Based On MCU Auto-adapted Digital PID Fluid Position Control System Design

Dong-yun Luo
Jiujiang University
Electronic Institute
Jiujiang, Jiang Xi
ldongyun2001@126.com

You-mu Zhang
Jiujiang University
Electronic Institute
Jiujiang, Jiang Xi
ldongyun2001@126.com

***Abstract*—This system design auto-adapted digital PID hardware and the software system based on the MCU, the auto-adapted digital PID system have the different controlled variable according to the input change, regarding the interference signal, nonlinear signal , the inertia system have the good control effect, this system applied in the fluid position control, the auto-adapted PID procedures save in MCU, and through its IO interface he fluid position is controlled corresponding fluid position actuating equipment.**

Keywords--MCU; Auto-adapted; Digital PID; Fluid position control

I. INTRODUCTION

The traditional PID control algorithm applied to a linear model, but if the control object with a large inertia, nonlinear characteristic, then the above control method is not applicable. Level control process in order to improve the control quality, cost-saving control, required control equipment and control process is always in optimal working condition. Resulting optimal control of a software algorithm, and the integration of traditional digital PID algorithm, which is called adaptive digital PID control. PID controller as the law is simple, reliable operation, easy to implement and so on, PID controller is still the industrial production process control system of the most common kind of controller. However, as industrial process control performance requirements on continuous improvement, the traditional PID algorithm can not fully meet the requirements of actual production. To this end many scholars in the modern control theory based on a number of new control algorithmsIn this control algorithm requires a system to the input of the measured parameters in the system automatically adjust the system at any time in the optimal state. And the system uses the MCU control system, adaptive control law to include adaptive pid control the level of changes under different control parameters[1–2].

II. SYSTEM DESIGN

A. Selecting a Template (Heading 2)

System structure as shown in Figure 1, including the auto-adapted digital PID link, the zeroth order retainer, the fluid position's control's mathematical model is, R settings for the level, C for the level of actual value, E value for the deviation , adaptive digital PID error E according to the changes resulting from a change in control parameters, zero-order holder is the role of the adaptive digital PID regulator for continuous signal, continuous signal can act on post-level implementation device.

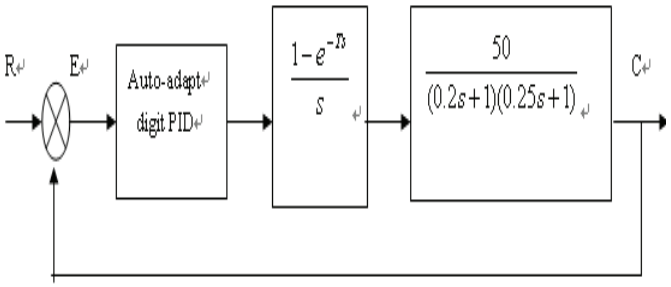


Figure 1 Systems control block diagram

III. SYSTEM HARDWARE DESIGN

System consists of A1, A2, A3, A4, B1, B4 and B5 cell formation, A1, A2 constitute bias circuit, B5 is the analog-digital conversion unit, MCU in storage adaptive digital PID algorithm, B1 number of mode conversion units, A3, A4 constitute the mathematical model of liquid level control[3]. MCU is small, low power consumption, controlling function, expansion flexibility, miniaturization and ease of use, it is widely used instrument, combining different types of sensors can be realized, such as voltage, power, frequency, humidity, temperature, flow, speed, thickness, angle, length, hardness, elemental, physical pressure measurement. SCM makes use of digital instrumentation, intelligent, miniaturized, and function compared to use of more powerful electronic or digital circuits. Such as precision measuring equipment (power meter, oscilloscope, various analytical instrument). MCU contains 8088 small periphery interface circuits and so on systems and communication, interrupt. 8088 have many addressing spaces, this experiment system provides to the user the use space: 00000H-6FFFFH,80000H-FFFFFH, including is always clear the entrance altogether 960K storage space. And 80300H-87FFFH is the RAM space which the testing aircraft provides,

Identify applicable sponsor/s here. *(sponsors)*

978-1-4244-8039-5/11/$26.00 ©2011 IEEE

may supply the subscriber system depositing fluid position control procedure. Its resource distribution space. the monitoring takes 80000H-80013H to take, the break point, to suspend unconditionally on foot. System 00000H-000FFH and 80000H-800FFH are the superposition, always visits tests internal RAM, therefore, this sector user's other interrupt the vector to be possible to deposit in this. Moreover, 80100H-802FFH is the monitoring data area or the user stack area, when test run load, the start address must be bigger than 80300H is also this truth [4].

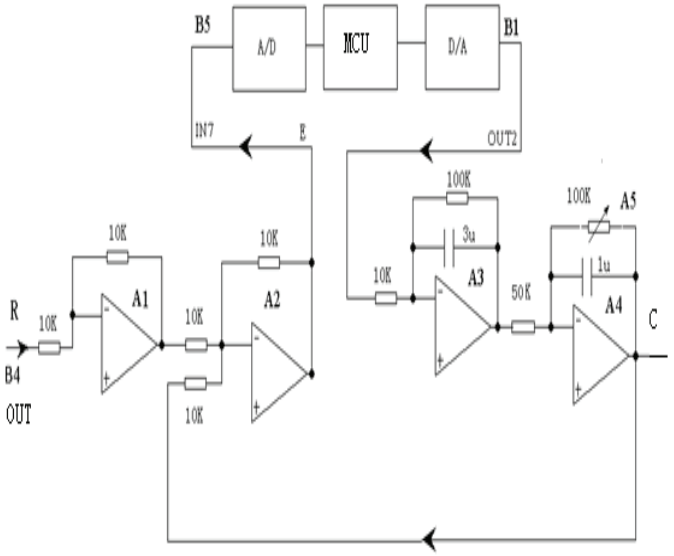


Figure 2 System hardware design

IV. SYSTEM SOFTWARE DESIGN

A. Auto-adapted PID control algorithm

Auto-adapted PID control algorithm changes the input to change the weighting coefficient in order to achieve adaptive function, adjust the formula as follows :

$$w_1(k)= w_1(k-1)+ \lambda_I Z(k)u(k)x_1(k) \quad (1)$$

$$w_2(k)= w_2(k-1)+ \lambda_p Z(k)u(k)x_2(k) \quad (2)$$

$$w_3(k)= w_3(k-1)+ \lambda_D Z(k)u(k)x_3(k) \quad (3)$$

$$w'_i(k)= w_i(k)/\sum_{i=1}^{3}\left|w_i(k)\right| \quad (4)$$

$$\Delta u(k)=K\sum_{i=1}^{3} w'_i(k)\ x_i(k) \quad (5)$$

$$\Delta e(k)=e(k)- e(k-1) \quad (6)$$

$$Z(k)= e(k);\ x_1(k)= e(k) \quad (7)$$

$$x_2(k)= \Delta e(k)=e(k)- e(k-1) \quad (8)$$

$$x_3(k)= \Delta^2 e(k)= e(k)- 2e(k-1)+ e(k-2) \quad (9)$$

Auto-adapted PID control algorithm changes the input to change the weighting coefficient in order to achieve adaptive function, adjust the formula as follows :

B. MCU Software Design

MCU master program as shown in Figure 3, when the procedure starts, has the superior machine and MCU carries on the communication, first is the superior embryonic period transmission handshake signal transmits the corresponding answering signal again for MCU, MCU, the MCU basis input value different adjustment corresponding controlledvariable [5]. The superior embryonic period transmits following parameter to MCU: Sampling period T; Integral, proportion, differential constant; Coefficient K; After MCU receives these parameters, has the output control parameter according to the auto-adapted digital PID algorithm [6].

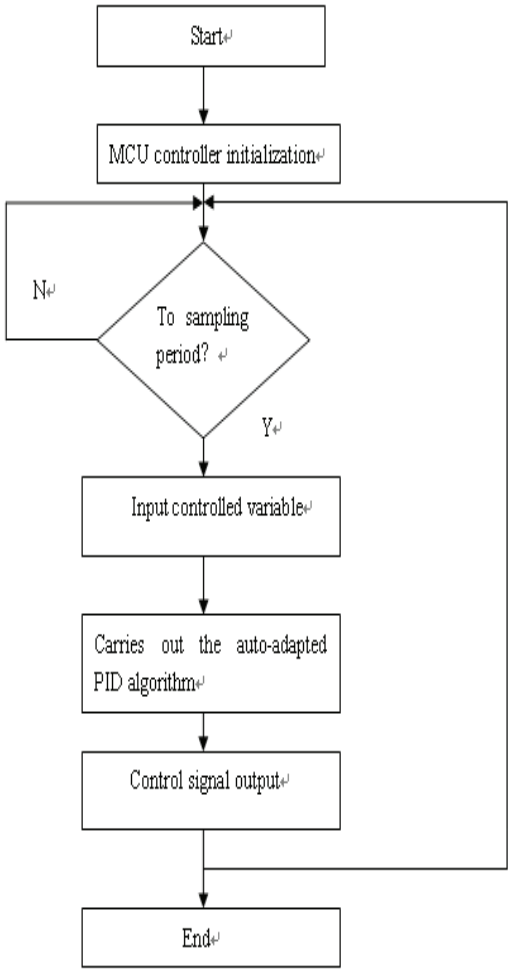
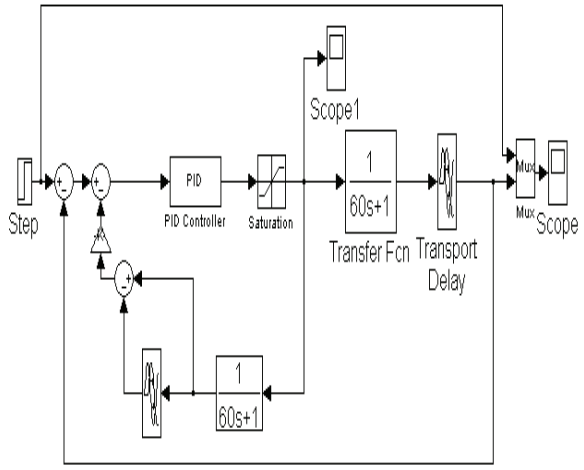


Figure 3 MCU main program

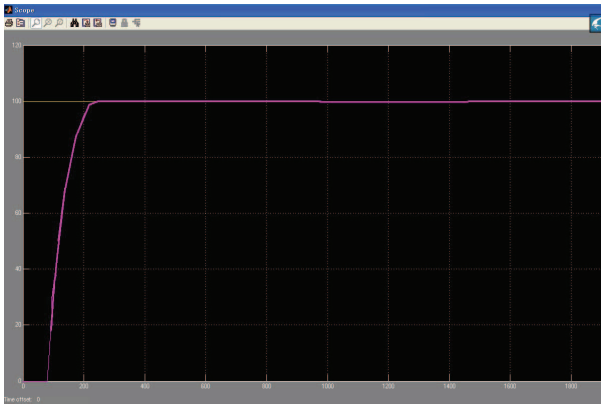
V. RUN RESULT

In the middle of the actual movement process is stable regarding the control system movement, the control speed is quick, Figure 4 is the signal which and the output signal inputs middle the systems operation. This article explains how to design the next on an adaptive PID control system, can not determine the precise mathematical model of controlled object, the necessary through adaptive control. First, system identification, was charged with using the least squares method to estimate the unknown parameters of the object model itself,

combined with the traditional PID control design procedure to achieve control requirements, the final simulation using MATLAB software.



（a） SIMULINK



（b）Output SIMULATION signal

Figure 4 System debugging result

REFERENCES

[1] G. Eason, B. Noble, and I. N. Sneddon, “On certain integrals of Lipschitz-Hankel type involving products of Bessel functions,” Phil. Trans. Roy. Soc. London, vol. A247, pp. 529–551, April 1955.

[2] J. Clerk Maxwell, A Treatise on Electricity and Magnetism, 3rd ed., vol. 2. Oxford: Clarendon, 1892, pp.68–73.

[3] I. S. Jacobs and C. P. Bean, “Fine particles, thin films and exchange anisotropy,” in Magnetism, vol. III, G. T. Rado and H. Suhl, Eds. New York: Academic, 1963, pp. 271–350.

[4] R. Nicole, “Title of paper with only first word capitalized,” J. Name Stand. Abbrev., in press.

[5] Y. Yorozu, M. Hirano, K. Oka, and Y. Tagawa, “Electron spectroscopy studies on magneto-optical media and plastic substrate interface,” IEEE Transl. J. Magn. Japan, vol. 2, pp. 740–741, August 1987 [Digests 9th Annual Conf. Magnetics Japan, p. 301, 1982

[6] M. Young, The Technical Writer's Handbook. Mill Valley, CA: University Science, 1989.