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Evaluation of the response of a Direct Current Servo Motor using a Hybrid Fuzzy Controller

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Abstract
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 controlling speed for DC servo 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 design 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.

Keywords: DC Servo Motors, PID, Fuzzy PID

1. Introduction

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 [7-17]. 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.

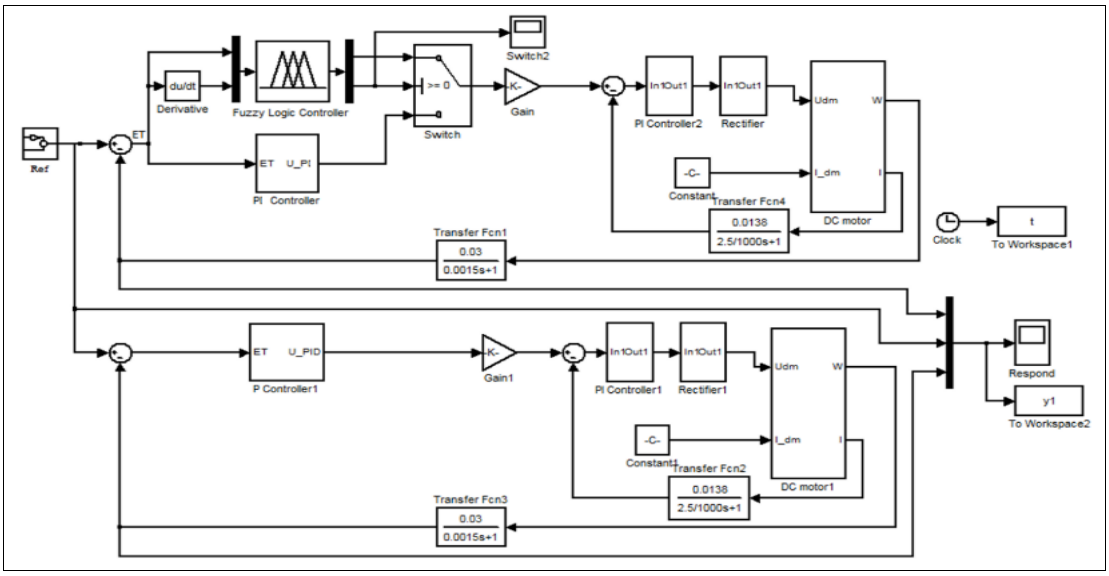

Fig 1: Structure simulation of the response between the PID controller and the hybrid fuzzy controller

2. The simulation of the Hybrid Fuzzy PID Controller

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 and the proposed hybrid fuzzy controller for the speed loop in the speed stability control problem. DC motor.

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 Figures 2-4.

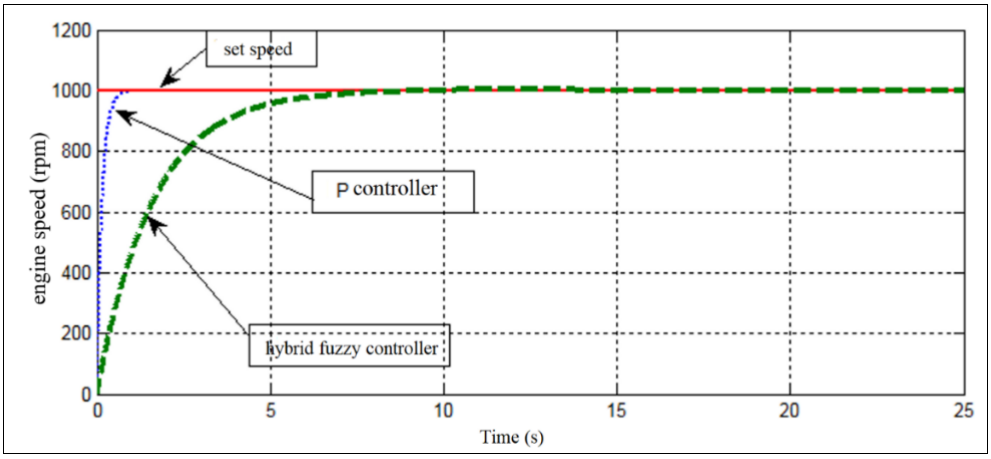

Fig 2: The response between the PID controller and the hybrid fuzzy controller with step function input

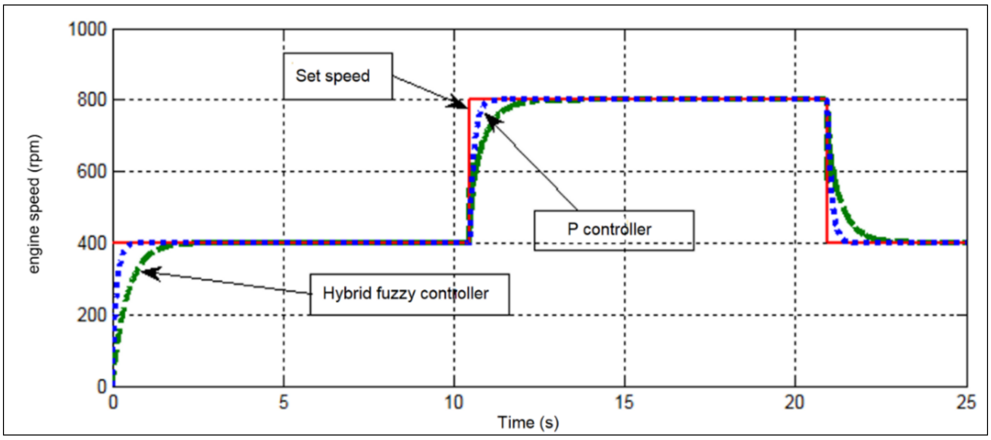

Fig 3: The response between the PID controller and the hybrid fuzzy controller with square function input

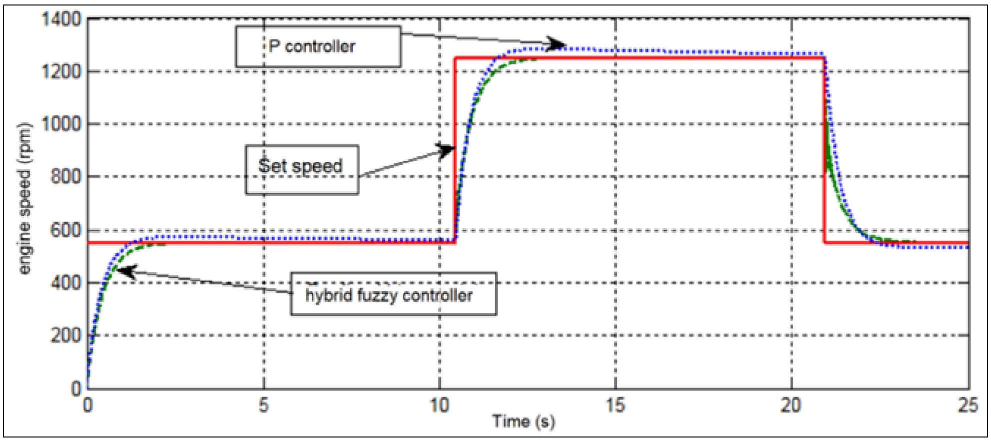

Fig 4: The response between the PID controller and the hybrid fuzzy controller when changing the setting speed

3. Conclusion

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. The value of the setting speed is changed, the response of the PID controller has a lower quality than the proposed hybrid fuzzy PID controller.

4. Acknowledgement

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