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# Evaluate the Effectiveness of the Hybrid Fuzzy Controller of Disturbance Noise for Dc Motor
# Part 1: Structure of the hybrid fuzzy controller with the effect of noise on the system

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**ABSTRACT**: In the control of DC motors in production, especially in industry, there are many systems with high requirements for operation, because it greatly determines the quality of products made and the productivity of the system. In fact, there have been many studies on classical controller and fuzzy controller, each controller has its own advantages and disadvantages. This paper will study the hybrid fuzzy controller, which is a controller that combines the advantages of the two classical and fuzzy controllers mentioned above. Specifically, the paper will focus on the problem of evaluating the effectiveness of the hybrid fuzzy controller in speed control for DC motors when disturbance noise affects the system. The paper of the article will be divided into 2 parts:
Part 1: Structure of the hybrid fuzzy controller with the effect of noise on the system.
Part 2: Evaluate the effectiveness of the hybrid fuzzy controller in controlling the DC motor when the system is affected by disturbance noise.
**KEYWORDS:**Fuzzy, controller, F-PID, DC motor, disturbance noise.

## I. INTRODUCTION

In the control field, especially precise control is increasingly demanding. Most industrial machines and household appliances use electric motors. The classic controllers applied to motor control have been studied a lot and have achieved many positive results. However, in modern control, fuzzy controller or hybrid fuzzy controller provides a new controller to improve the quality of classical controller, as well as control unknown or difficult to identify objects.

Many fuzzy logic control schemes used in industrial practice today are based on some simplified fuzzy reasoning methods [1], which are simple but at the expense of losing robustness, missing fuzzy characteristics, and having inconsistent inference[2]. A novel non-Gaussian stochastic control framework for the problem of disturbance estimation and rejection by combining fuzzy identification technology with disturbance observer design [3].The undesirable characteristics of the fuzzy PI controller are caused by integrating operation of the controller, even though the integrator itself is introduced to to overcome steady state error in response [4]. A systematic procedure for constructing a multi-input multi-output fuzzy controller that guarantees identical performance to an existing stabilizing linear controller [5]. A computation of fuzzy modelis applied of fuzzy controllers in a noisy environment which shows in [6]. This paper focus on the problems of evaluating the effectiveness using the hybrid fuzzy controller in speed control for DC motors with disturbance noise affects on the system

## II. STRUCTURE OF THE HYBRID FUZZY CONTROLLER WITH THE EFFECT OF NOISE ON THE SYSTEM

On the basis of the theory of fuzzy control, the classical control has two common structures of the hybrid fuzzy controller: FLC is connected in

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parallel with classical PID and FLC is responsible for a fuzzy lock. Below is a proposal of a hybrid fuzzy control structure for the problem of motor speed stability, based on the distribution of the working area between the fuzzy controller and the classic PID controller through the switching switch as shown in Figure 1.

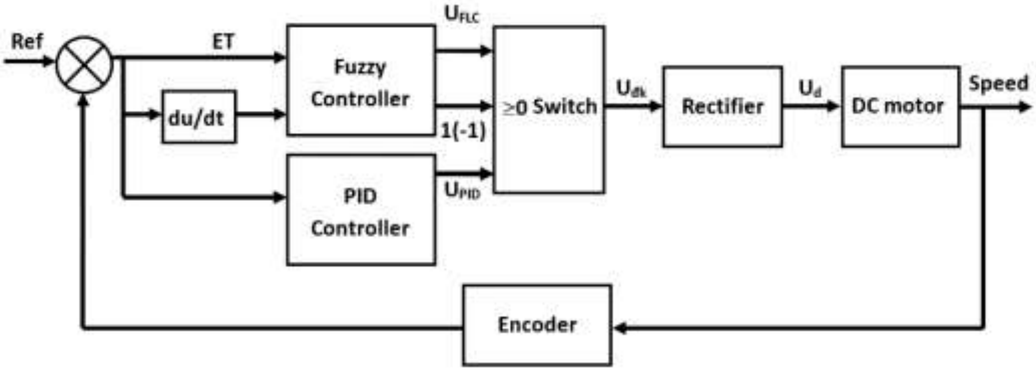


**Figure 1: The hybrid fuzzy PID system architecture for motor speed control using a switching**

In controlling the speed of the DC motor, we use a two-loop control structure as shown, the system is capable of stabilizing the motor speed. Specifically, there are two feedback loops, the inner loop is the current loop and the outer loop is the speed loop. The design calculation of the regulator for the current loop and the speed loop according to the typical system method is adopted.

With the characteristics and properties of the current loop circuit, we design a current loop circuit according to a I typical system, then the current loop circuit is given that shown in Figure 2. Then we can consider that the current loop control is the PI controller.

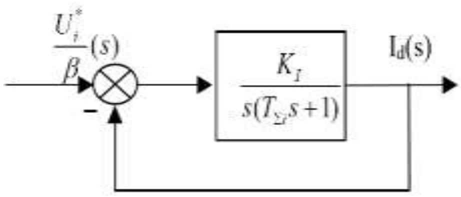


**Figure 2: The Synthetic current loop circuit structure according to a I typical**

Similar to the characteristics and properties of the speed loop circuit, we design a speed loop circuit according to a II typical system, then the speed loop circuit as shown in Figure 3 which we can consider that the speed loop control is the PI controller.

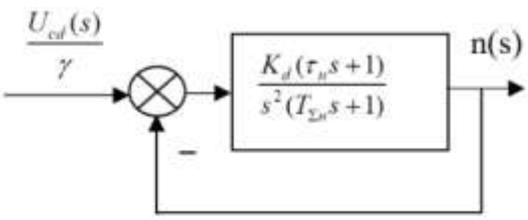


**Figure 3: The Synthetic speed loop circuit structure according to a II typical**

Base on theoretical basis of the above section, combining the control structure diagram for the DC motor proposed in Figure 1, the next section gives a simulation structure for the stable speed control system of a DC motor using hybrid fuzzy PID algorithm in Matlab Simulink software as shown in Figure 4

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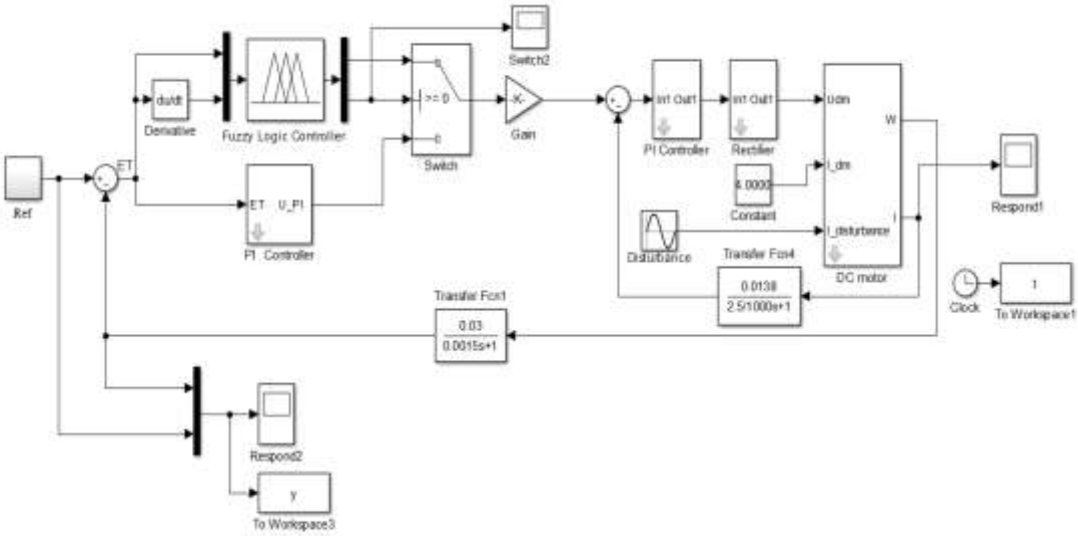


**Figure 4: Structural diagram of simulation of hybrid fuzzy PID controller system for DC motor on Matlab Simulink**

Hybrid fuzzy simulation structure in the Figure 4 shows the hybrid fuzzy PID controller in speed loop, which is the combination of fuzzy controller and classical PI controller for speed stable loop. In which the hybrid fuzzy PID controller, through the switch decides that if the error and the difference derivative error are large, the fuzzy controller will work, if the error and the difference derivative error are small then the PI controller will work. Thus, we can realize the flexibility of the hybrid fuzzy PID controller during the operation of the system. In the Figure 5 which illustrates the operating principle switche between the fuzzy controller and the PI controller in the proposed hybrid fuzzy PID controller structure.

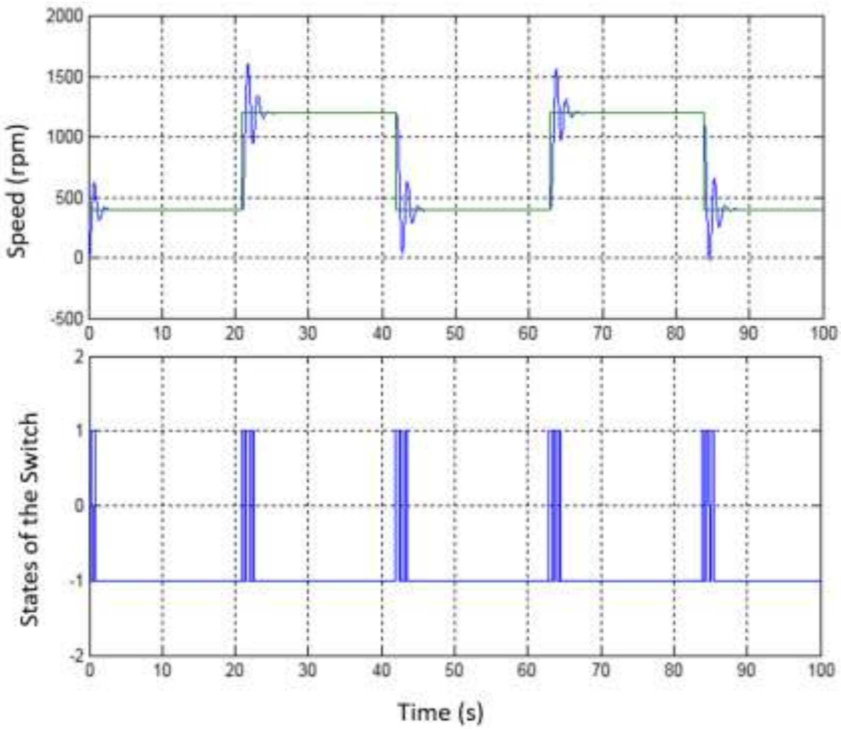


**Figure 5: Illustrating the operating principle of a switching in the hybrid fuzzy PID controller**

## III. CONCLUSION

This paper focuses on presenting a control structure for a DC motor, which using a hybrid fuzzy PID controller to control the speed for DC motor and demonstrating the stability of the system. Besides, through Matlab Simulink software, the simulation control algorithms to control motor speed, with the sinusoidal noise on the system. In the paper which evaluating the effectiveness of the hybrid fuzzy controller when the system is affected by external noise in the control of a DC motor, in part 1 the author presented the structure of the system and the switching principle of the DC motor to implement hybrid fuzzy PID controller. In the next study, the simulation results will be adopted to evaluate the effectiveness of the proposed hybrid fuzzy PID controller.

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