

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

**Ritu Shakya<sup>1</sup>, Kritika Rajanwal<sup>2</sup>, Sanskriti Patel<sup>3</sup> and Smita Dinkar<sup>4</sup>**

<sup>1</sup>*Department of Electrical Engineering, SRMSCET, Bareilly, INDIA.*  
<sup>2,3</sup>*Department of Electrical Engineering, SRMSCET, Bareilly, INDIA.*

### **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.

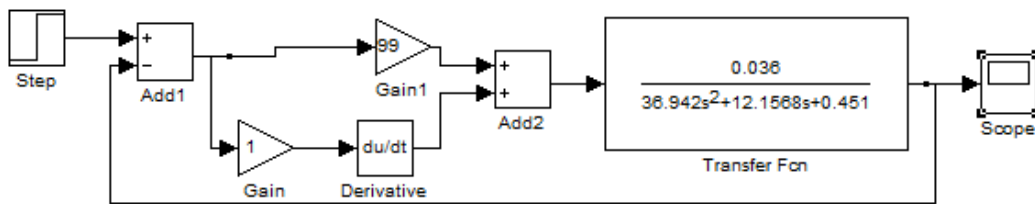


Fig. 1: Simulink diagram of PD Controller.

### 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.

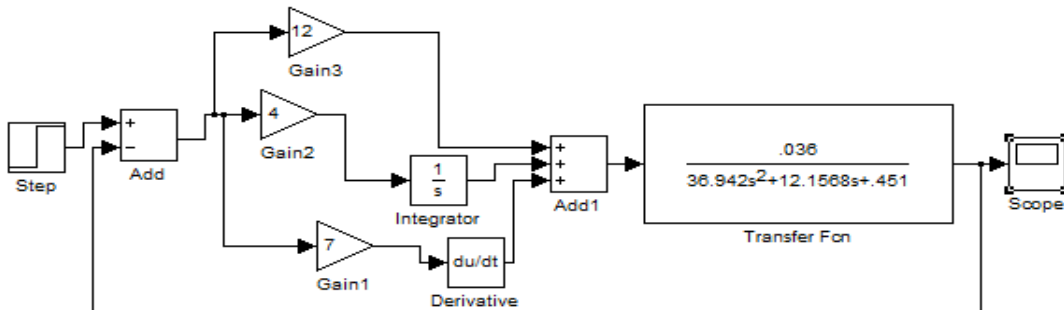


Fig. 2: Simulink diagram of PID Controller.

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.

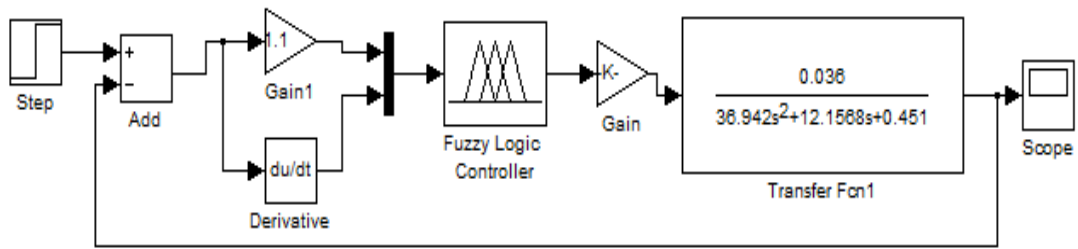


Fig. 3: Simulink diagram of Fuzzy Controller

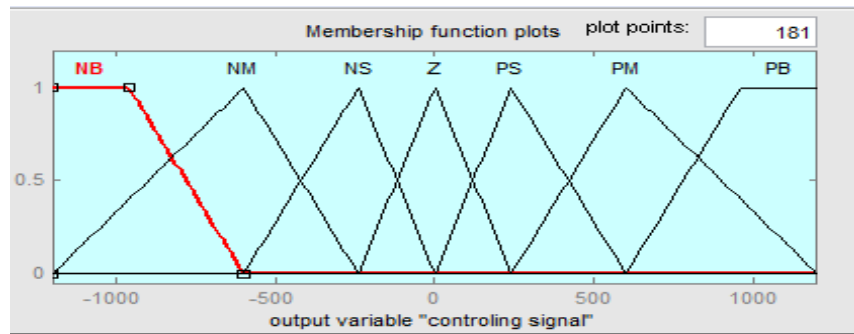


Fig. 4: Membership function for output.

### 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.

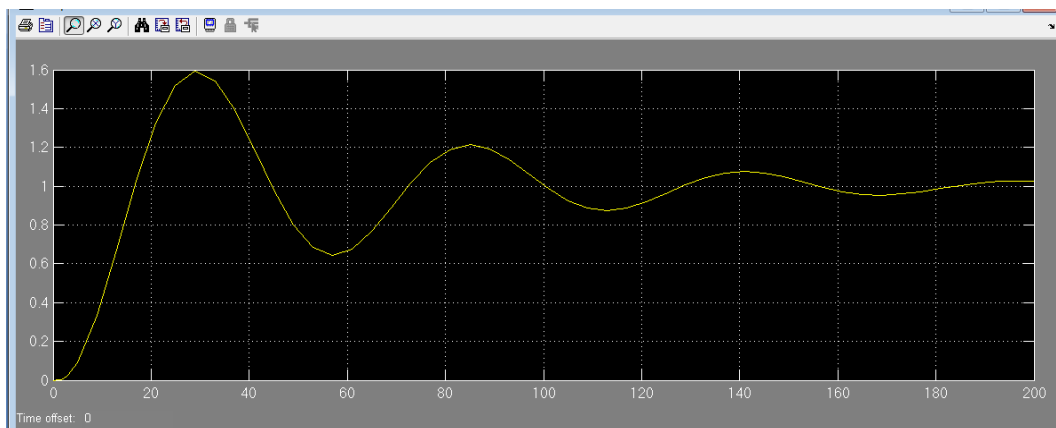
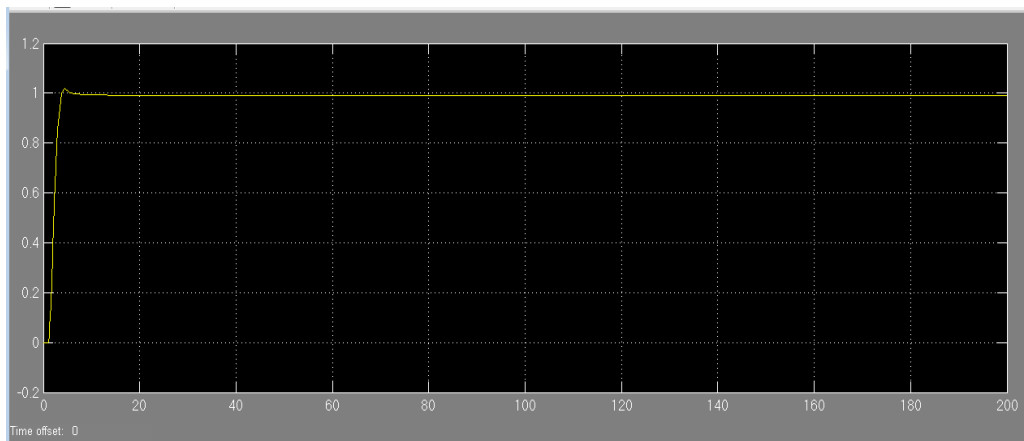


Fig. 5: The step response of the PD controller.



**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.

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