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Design of Hybrid Fuzzy Pid Controller for Dc Servo Motor
Part 3: The simulation of the hyrid fuzzy PID controller for DC servo motor

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ABSTRACT: The controlling speed for DC motors, especially in industry, is always associated with the production technology process and it greatly determines the quality of the products. Depending on the nature and requirements of the process, it requires appropriate control methods. This paper given a designs of speed controlling for a DC servo system based on a newly developed fuzzy system, which is very powerful and has brought about many unexpected achievements in the field of fuzzy logic control. The basic advantage of fuzzy control over classical control methods is that it is possible to synthesize the controller without knowing the exact characteristics of the object in advance. In fact, in order to make full use of the advantages of each type of fuzzy controller and classical controller, people often use systems that combine two types of traditional and fuzzy controllers to create a controller which is the new fuzzy controller. In this paper, we present the hybrid fuzzy PID controller for controlling the speed of DC servo motors.

To achieve the goal we organize into 3 main contents as follows: Part 1: Design of hybrid fuzzy PID controller; Part 2: The hybrid fuzzy pid controller for a dc motor; Part 3: The simulation of the hybrid fuzzy pid controller for dc servo motor.

KEYWORDS:DC servo motors , fuzzy controller, fuzzy PID, Fuzzy logic,…

I. INTRODUCTION

DC servo motors are popularly used as prime movers in computers, numerically controlled machinery, or other applications where starts and stops are made quickly and accurately. Servo motors have lightweight, low-inertia armatures that respond quickly to excitation-voltage changes.

The speed of DC motor can be adjusted to a great extent so as to provide easy control and high performance. There are several conventional and numeric controller types intended for controlling the DC motor speed at its executing various tasks: PID Controller, Fuzzy Logic Controller (FLC) [1]; or the combination between them: PID-Particle Swarm Optimization, PID-Neural Networks, PID-Genetic Algorithm. One of the problems which might cause unsuccessful attempts for designing a proper controller would be the time-varying nature of parameters [2-6], unknown the parameters of the plants and variables which might be changed while working with the speed systems. One of the best suggested solutions to solve this problem would be use of the new Fuzzy PID Controller call hybrid fuzzy PID controller [7-11]. The hybrid fuzzy PID controller is not sensitive to change and yet would have a fair response to the system variations.The new Fuzzy PID Controller which is computationally efficient analytic scheme suitable for a real-time closed-loop digital control implementation [12-14]. Numerous computer simulations are included to demonstrate the effectiveness of the controller not only in linear but also in nonlinear systems. The better response can be achieved by the hybrid fuzzy PID Controller in comparison with classical methods in terms of shorter settling time, less overshoot and more stability. Thus, the hybrid fuzzy PID controller is adopted in this paper which is very flexibility to control the speed of the DC servo motor.

In the part 1 and part 2 of the paper, the control method and control system structure for the motor speed control system using hybrid fuzzy controller are proposed, and in this part we continue to evaluate the quality of the hybrid fuzzy PID controller through the simulation results response with DC motor as the object of system.

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II. THE SIMULATION OF THE HYBRID FUZZY PID CONTROLLER FOR DC SERVO MOTOR

To clearly see the superiority of the hybrid fuzzy control structure for the speed stability control problem, the noise factor is taken into account. Below is a comparison of the simulation results between the classical PID controller (specifically, the P controller) and the proposed hybrid fuzzy controller for the speed loop in the speed stability control problem. DC motor. Parameters of controller P: Kp= 25.

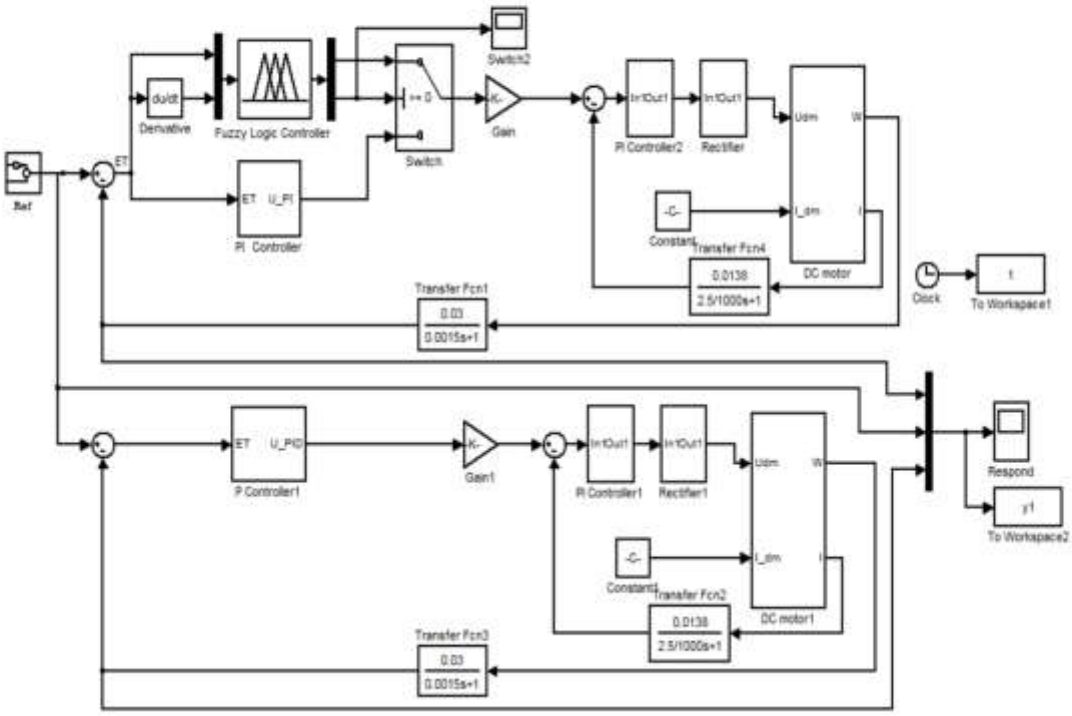

Figure 11: Simulation of the response between the P controller and the hybrid fuzzy controller in the problem of DC motor speed stability when there is no interference

In the research field of the paper, we consider some value of setting speed and we evaluate the response quality of the system to different speed variables as shown in the Figure 12-14

☞With the Step function input:

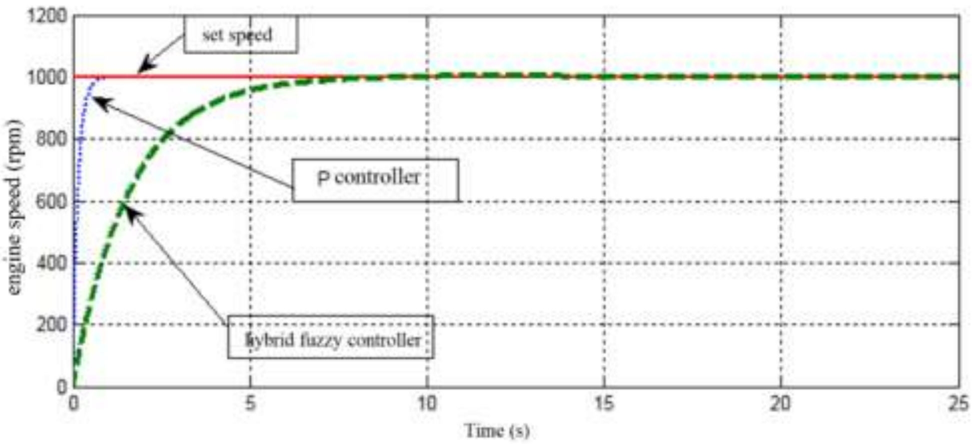

Figure 12: Comparison of the response between the P controller and the hybrid fuzzy controller of the speed loop with step function input

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☞With Square function input:

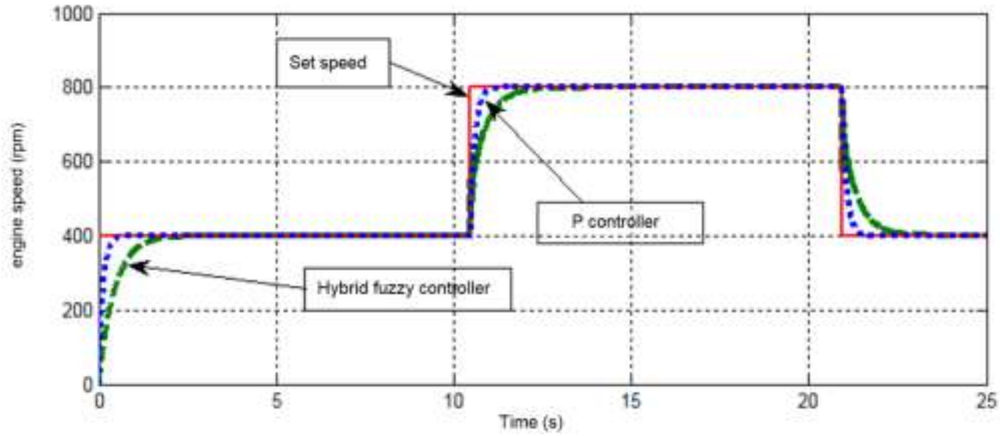

Figure 13: Comparison of the response between the P controller and the hybrid fuzzy controller of the speed loop with square function input

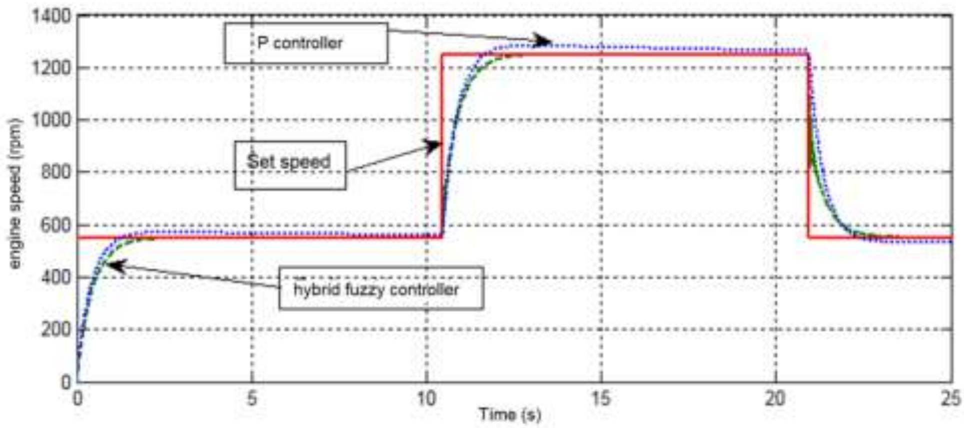

Figure 14: Comparison of the response between the P controller and the hybrid fuzzy PID controller of the speed loop when changing the setting speed

CONCLUSION

The simulation results show that when the DC motor is not affected by noise, the speed response of the two P-controller and the hybrid fuzzy PID controller for the speed loop circuit are of good quality with an error rate. However, when there is no interference, the control quality of the hybrid fuzzy PID controller also gives slower response, which can explain that the hybrid fuzzy PID controller in the working process is given a better response. Besides, Figure 14 shows that if the value of the setting speed is changed, the response of the P controller has a lower quality than the proposed hybrid fuzzy PID controller; so that the speed loop controller uses the hybrid fuzzy controller with the above control algorithm achieves good quality and stable operation much more accurately than the P controller.

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