A Study of Fuzzy PID Control Design by Using FPGA and GUI

林德、胡永栴

E-mail: 9419693@mail.dyu.edu.tw

ABSTRACT

Fuzzy PID controller has been developed and applied over 10 years, comparing tradition PID control and fuzzy PID control and numerous studies have indicated that the fuzzy control may perform better and may be more robust. But fuzzy PID controller may be induced unstable in certain plant, in order to provide better performance, the DF approach is employed once again to analyze the stability and modify the fuzzy rules. Using field -programmable-gate-array (FPGA) and Verilog hardware description language (HDL) to designs a PID control chip, the parameters kp, kd, ki of PID control rules have been sent through serial port in PC and determined by fuzzy rules in GUI program. Also using parallel port to receive the feedback of server motor as plant and display the performance in GUI.

Keywords : Fuzzy PID control、DF approach、FPGA、GUI

Table of Contents

REFERENCES

[1] 施慶隆，李文猶，控制系統實務-圓周倒單擺系統之PID 與模糊控制，飛統出版社，2003。

[2] 施慶隆，李文猶，機電整合與運動控制:原理與單軸平台實例，高立圖書有限公司，1997。

[3] Gupta, M.M., Trojan, G.M., and Kiszka, J.B.,IEEE Trans. Syst. Man Cybern.,16,576-582. 1986.

[4] C.C. Hang, K.J. Astrom and W. K. Ho.“ Refinements of the Ziegler-Nichols tuning fomula, ” Automatica, vol. 138,no. 2, 111-117,1991.

[5] Kwok, D.P., Tam, P., Li, C.K., and Wang, P.,“ Linguistic PID controller ”, IFAC 11th Conq. Proc., 1990.

[6] Eli Sternheim, Rajvir Singh, Rajeev Madhavan, Yatin Trivedi,“ Digital Design and Synthesis with verilog HDL, ” Automata Publishing Company, 1993.

[7] Douglsa, J. Smith,“ HDL Chip Design: A practical guide designing, synthesizing and simulating ASICs and FPGAs using VHDL or Verilog, ” Doone Publications, 1990.

[8] Pedrycz, w., Int. j. Control, 34,402-421.

[9] 楊克勤，“ 設計直流馬達轉速遠端模糊監控系統 ”， 國立台灣海洋大學電機工程研究所碩士論文 ，2001。

[10] F. Aubepart, P. Poure, C. Girerd, Y.A. Chapuis, and F. Braun,“ Design and simulation of ASIC-base system control: application to direction torque control of induction machine, ”IEEE ISIE Proc., vol. 3, pp. 1250-1255,1999.

[11] Ray, K.S., and Majumder, D.D., IEEE Trans. Syst. Man Cybern., 14, 345-349.,1984.

[12] Douglas J. Smith, “ HDL Chip Design ”, Doone Publications, 1994.
[13] J. Pasanen, P. Jahkonen, S. J. Ovaska, O. Vainio, H. Tenhunen, “ An Integrated Digital Motion Control Unit, ” Instrumentation and Measurement, IEEE Transactions, vol.40, pp. 654 – 657,1991.
[14] A. H. Scottedward and C. E. Hall, “ Variable-structure PID control to prevent integrator windup, ” IEEE Trans. Ind. Electron., vol.48, no. 2, pp. 442-451, Apr. 2001.
[15] S. Kumar, K. Forward, M. Palaniswami, “ A fast-multiplier generator for FPGAs, ” VLSI Design, Proceedings of the 8th International Conference on, pp. 53-56, 4-7 Jan 1995.
[16] E. Samahy, “ Adaptive Multi-Layer Self-Tuning High Performance Tracking Control for DC Brushless ”, IEEE Transactions on Energy Conversion for, Vol.9, No.2, 311-316, Jul.1994.
[17] J. G. Ziegler and N. B. Nichols, “ Optimum settings for automatic controllers ” Trans. ASME, vol.64,759-768,1942.
[18] Y. Khalilollahi, “ Switching elements, the key to FPGA architecture, ” Idea/Microelectronics, Conference Record, pp. 682-687, 27-29 Sep 1994.