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Comparison Of Classical Methods With PID The Case Of The Temperature Control Process.

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ABSTRACT: *For comparison of classical PID methods we will get the modelof temperature control process model.[1]Model [1]is a first-order process with a delay time, with predominant time constants. The simulations were performed in Matlab engineering software, implementing control design methods, for various time-delayed process models. In the first part of the simulations, PID regulators were based on classical methods. Subsequently, the transitive responses of the closed contour to the proposed classical PID methods were compared. From the results obtained, the best quality of regulation is obtained through Chien-Hrones-Reswick (0% control) and Wang-Juang-Chan methods.*

Keywords: *PID, Quality of regulation,SIMC-PID ,WJC-PID,CHR-PID*

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I. INTRODUCTION

PID regulators are widely used in all industries. In controlling the processes, more than 95% of the control contours are with PID regulators [2], [3]. PID enables that by means of a simple reverse link algorithm, eliminate deviations from the condition durable and achieve a reasonable quality of closed contours in many processes the simplest of the industry. Recent years have been reported in the industrial application of regulators Simple PID usually find a bad process repair and design errors. For this reason, new regulation methods have been developed for PID algorithms. Because of the importance of the PID regulators in the industry, in the following sections will be addressed several methods that Accept a presentation of the process as a first-rate pattern with a delay time. A way Efficient to control a delayed process is using a control structure Predictive. It is known as the fact that PID regulators are often used to control time delay processes achieving a reasonable success, at least in some cases.

II. THE CASE OF THE TEMPERATURE CONTROL PROCESS

We take the process of controlling the temperature of the laboratory furnace with the transmit function:

$$\frac{1.33e^{-30s}}{1400s+1}=Gp$$

In this case, we consider 6 different regulators PID, ZN-PID, CC-PID, SIMC-PID, WJC, CHR-0% , CHR-20% on regulation. The obtained quality of the closed-loop system for the 6 regulated regulators is given in the figure 1.1 .For performing simulations, a unit scale entry was used at the time t=0 sec, and a valued degree concern -2 in time t=1000 sec.The duration of the simulation is t=2000 sec, As seen in the block built in Simulink, for regulators ZN-PID and CC-PID filters are applied to the referential input signal with the transmit function$GF=\frac{1}{50s+1}$,because these two regulators provide good regulation only to eliminate the concerns that arise in the outbound process, and present a major overwhelming in the tracking of the reference signal at the input of the process.

As can be seen, from the characteristics obtained, the response to the process of distress at the time t=1000 sec, for regulators ZN-PID and CC-PID is faster. These two regulators give oscillations in the tracking of the reference signal.The SIMC-PID regulator provides a slow response to both the tracking of the referral signal and the elimination of exit disturbance. The CHR-PID-20% regulator provides a high input overrun due to the large control signal it implements in comparison to other regulators, and a slow response to outbreak disturbance.

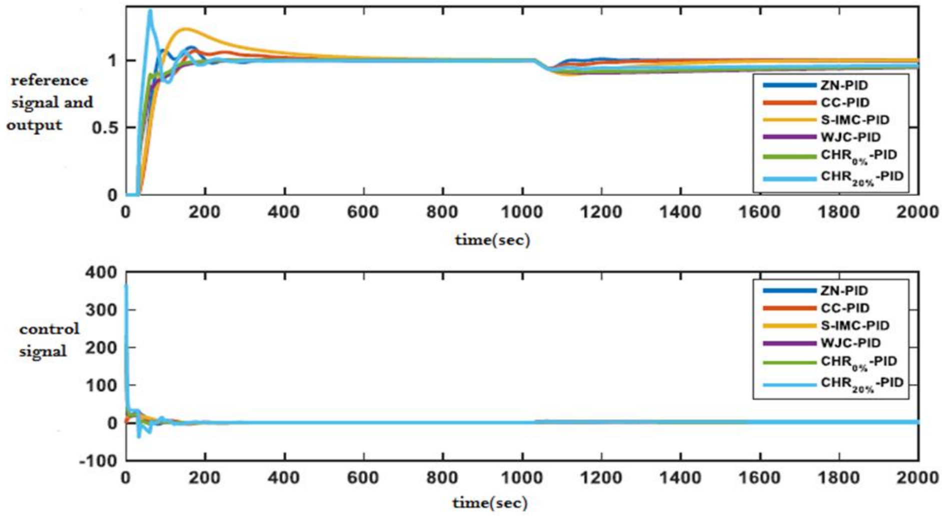

Fig.1.1: Comparison of classical PID methods for controlling the temperature process for τ = **30** sec

WJC-PID and CHR-PID-0% methods have the best responses in the tracking of the reference signal and a slow response to the outbreak of the process. Table 1 reflects the values obtained of the quality criteria in the time domain, the integral criteria IGK and IGA and the maximum sensitivity values Ms for each of the adjustment methods.

Table 1 Characteristics of Fig 1.1 quality adjustment

Methods of regulation	t_{ng}	t_s	M_r	h_{max}	t_{max}	IGK	IGA	M_s
ZN-PID	19.16	606.62	9.5	1.095	99	8.78	39.39	3.412
CC-PID	48.42	636.99	6.73	1.067	105	8.064	45.45	2.757
SIMC-PID	27.22	701.29	23.13	1.23	93	57.52	135	1.4854
WJC-PID	29.51	759.09	5.81	1	412	44.86	128.4	1.507
CHR-PID-0%	14.02	748.66	5.17	1	235	41.67	115.7	1.6011
CHR-PID-20%	7.21	636.85	42.94	1.37	35	37.56	102.3	2.323

The SIMC-PID, WJC-PID and CHR-PID-0% regulators have robust better character, based on the low sensitivity values Ms. By making a compromise between response speed and robust character, the best regulators are WJC-PID and CHR-PID-0%. The robust PID regulator character is further studied for the same process but with a delay time of about 20% less (τ = 24 sec) than the time delay of the identified process. So this is the case of error in determining the delay of the process time. Figure 1.2 shows the characteristics obtained in this case. The characteristics are similar to the first case.

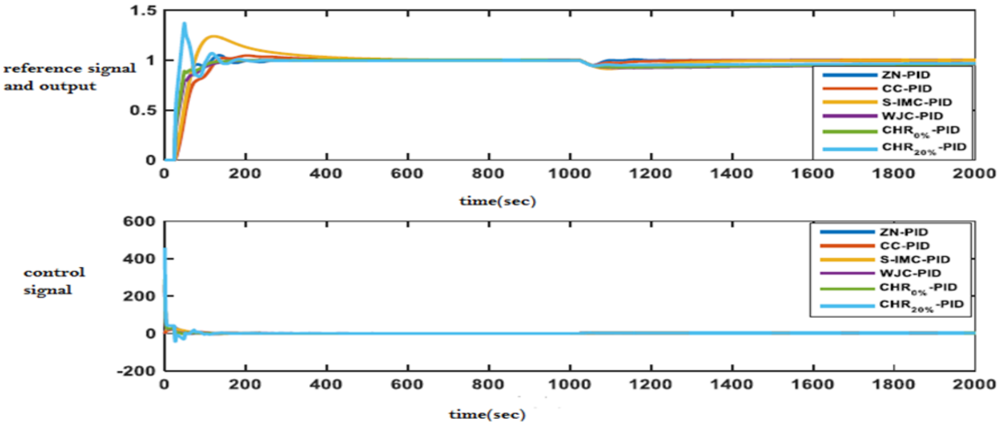

Fig.1.2: Comparison of classical PID methods for controlling the temperature process for τ = 24 sec

Table 2 reflects the values obtained of the quality parameters by the time, quality integrals IGK and IGA and the maximum sensitivity values Ms for each of the adjustment methods.

Table 2: Characteristics of Fig 1.2 quality adjustment

Methods of regulation	t_{ng}	t_s	M_r	h_{max}	t_{max}	IGK	IGA	M_s
ZN-PID	20.53	324.78	0.67	1.066	316	5.088	26.95	4.1468
CC-PID	180.17	401.63	0.023	1	1	4.946	32.81	3.3204
SIMC-PID	228.89	610.31	0.28	1	1	45.96	105.5	1.6755
WJC-PID	5.77	955.9	4.55	1.45	1	35.09	103.5	1.5815
CHR-PID-0%	5.42	969.39	4.04	1.4	1	32.62	92.97	1.6972
CHR-PID-20%	4.86	935.49	2.9	1.2	242	29.68	82.37	2.6827

In this case we have an improvement of the characteristics obtained with the ZN-PID and CC-PID regulators, but the maximum sensitivity values are again high. By making a compromise between response speed and robust character, the best regulators are WJC-PID and CHR-PID-0%.The next case of robust PID characterization is seen for the same process but with constant time the process is about 20% smaller(T=1140 sec) than the process value identified. So this is the case of error in determining the time constants of the process.Figure1.3 :shows the characteristics obtained in this case.

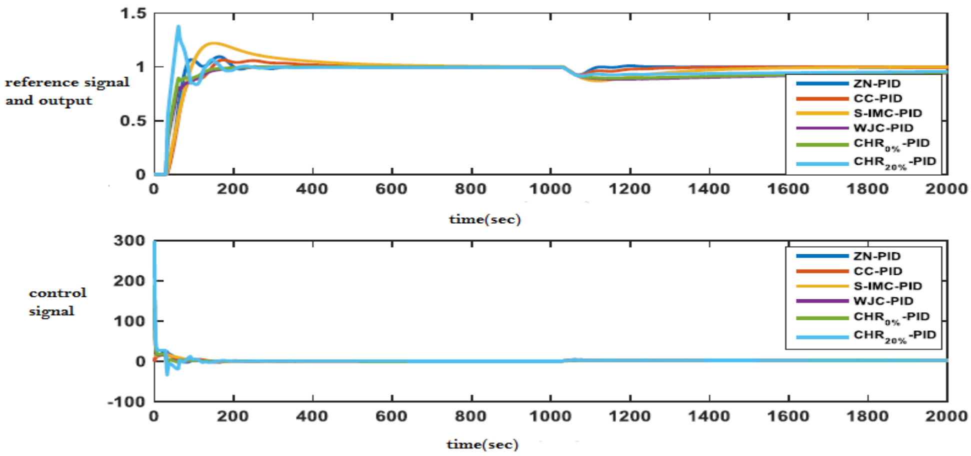

Fig.1.3:Comparison of classical PID methods for controlling the temperature process for τ = 1140 sec

Table 3 reflects the values obtained of the quality parameters by the time, IGK and IGA integers and the maximum sensitivity values Ms for the characteristics obtained in Figure 1.3. Even in this case, the best regulators are WJC-PID and CHR-PID-0%.

Table 3: Characteristics of **Fig 1.3** quality adjustment

Methods of regulation	t_{ng}	t_s	M_r	h_{max}	t_{max}	IGK	IGA	M_s
ZN-PID	17.96	608.36	9.47	1.094	100	8.77	39.94	4.135
CC-PID	48.28	646.68	6.41	1.064	106	8.149	46.85	3.318
SIMC-PID	27.2696	716.61	22.13	1.22	94	57.83	139	1.67
WJC-PID	27.87	806.05	6.14	1	393	46.7	138.9	1.584
CHR-PID-0%	13.32	794.69	5.47	1	227	43.26	125.6	1.695
CHR-PID-20%	7.24	704.31	44.22	1.38	33	38.44	110.5	2.674

III. CONCLUSION

The ZN-PID and CC-PID regulators require the application of the filters in the reference signals, in order to obtain better tracking characteristics of the reference signal change. In the case of a dominant time constrained process, the SIMC-PID regulator provides a slow response to both the tracking of the reference signal and the elimination of exit disturbance. In the case of a dominant time constrained process, the WJC-PID and CHR-PID-0% methods have the best responses in the tracking of the reference signal and a slow response to the outbreak of the process. By compromising the response speed and robust character, in the case of a dominant time constrained process, the best regulators are WJC-PID and CHR-PID-0%..

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