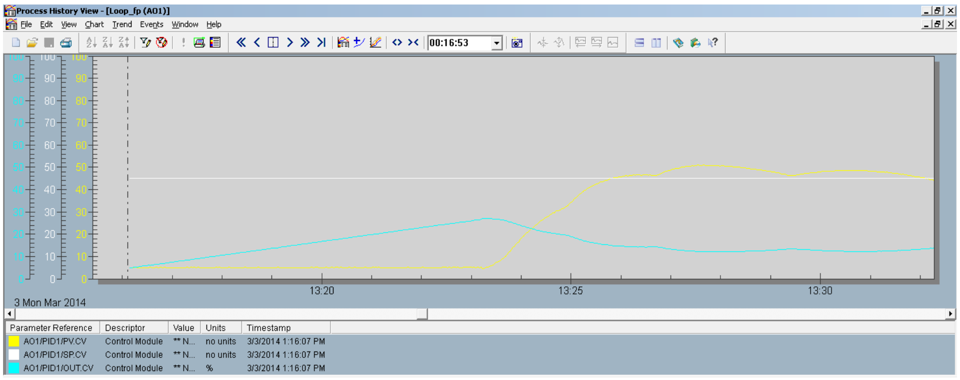

Figure 3. The response of the process for the first scenario: Conventional PID algorithm

However, the response of the process to the standard PID algorithm has a large transport delay and the time constant of the process, and the need to adjust the PID parameters. In this scenario used a method that automatically adjusts PID parameters of the DeltaV controller using DeltaV InSight software embedded in the controller alone [1]. After entering the value of the proposed PID parameters (K_P = 0.65, T_I = 144.5 s T_D = 23.11 s) in the DeltaV controller, Figure 4. shows the resulting desired aperiodic response the managed variable with lower transport delay and the time constant of the process in relation to the previously obtained response as shown in Figure 3.

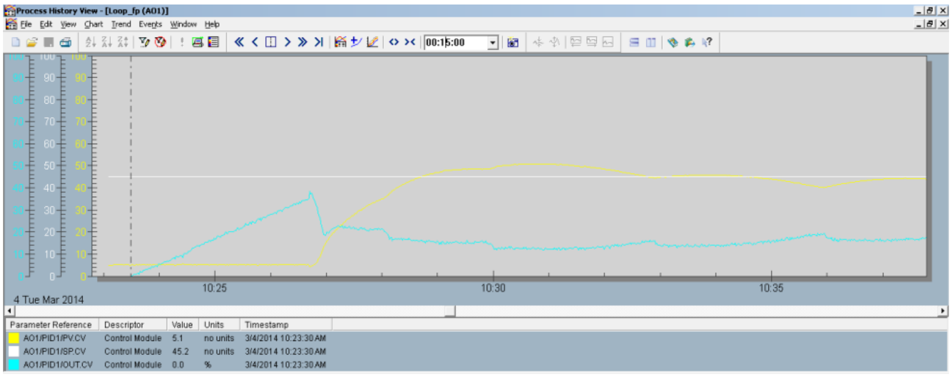

Figure 4. The desired response process with the conventional PID algorithm

3. THE SECOND SCENARIO

In the second scenario, the research includes analysis of the integrated wired/wireless communication network, which is based on HART protocol within the laboratory model. In this network wired transmitter on the middle tank has a full function wireless devices using a specialized adapter as integrator of HART devices with WirelessHART network. The results in Figure 5. show that the conventional PID algorithm correctly monitor the management of the integrated wired/wireless network which is based on HART protocol [1], [5], [6].

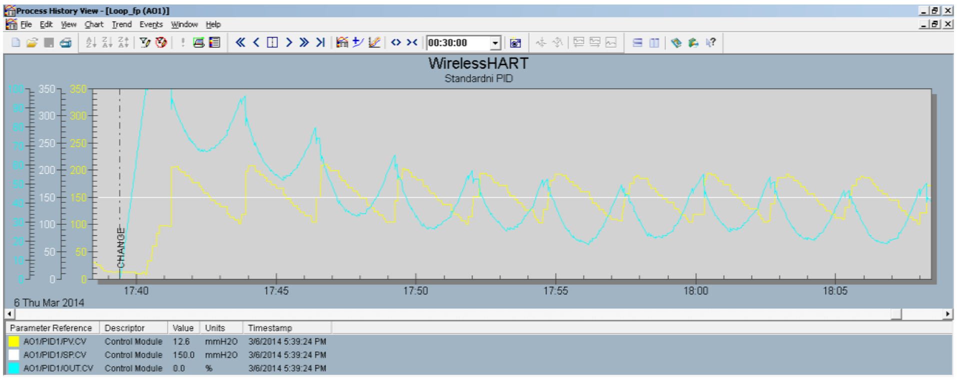

Figure 5. The response of the process for the second scenario: Conventional PID algorithm

However, from a theoretical point of view of the result is correct, but from a practical point of view is unacceptable because the control valve due to periodic loss of communication is not able to correctly do the control variable. When it comes to periodic loss of communication, there are two main problems in the application of the conventional PID algorithm in integrated wired / wireless network:

continued execution during a loss of communications and

unexpected changes in output when communication is re-established..

In order to overcome these problems due to periodic loss of communication in integrated wired/wireless network is proposed that is a modified PID algorithm [1], [4], [7], [8].

3. THE THIRD SCENARIO

In the third scenario, the research includes analysis of the integrated wired/wireless network using PIDPLUS algorithm is shown in Figure 6. [3].

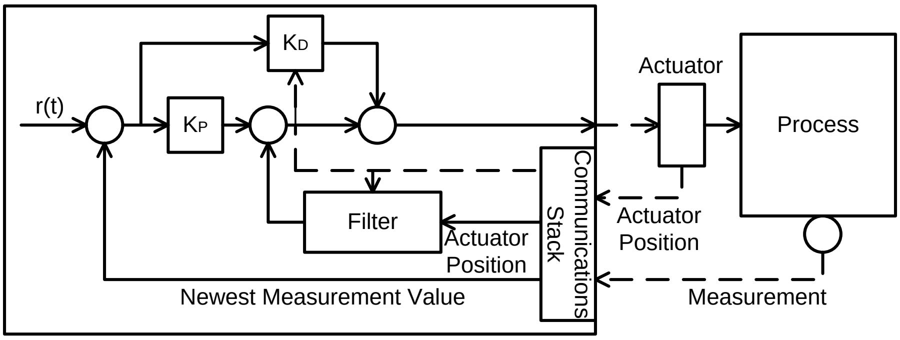

Figure 6. The modified PID algorithm

Proposed PIDPLUS algorithm is adapted for periodic loss of communication in integrated wired/wireless network and whose behavior can be described by the following equation:

$$U(k)=P(k)+F(k)+D(k)$$

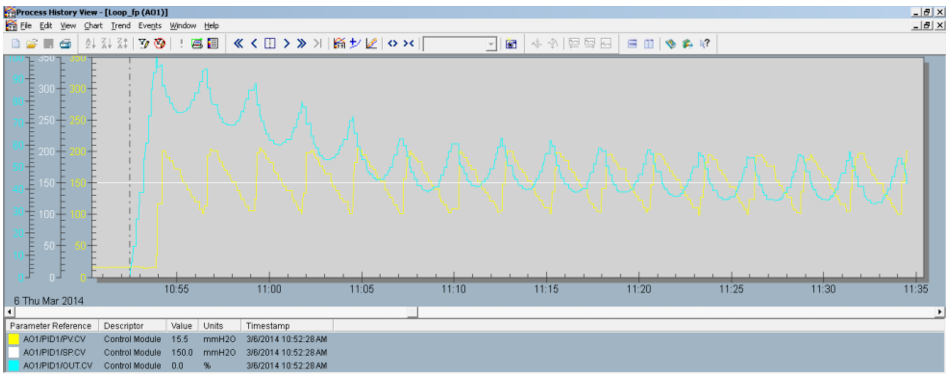

Figure 7. The response of the process for the third scenario: PIDPLUS algorithm

The obtained results in Figure 7. show that the PIDPLUS algorithm correctly follows the management in integrated wired/wireless network which is based on HART protocol within the laboratory model in Figure 1. However, the response of the process PIDPLUS algorithm has a constant amplitude which is greater than 15% of the reference value of the managed variable, and it is necessary to adjust the PID parameters. After complete testing of PID parameters DeltaV InSight software proposes new values of the parameters: K_P = 0.10; T_I = 332.8 s and T_D = 53.25 s. After testing the proposed PID parameters, on the output of the process was set up the stationary state of oscillation of constant amplitude to 5% of the reference value of the managed variable, such as shown in Figure 8. The obtained response of the managed variable from theoretical and practical point of view was the correct and acceptable [1], [5], [6].

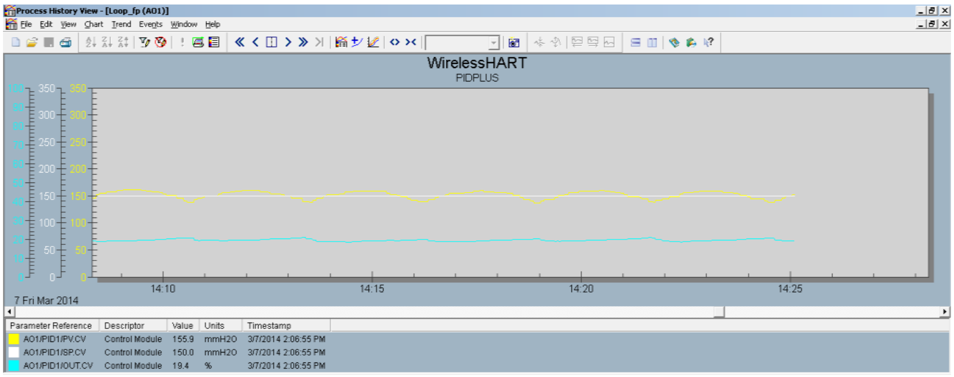

Figure 8. The desired response process with PIDPLUS algorithm

4. CONCLUSION

The analysis of management performance in the realized laboratory model of integrated wired/ wireless communication network, which was implemented using THUM adapter, it can be concluded:
PIDPLUS algorithm will not result in unstable oscillations of the managed variable and
PIDPLUS algorithm can return the managed variable stable up or down until it reaches the new desired value.
However, the lack of challenging PIDPLUS algorithm in integrated wired/wireless network was its limited ability to deal with processes where fast response. Based on the experimental results that were analyzed through three scenarios proved is that for slow process of the integrated wired/wireless industrial network PIDPLUS algorithm provides with theoretical and practical point of view correct and acceptable management performance. In other words, justified the integration of wired and wireless industrial communication networks based on HART protocol using THUM adapter.

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