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Method's and Test Stand for Electronic PID Controller

The paper presents method's and a testing stand for electronic controller using for this a signal generator and a digital oscilloscope respectively the virtual instrumentation and the signal acquisitions from the controllers input and output through an data acquisition board and an PC on that Lab View program runs.

***Keywords**: PID controller, acquisition board, test stand*

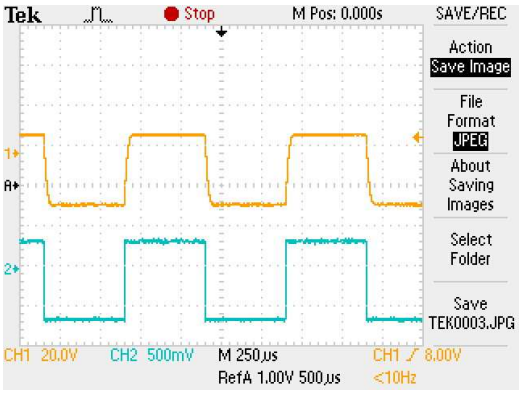
1. Introduction

The PID electronic controller, realised with operational amplifiers (OA), implements the PID classic control law having a large field of applicability on different automatic control system. For their use in automat control systems it is necessary to establish a testing method and its application on a adequate test stand. The manner in which a process variable responds over time to changes in the controller output signal is fundamental to the design and tuning of a PID controller [7]. The use of the PID controls in many cases, it is predominant industrial controller that constitutes more than 90% of feedback loops, have proven themselves to be perfectly adequate, and, given to that, nothing more complicated is justified [1].

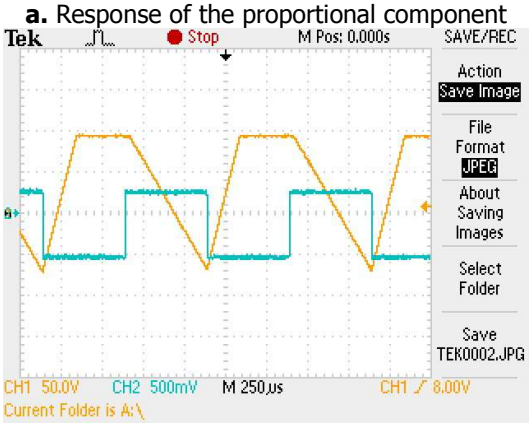
2. Test stand

The first method refers to the classical test stand and test method, using an signal generator Tektronix AFG 3102 and a digital oscilloscope Tektronix TDS 2024B.

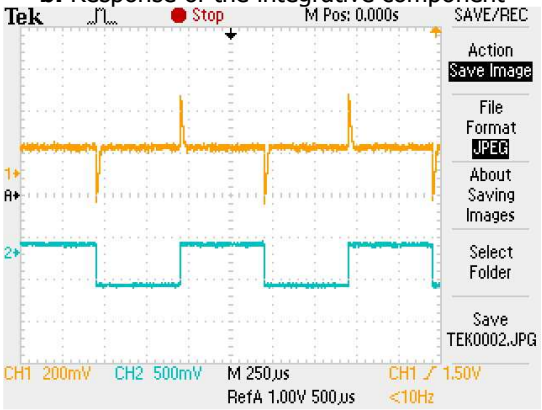
In the first step, the correctness of each control law of the PID controller will be separately proved by applying a train of rectangular signal to the proportional, derivative and integrative component [2]. The obtained results are shown in figure 1 a, b and c. From those three diagrams, the specific amplifying, integrative and derivative effect realized by the PID controller can be seen.



a. Response of the proportional component



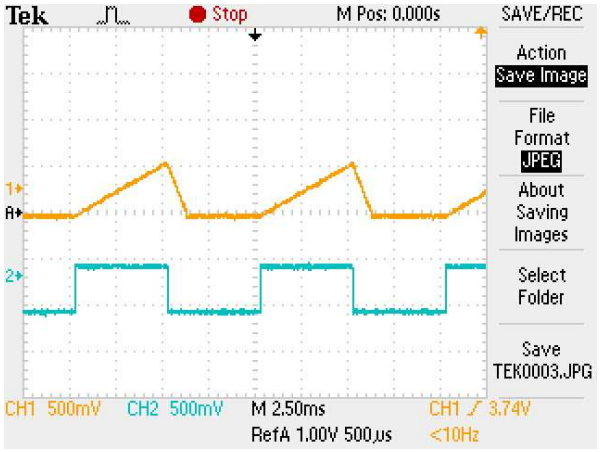
b. Response of the integrative component



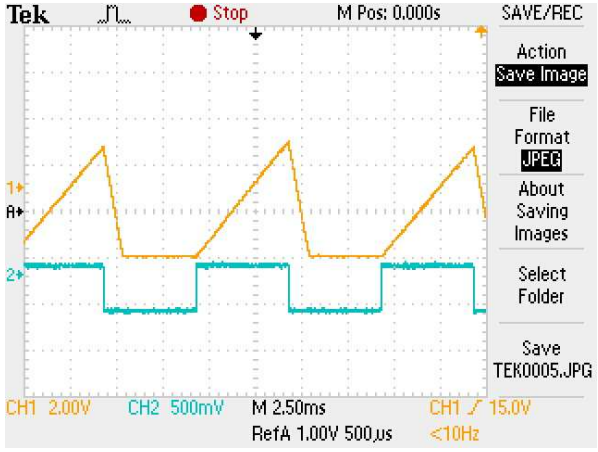
c. Response of the derivative component

Figure 1. Response of the P, I and D component on a rectangular train

The second step consisted in the experimental chek of the controll laws. In this case, the oscilloscope probe which has viewed the output signal will not be fixed now on the connections referred to as P, I and D but directly to the controller's output [6]. For a rectangular train signal, the behavoiur for different values of the controller components can be checked [5]. The next figure presents the PI response of the controller, with a small value for the proportional component, figure 2.a, respectively with a higher value for the P component, figure 2.b.



a. Kp small value



b. Kp big value

Figure 2. PI response of the controller to a rectangular train signal

The second method of the experimental analysis of the controller behaviour can be achieved with the help of the data acquisition and processing from National Instruments, usind LabView 8.1, the plate NI SCXI-1000 and a signal generator, appealing for this also on LabView and his acquisitions board or separatly, to a usual signal generator.

That for in LabView was create an interface to acquire and process the data, using for this the *DAQ Assistant* bloc. Then, each signal, controller input and output, measured over two separatly channels of the aqcuisition board, have been separated for individual processing, through the *Select Signal* block [8].

Beeing able to verify and validate the measured signals, the features of the block scheme can be extended, providing the *Amplitude and Level Measurements* as well the *Timing and Transition Measurements* block. The block scheme with the implemented features in LabView for processing the PID controller input and output signal, is presented in figure 3. The visualisation interface of the implemented block scheme in LabView, with the input and output waveform graph, the separately input and output signal, the mean, peak to peak and frequency of the signal, is presented in figure 4.

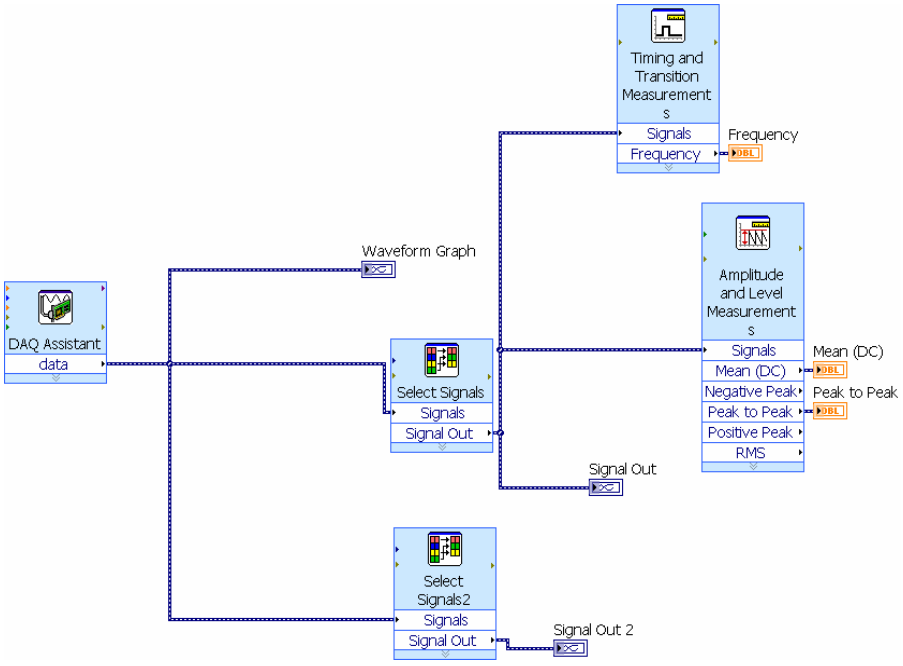


Figure 3. Acquisition and data processing block scheme implemented in LabView

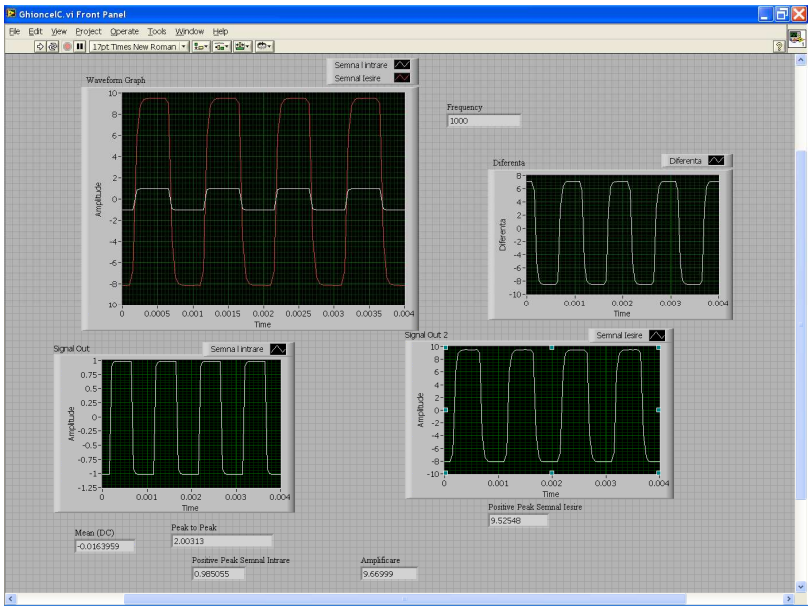
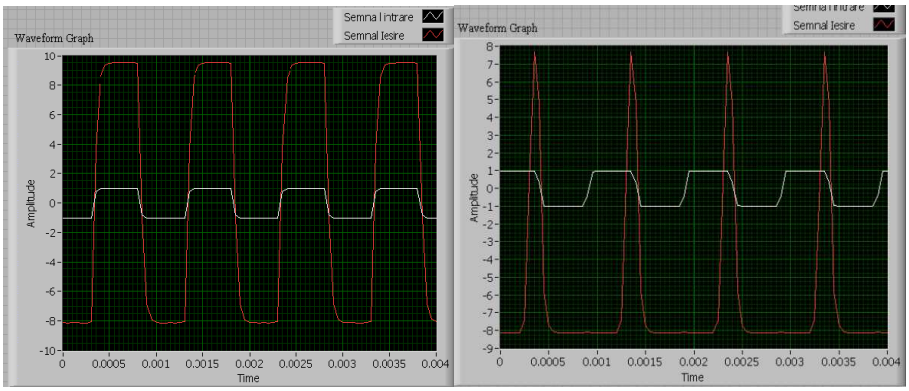


Figure 4. Visualisation interface in LabView

Figure 5 presents the input and output wave forms of the PID controller, for an input rectungular train signal, with P, figure 5.a, and PID component, in figure 5.b.



a. Response with P component **b.** Response with PID component

Figure 5. PID controller response monitorised in LabView

4. Conclusion

The method's and the stand on those the test of the electronic controllers are implemented, allow the determinations of the basic parameter and the possibility to adjust them depending on the controlled process. [3]

The test method's and the testing stand can be developed, including a special signal generator that can provide the classical testing signals, impulse and step signal, to be able to compare the experimantal response with the simulation results.

References

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