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Design and Simulation of PD, PID and Fuzzy Logic Controller for Industrial Application

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Abstract

Measuring the flow of liquid is a critical need in many industrial plants. The aim of this paper is to do the comparative study of Proportional Derivative controller, conventional PID controller and fuzzy logic controller for flowing fluids. In this paper, performance analysis of proportional derivative, conventional PID controller and fuzzy logic controller has been done by the use of MATLAB and simulink and in the end comparison of various time domain parameter is done to prove that the fuzzy logic controller has small overshoot and fast response as compared to PID controller and PD controller. PID controller is the most widely used control strategy in industry. The popularity of PID controller can be attributed partly to their robust performance and partly to their functional simplicity. In this paper, the response of the PID and PD controller is oscillatory which damage the system. But the response of the fuzzy logic controller is free from these dangerous oscillation in transient period. Hence the Fuzzy logic controller is better than the conventionally used PID controller.

Keywords: Fuzzy Logic Controller, PID and PD Controller, Matlab/ Simulink.

1. Introduction

Flow control is critical need in many industrial processes. The control action of chemical industries maintaining the controlled variables. In this paper, we control the flow via three method: PD, PID and FLC. PD and PID control is one of the earlier control strategies [1]. PID controller has a simple control structure which is easy to understand but the response of PID, PD controller is not fast. To overcome these problems we use fuzzy logic controller. Performance analysis of PD, PID and FLC has been done by the use of MATLAB and simulink. Comparison of various time domain parameters is done to prove that the FLC has small overshoot and fast response as compared to PD and PID controller.

2. Design Consideration

2.1 Design of PD Controller

Figure.1 shows the simulink model of the PD Controller with unity feedback. Derivative controller (Kd) reduces both the overshoot and the settling time.

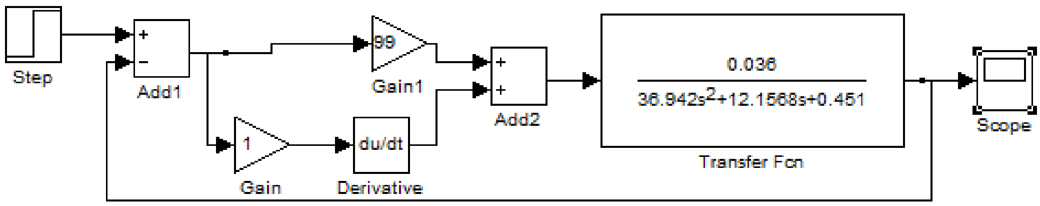

Fig. 1: Simulink diagram of PD Controller.

2.2 Design of PID Controller

A simple strategy widely used in industrial control is PID controller [4]. A PID Controller is being designed for a higher order system. Fig.2 shows the simulink diagram of the PID Controller with unity feedback.

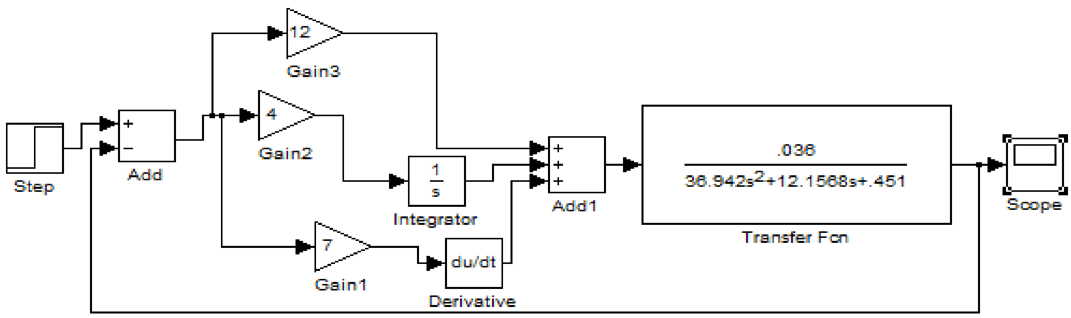

Fig. 2: Simulink diagram of PID Controller.

The response of this technique is not fast and reliable. To overcome these problem we proposed the Fuzzy Controller so that the closed loop system exhibit small overshoot and settling time with zero steady state error.

2.3 Design of Fuzzy Logic Controller

Figure.3 shows the simulink model of the Fuzzy Controller with unity feedback.

Figure.5 shows the fuzzy membership function editor where the number of membership function and type of membership function is choose, such as trapezoidal, triangular and Gaussian according to the process parameter. In this paper it is suitable to choose triangular and trapezoidal.

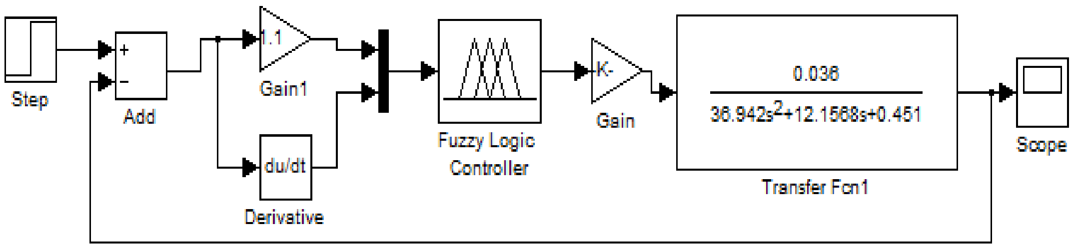

Fig. 3: Simulink diagram of Fuzzy Controller

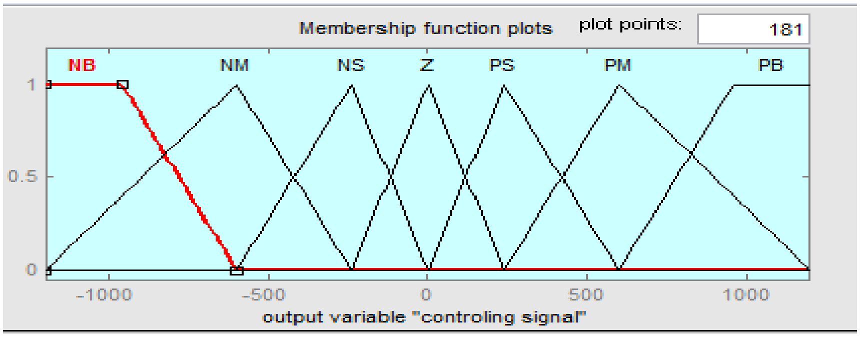

Fig. 4: Membership function for output.

3. Simulation Results

The Fig. 8, 9 and 10 shows the response of PD, conventional PID controller and the response of the fuzzy logic controller to the step input.

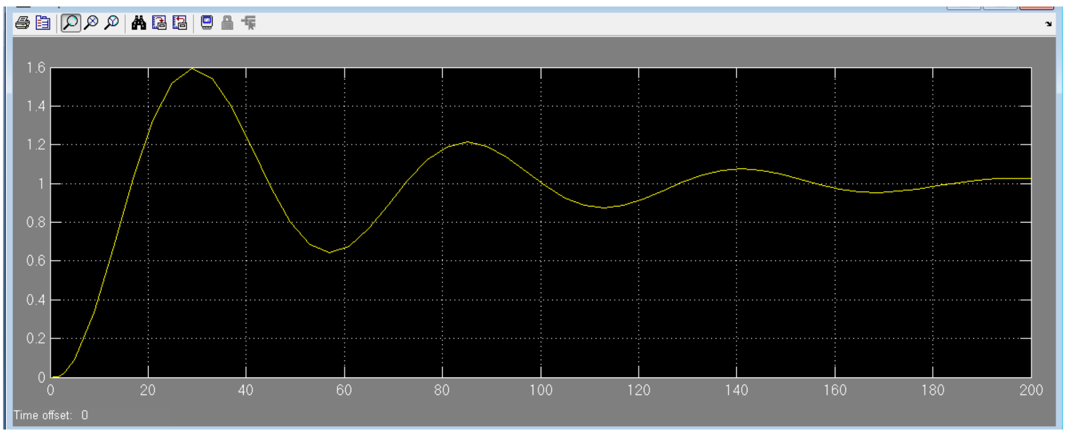

Fig. 5: The step response of the PD controller.

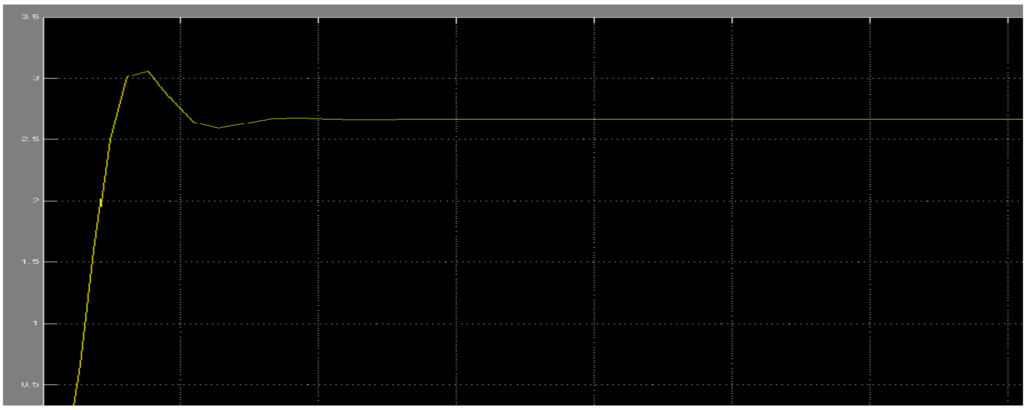

Fig. 6: The step response of the PID controller.

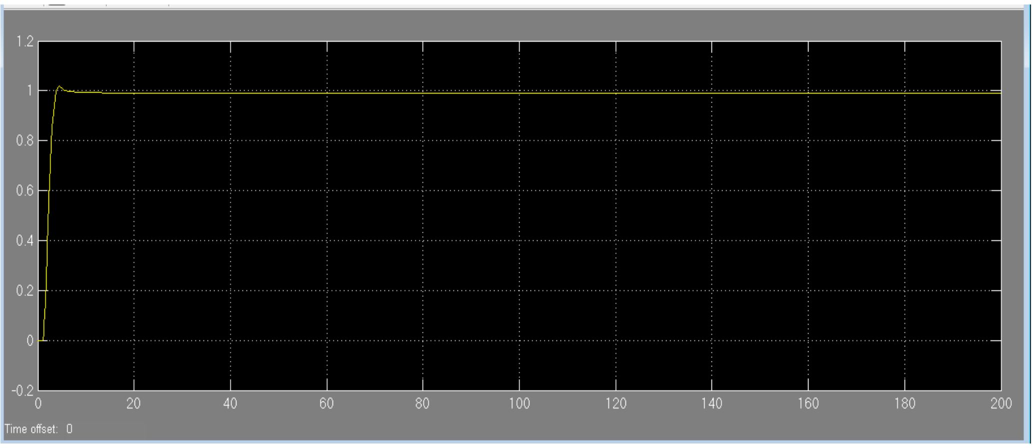

Fig. 7: The step response of the fuzzy controller.

From Fig. 8, 9 and 10 it is clear that fuzzy logic controller has small overshoot and is having the fast response as compared to PD and PID Controllers.

4. Conclusion & Discussion

In this paper, we design three kinds of controllers which is PD, PID and fuzzy logic controller.

From the figure, results shows that the response of PD and PID Controller is oscillatory which can damage the system. But the response of FLC is free from these dangerous oscillations in the transient period. Hence the proposed FLC is better than the PD and PID controller.

References

[1] Rahul Malhotra and Tejbeer Kaur, "DC motor control using fuzzy logic controller," International journal of advanced engineering sciences and technologies vol no. 8, issue no. 2, 291 – 296.

[2] Philip A. Adewuyi, "DC Motor Speed Control: A Case between PID Controller and Fuzzy Logic Controller," international journal of multidisciplinary sciences and engineering, vol. 4, no. 4, may 2013.

[3] Zhang Shengyi and Wang Xinming, "Study of Fuzzy-PID Control in MATLAB for Two-phase Hybrid SteppingMotor," Proceedings of the 2nd International Conference On Systems Engineering and Modeling (ICSEM-13).

[4] Awang N.I. Wardana, "PID-Fuzzy Controller for Grate Cooler in Cement Plant," IEEE transaction of fuzzy system, no.7, vol. 32, 2005, 1345-1351.

[5] Farhad Aslam and Gagandeep Kaur, "Comparative Analysis of Conventional, P, PI, PID and Fuzzy Logic Controllers for the Efficient Control of Concentration in CSTR,"International Journal of Computer Applications (0975 – 8887) Volume 17– No.6, March 2011.

[6] D. Puangdownreong, T. Kulworawanichpong, S. Sujitjorn, Input weighting optimization for PID controllers based on the adaptive tabu search, 2004 IEEE Region 10 Conference D (2004) 451–454.

[7] Gaddam Mallesham and Akula Rajani, " Automatic tuning of pid controller using fuzzy logic," 8th International Conference on development and application systems Suceava, Romania, May 25 – 27, 2006.

[8] Gaurav and Amrit Kaur, " Comparison between Conventional PID and Fuzzy Logic Controller for Liquid Flow Control: Performance Evaluation of Fuzzy Logic and PID Controller by Using MATLAB/Simulink," International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, Volume-1, Issue-1, June 2012.

[9] S.R.Vaishnav and Z.J.Khan, "Design and Performance of PID and Fuzzy Logic Controller with Smaller Rule Set for Higher Order System," Proceedings of the World Congress on Engineering and Computer Science 2007 WCECS 2007, October 24-26, 2007.

[10] Elangeshwaran Pathmanathan and Rosdiazli Ibrahim, "Development and Implementation of Fuzzy Logic Controller for Flow Control Application," Intelligent and Advanced Systems (ICIAS), International Conference on Digital Object Identifier, pp.1-6, 2010.

[11] Gaurav and Amrit Kaur, "Conventional PID controller and Fuzzy logic controller for Liquid flow control: Performance Analysis Using MATLAB/Simulink," International Journal of Engineering Research & Technology (IJERT) Vol. 1 Issue 3, May – 2012.

[12] Sahil Chandan and Rahul Agnihotri, "Fuzzy logic Controller for Flowing Fluids," *International Journal of Advanced Research in Computer Engineering & Technology Volume 1, Issue 4, June 2012.*

[13] Chuen Chien Lee, “Fuzzy logic in control systems i.e. fuzzy logic controller,”IEEE Transactions on Systems, man and cybernetics, Vol 20, No.2, March/April 1990.

[14] R. Manoj Manjunath,S, S. Janaki Raman ,” Fuzzy Adaptive PID for Flow Control System based on OPC,” IJCA Special Issue on “Computational Science - New Dimensions & Perspectives NCCSE”, 2011.

[15] R. Rajesh,“Fuzzy Logic Control - A Quick Review,” *international journal of wisdom based computing, VOL. 1(1), 2011*.