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Analysis of Load Frequency Control of Two Area Power System Using Different Control Techniques

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Abstract
To maintain stability is a mandatory requirement of any kind of power network. Interconnected power systems have significant advantages in maintaining stability and frequency at their nominal values. The control of the interconnected power systems is performed by Automatic Generation Control (AGC), which has two parts: the Automatic Voltage Regulator (AVR) and Load Frequency Control (LFC). When a disturbance occurs in the system, Load Frequency Control (LFC) acts to re-establish the system into its steady state with zero error as well as the desired transient response characteristics. This paper exhibits the design and implementation of a PID and Fuzzy Logic Controller for two area power systems, taking the steady state error and percentage of overshoot, undershoot, and pre-shoot as comparison parameters. MATLAB/Simulink software was used to bring out the implementation and obtain results. System dynamic performance is observed for PID and Fuzzy Logic Controllers in Simulink. The comparison study indicated that the proposed Fuzzy Logic controller has better performance than the PID controller.

1. Introduction

The reliability and power quality are the major criterion of modern power system network. The reliability of the power network is achieved through the interconnection of generating stations. The simplest form of interconnected system is two-area system. It is the interconnection of two control areas through tie lines. The generator in a control area always vary their speed together for maintaining frequency and the relative power angles to the predefined values in both static and dynamic conditions. The frequency of a power system depends on active power balance (Bayazid *et al.*, 2023). If any change occurs in active power

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demand/generations in power systems or if any sudden load change occurs in a control area of an interconnected power system then there will be frequency deviation. Load frequency Control (LFC) is maintains the real frequency and the desired power output in the interconnected power system. It is basic control apparatus in the power system operation (Rahman *et al*., 2017). The Load Frequency Control (LFC) of a two-area power system is the mechanism that balances between power generation and the demand regardless of load fluctuations to maintain the frequency deviations within acceptable limits (Bahgaat *et al*., 2014). The nominal frequency of a system is dependent on the balance between the load demand and the generated real power (Deb *et al*., 2023).

Load Frequency Control (LFC) is a crucial aspect of managing and regulating electric power systems. It falls under the broader umbrella of Automatic Generation Control (AGC), which is a system used to maintain the balance between electricity generation and consumption to ensure that the system frequency remains stable. The system frequency is typically set at 50 Hz in Europe and many other parts of the world, and 60 Hz in North America (Yousef *et al*., 2014). LFC is responsible for continuously adjusting the power output of generators within the power system to match the power demand from consumers. Its primary objective is to ensure that the system frequency remains close to the nominal frequency (e.g., 50 Hz or 60 Hz). When the demand for electricity increases, more power needs to be generated to maintain the frequency, and conversely, when demand decreases, generation must be reduced (Azeer *et al.*, 2017). AGC is the overarching control system that encompasses LFC. It consists of control algorithms and mechanisms that monitor the system's frequency and adjust the output of power plants accordingly. The goal is to maintain the balance between generation and consumption in real-time. The system frequency is a measure of how fast the alternating current (AC) cycles in an electric power system. In a 50 Hz system, the current oscillates 50 times per second, while in a 60 Hz system, it oscillates 60 times per second (Rahman *et al.*, 2016). Maintaining this frequency within a narrow range around the nominal value is essential for the reliable and stable operation of electrical equipment. Fuzzy logic is a mathematical approach that deals with uncertainty and imprecision. It is particularly useful in control systems where precise mathematical models may be challenging to develop due to complex and dynamic behaviors (Rahman *et al.*, 2022).

A fuzzy logic controller uses linguistic variables and a set of rules to make decisions and control a system. In the context of LFC and AGC, a fuzzy logic controller can be employed to adjust the output of generators based on inputs such as system frequency, load changes, and other relevant parameters (Bevrani and Daneshmand, 2011). This allows for a flexible and adaptive control strategy. Developing a complete mathematical model of an electric power system can be very complex due to its size and the numerous variables involved. However, it is essential for understanding the system's behavior and designing effective control strategies. Fuzzy logic controllers can be used to approximate and simplify the control logic required for AGC/LFC without relying on a highly detailed mathematical model

(Rasolomampionona *et al*., 2022). Load Frequency Control (LFC) plays a critical role in maintaining the stability and reliability of electric power systems by ensuring that the system frequency remains close to the desired nominal value (Rahman *et al*., 2017). Fuzzy logic controllers offer a flexible and adaptive approach to AGC/LFC, allowing for real-time adjustments to generation outputs based on system conditions, and they can be particularly useful when dealing with systems that are difficult to model precisely (Peddakapu *et al*., 2022).

In the context of controlling the frequency in an electric power system, both PID (Proportional-Integral-Derivative) controllers and Fuzzy Logic Controllers (FLCs) are used as control strategies (El-Sousy *et al*., 2023). These controllers aim to regulate the system frequency and ensure it remains close to the desired nominal value (e.g., 50 Hz or 60 Hz). The P component produces an output that is proportional to the error, which is the difference between the desired setpoint (e.g., 50 Hz) and the actual measured frequency (Rahman *et al*., 2014). The P component responds to the present error. The I component accounts for accumulated past errors by integrating them over time. This component helps eliminate any steady-state error that may exist and ensures the system reaches and maintains the desired setpoint. The D component anticipates future errors by considering the rate of change of the error. It helps in reducing overshoot and stabilizing the system (Rahman *et al*., 2019). PID controllers are widely used and can provide good control in many applications. However, they require tuning of their parameters (P, I, and D gains), which can be a challenging and time-consuming task, especially for complex systems like power grids. Fuzzy Logic Controllers use linguistic variables and a set of rules to make control decisions based on imprecise or uncertain information (Lee, 1990). Instead of relying on precise mathematical models, FLCs use linguistic terms like "high," "low," "medium," etc., to describe the control inputs and outputs (Lashin *et al*., 2022). FLCs are inherently adaptable and can handle complex and nonlinear systems more effectively than PID controllers, without the need for precise mathematical models.

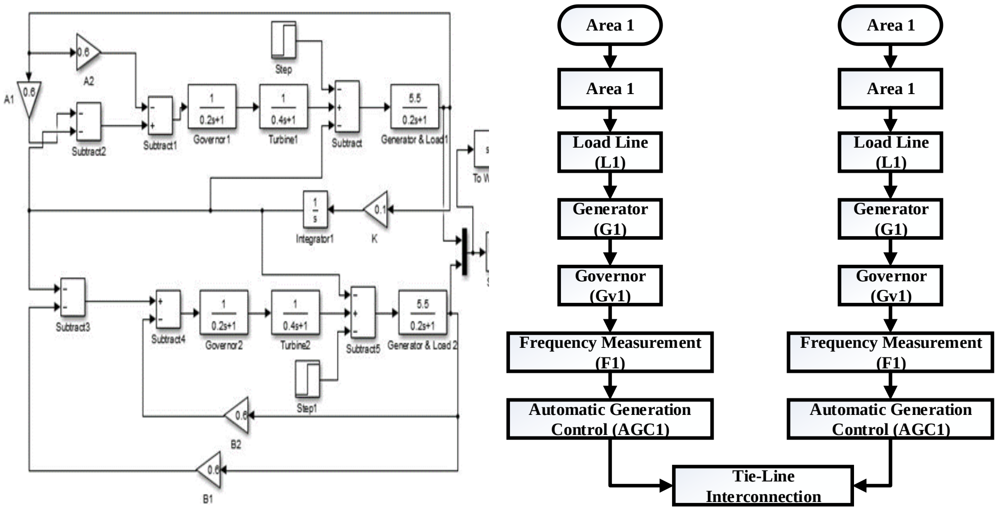
FLCs are well-suited for systems with complex and nonlinear behavior, such as electric power systems. They can adapt to changing conditions and handle uncertainties in the system, making them more versatile. Tuning a PID controller for optimal performance in a power system can be a challenging task, and it often requires expert knowledge (Magzoub & Alquthami *et al*., 2022). FLCs, on the other hand, are generally easier to implement and tune, especially in systems with dynamic and uncertain characteristics. FLCs tend to be more robust in the face of parameter variations and disturbances, which are common in power systems. The comparison study suggests that the FLC outperforms the PID controller in terms of frequency control. This improvement in performance may manifest as better frequency regulation, faster response to disturbances, and reduced oscillations around the desired setpoint. while PID controllers are effective in many control applications, Fuzzy Logic Controllers offer advantages in systems with complex and nonlinear dynamics, such as electric power systems (Zhu *et al*., 2022). Their adaptability, ease of implementation, and robustness can lead to better frequency control performance, as indicated by the comparison study mentioned.

2. Material and methods

Analyzing the load frequency control (LFC) of a two-area power system using different control techniques involves studying how these techniques affect the system's ability to maintain frequency and meet load demands.

2.1 Two Area Power Systems

A two-area power system, as described, consists of two separate regions, each of which is treated as a single control area. These control areas are connected to each other through a power transmission line. The key characteristics of such systems are their nonlinearity and non-minimum phase behavior (Rahman *et al.*, 2017). In a larger power grid, such as an interconnected electrical network serving a region or a country, it's common to divide it into smaller control areas. Each control area is responsible for managing its own generation and load to maintain system stability. These control areas are often interconnected through transmission lines to facilitate the sharing of electricity and to improve overall system efficiency (Zhu *et al*., 2022). The term "nonlinearity" implies that the behavior of the two-area power system is not described by a simple linear model. In other words, the relationship between inputs (e.g., control signals) and outputs (e.g., system frequency) is complex and may involve nonlinear functions or dependencies. Nonlinearity can make the system more challenging to control and analyze. Figure 1(a) and Figure (b) shows that the block diagram of the two-area system provides a graphical representation of how the control system is structured and how different components interact. It typically includes elements such as generators, loads, controllers, and the transmission line connecting the two areas. The block diagram is a visual aid used in control system design and analysis. From Figure (1a), A two-area power system consists of two interconnected regions, each with its own load, generator, turbine/prime mover, and governor. In Area 1, the electrical demand is represented by Load 1 (L1), which is supplied by Generator 1 (G1). The generator is driven by Turbine 1 (T1), which is regulated by Governor 1 (Gv1). Similarly, in Area 2, Load 2 (L2) represents the electrical demand, supplied by Generator 2 (G2), driven by Turbine 2 (T2), and regulated by Governor 2 (Gv2). Both areas are interconnected through a tie-line, which allows for the exchange of power between them. The frequency in each area is monitored by Frequency Measurement units (F1 and F2), which send signals to the respective governors to adjust the turbine speed and maintain system stability. Each area also has an Automatic Generation Control (AGC) unit (AGC1 and AGC2) that adjusts the power output of the generators based on tie-line power flow and frequency deviations. The AGC ensures that the load demand is balanced and the desired frequency is maintained, facilitating stable and reliable operation of the interconnected power system.



(a) (a)

Figure 1. Two-Area Generation System (a) Simulation Model and (b) Simplified Block Diagram.

To effectively control each control area, the control system in each area needs information about the transient behavior of both areas. This means that the controllers in each area require data on how the neighboring area is responding to disturbances or changes in load. This information is crucial for coordinating the control actions and ensuring that the local frequency returns to its steady-state value (Rahman *et al.,* 2017). A non-minimum phase system is one in which the output responds to a disturbance or control input in a way that does not follow a simple, minimum-phase behavior. In such systems, the output may initially move in the opposite direction of the desired response before eventually reaching the desired steady-state value. This behavior can be particularly challenging to control. The transfer function of governor is

$$G_g(s) = \frac{1}{1+sT_g} \tag{1}$$

The transfer function of turbine is

$$G_T(s) = \frac{1}{1+sT_T} \tag{2}$$

The transfer function of generator & load is

$$G_p(s) = \frac{k_p}{1+sT_p} \tag{3}$$

In practical terms, controlling a two-area power system with nonlinearity and non-minimum phase behavior can be challenging due to the complexity of the interactions between the control areas. It requires sophisticated control strategies and coordination between the control systems in each area to ensure stable operation and rapid response to disturbances. To address these challenges, control engineers often use advanced control techniques, such as fuzzy logic control, adaptive control, or model predictive control, to design controllers that can handle the nonlinearity and non-minimum phase behavior of the system (Saiteja *et al.,* 2022). Table 1 shown the parameters of the sensor for fuzzy logic control. Additionally, real-time monitoring and communication between control areas play a vital role in achieving effective load frequency control in interconnected power systems.

Table 1. The parameters of the sensor

Parameter	Nominal Value
TG	0.2
TT	0.4
A1 and B1	0.6
A2 and B2	0.6
k	0.1

The two areas are interconnected through "Tie line". At balanced condition, the Tie line power is equal to zero (Chen *et al.,* 2017). Generally, the characteristics of two areas are same. Means if any disturbance chances the two areas are responding in same manner. Therefore, the Controller of two thermal areas is very easy. The system is design without controller.

2.2 Frequency Deviation Step Response without Controller

The frequency deviation step response without a controller reveals the intrinsic behavior of a power system when subjected to sudden load or generation changes. In a stable state, the system maintains the frequency at its nominal value, typically 50 Hz or 60 Hz. However, when a disturbance occurs, such as a significant load increase or generator tripping, the frequency instantaneously deviates from the nominal value (Xiong, *et al*., 2020). Figure 2 illustrates the frequency deviation (Δf) of a power system in response to a sudden load disturbance, with the Y-axis representing the change in frequency in Hertz (Hz) and the X-axis representing time in seconds (s). Initially, from 0 to 1 second, the frequency appears relatively stable, indicating that the system's inertia temporarily buffers the load increase. However, around 1 second, the frequency begins to decrease as the inertial energy becomes insufficient to counteract the increased load. By 1.2 seconds, the frequency reaches a significant deviation of approximately -3.2 Hz, highlighting the system's vulnerability to the disturbance. Following this sharp decline, the frequency starts to increase but exhibits oscillatory behavior, reflecting an underdamped response where the system overshoots and undershoots around the nominal frequency. Despite these oscillations, the frequency signal does not reach a steady state, indicating persistent instability without a secondary control mechanism to restore the frequency to its nominal value. This response underscores the importance of effective control mechanisms in maintaining long-term frequency stability in power systems.

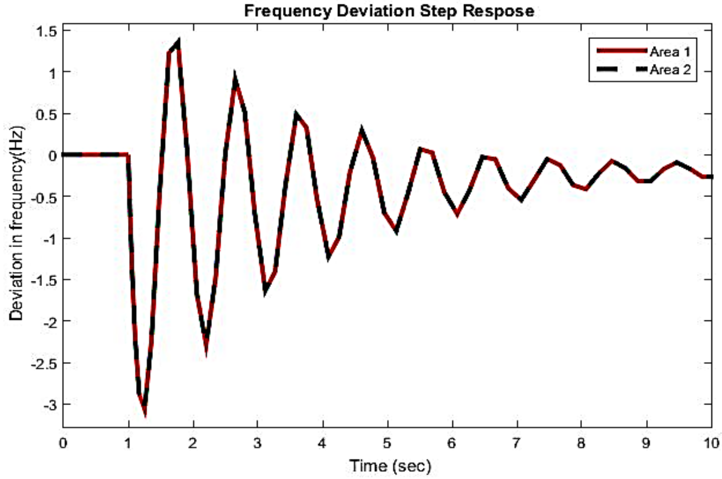


Figure 2. Frequency Deviation Step Response without Controller.

This disturbance triggers a transient response, during which the frequency gradually returns to a new steady state. The rate and extent of this recovery depend on various factors, including generator inertia, governor controls, and energy storage (Lee, 1990). Understanding this response is crucial for power system operators and engineers, as it informs the design of control strategies to swiftly restore and maintain the nominal frequency, ensuring the grid's stability and reliability.

2.3 Frequency Deviation Step Response using PID Controller

PID controllers characteristically use control loop feedback in control systems applications as shown in Figure 3. The controller initial computes a value of error as the variation between a precise process variable and a desired set point. It then tries to reduce the error by increasing or decreasing the control inputs or outputs in the course of action so that the process variable moves closer to the set point. The best admired controller used in the process industries for closed loop control is Proportional Integral Derivative controller, as it can ensure suitable acts with unworldly algorithm for a comfortable range of processes (Peddakapu *et al.*, 2022). In a two-area power system, maintaining frequency stability is crucial, particularly during load changes or disturbances. To achieve this, a PID (Proportional-Integral-Derivative) controller is employed to manage frequency deviations effectively. When a disturbance occurs, such as a sudden change in load, it causes a frequency deviation from the nominal value. The PID controller helps to correct this deviation by adjusting the power output of the generators.

The PID controller works by calculating an error value as the difference between the desired frequency setpoint and the actual frequency. The proportional component (P) of the controller produces an output that is proportional to the current error value, addressing immediate deviations. The integral component (I) sums the error values over time, correcting accumulated past errors and eliminating steady-state errors. The derivative component (D) predicts future errors based on the rate of change of the error, providing a damping effect and reducing overshoot.

In the context of a two-area system, the PID controllers in each area (PID1 and PID2) receive the frequency deviation signals from their respective frequency measurement units (F1 and F2). These controllers adjust the governor settings to change the turbine speed and, consequently, the generator output. This adjustment helps to bring the system frequency back to its nominal value. Additionally, the tie-line power flow is monitored and used as an input to the PID controllers to ensure coordinated control between the two areas.

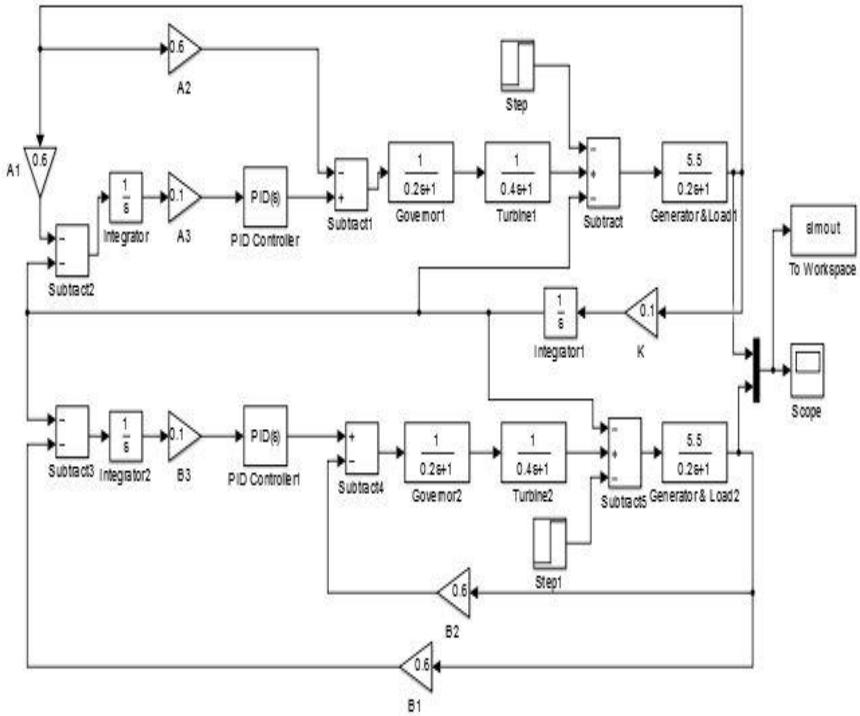


Figure 3. Simulation Model of Two-Area Generation System using PID controller.

In inter connected power system the load frequency control of each area is controlled by different PID controllers. Generally the characteristics of two areas are same that means if any disturbance chances the two areas are responding in same manner. In a power system, the frequency deviation step response with a PID (Proportional-Integral-Derivative) controller showcases the controller's vital role in maintaining grid stability. When the system encounters a sudden change in load or generation, the PID controller swiftly responds to correct the frequency deviation and restore it to the nominal value, such as 50 Hz or 60 Hz (Rasolomampionona *et al.*, 2022).

The step response of the frequency deviation under PID control typically shows how the system responds to a sudden disturbance. Ideally, the response will show a quick correction of the frequency deviation with minimal overshoot and a smooth return to the nominal frequency, indicating effective control and system stability. By fine-tuning the PID parameters, the system can achieve an optimal balance between fast response and minimal oscillations, ensuring reliable and stable operation of the interconnected power system. From Fig 4, we observe that the responses of steady state frequency deviation are zero, and the frequency returns to its nominal value in approximately 9.5 seconds. Here we can see that the oscillation is getting lower.

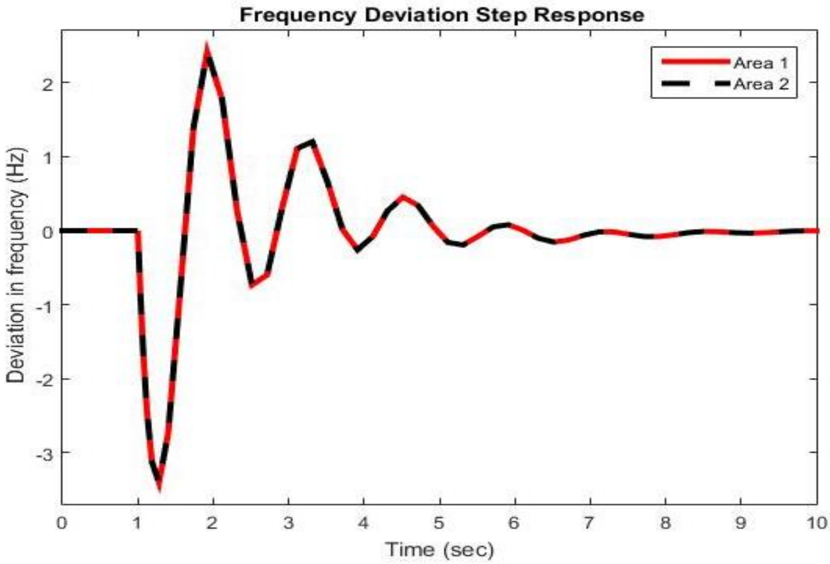


Figure 4. Frequency Deviation Step Response with PID Controller

The PID controller's three components – proportional, integral, and derivative – work harmoniously to minimize transient oscillations, reduce overshoot, and ensure a controlled return to the desired frequency. This dynamic response not only safeguards the integrity of the power system but also guarantees that consumers receive a reliable and consistent supply of electricity, making PID controllers an indispensable tool in load frequency control and power grid management (Rahman *et al.*, 2017).

2.4 Fuzzy Logic Controller

Fuzzy logic may be a basic system that depends on the degrees of state of the input and also the output depends on the state of the input and rate of amendment of this state as shows in Figure 5. In different words, a formal logic system works on the principle of distribution a specific output counting on the chance of the state of the input (Lee, 1990).

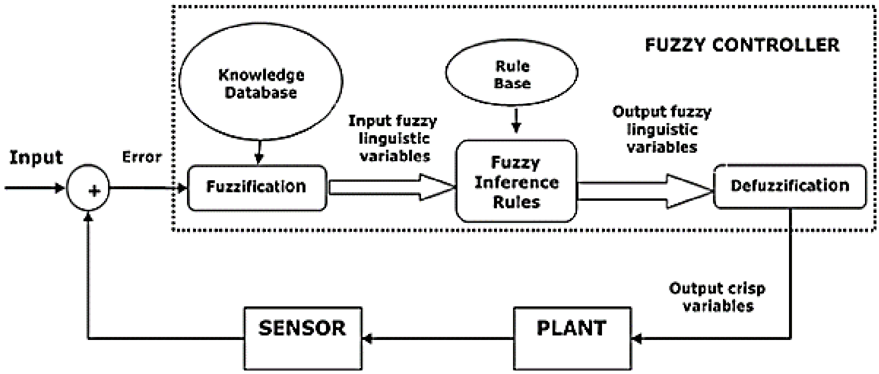


Figure 5. Fuzzy Logic Controller

A Fuzzy Logic Controller (FLC) is a sophisticated control system that operates on the principles of fuzzy logic, a mathematical framework designed to handle imprecise and uncertain information. Unlike traditional control systems, which rely on crisp, binary decisions, FLCs work with linguistic variables and fuzzy sets to describe input and output relationships. These linguistic variables use terms like "low," "medium," and "high" to represent values, making FLCs more intuitive and adaptable to situations where precise numerical measurements are challenging or where human-like decision-making is required (El-Sousy *et al.*, 2023). Fuzzy logic controllers are versatile and find applications across various fields, including automotive systems, consumer electronics, industrial processes, and robotics. Their ability to handle complex, nonlinear systems and adapt to changing conditions makes them valuable tools for improving control and automation in a wide range of industries. However, designing and fine-tuning FLCs require expertise to ensure optimal performance and reliable operation in real-world scenarios.

3. Results and Discussion

3.1 Implementation of Fuzzy Based Controller

To get improved performance fuzzy logic can be implemented in an operative method for load frequency controller (Rasolomampionona *et al.*, 2022). The fuzzy controller Comprise of two phases, first one fuzzy system unit where the Area control error (ACE) and its derivative (ΔACE) are set as input parameters and then fuzzy rules are given and in accordance to the rules, the output was the control action. The two inputs results 49 rules are given in Table 2. When many loads are considered, it’s somewhat hard to set the load perturbation as an input parameter of fuzzy logic controller.

Table 2: The Fuzzy rule set

ACE/ΔACE	NB	NM	NS	ZE	PS	PM	PB
NB	NB	NB	NB	NB	NM	NS	ZE
NM	NB	NB	NM	NM	ZE	PS	NB
NS	NB	NM	NS	NS	ZE	PS	PM

ZE	NB	NM	NS	ZE	PS	PM	PB
PS	NM	NS	ZE	PS	PS	PM	PB
PM	NS	ZE	PS	PM	PB	PB	PB
PB	ZE	PS	PM	PB	PB	PB	PB

NB: Big Negative, NM: Medium Negative, NS: Small Negative, ZE: Zero, PS: Small Positive, PM: Medium Positive, PB: Big Positive.

The fuzzy codes are written in the fis.file in MATLAB using AND function in the Mamdani inference using Triangular Membership function. The rules highly depend on the membership function, the rules are set in appropriate collection of input and output parameters (Lee, 1990). In this study ACE and its derivative (ΔACE) were used as inputs to the proposed controller. Seven linguistic variables: NB, NM, NS, ZE, PS, PM and PB represented by triangular membership function that have been chosen to represent the two inputs with universe of discourse between 1- and 1. The centroid area method was used for defuzzification .The fuzzy rule based decides the fuzzy output using AND operation. If the system robustness and reliability are more important, fuzzy logic controllers can be more useful in solving a wide range of control problems since conventional controllers are slower and also less efficient in nonlinear system applications (Peddakapu *et al.,* 2022; El-Sousy *et al.,* 2023).

The Mamdani fuzzy inference block is a pivotal component within a Fuzzy Logic Controller (FLC) that forms the heart of the decision-making process as shown in Figure 6. Named after its creator, Lotfi A. Zadeh, who pioneered the concept of fuzzy logic, the Mamdani block is responsible for bridging the gap between crisp input data and fuzzy output decisions. It begins by converting precise input values into fuzzy representations using membership functions that assign linguistic labels like "low," "medium," and "high" to the input data. Next, it evaluates a set of if-then rules that encode the controller's behavior, considering the fuzzy memberships of the inputs and producing fuzzy outputs for each rule. These fuzzy outputs are then aggregated, and the final step involves defuzzification to yield a crisp, actionable control signal. The Mamdani fuzzy inference block's strength lies in its ability to handle imprecision and uncertainty, making it a valuable tool in applications requiring human-like decision-making, particularly in fields such as automation, control systems, and decision support systems. The membership functions of ACE (Area Control Error) are an integral part of a Fuzzy Logic Controller (FLC) employed in power systems to handle frequency regulation.

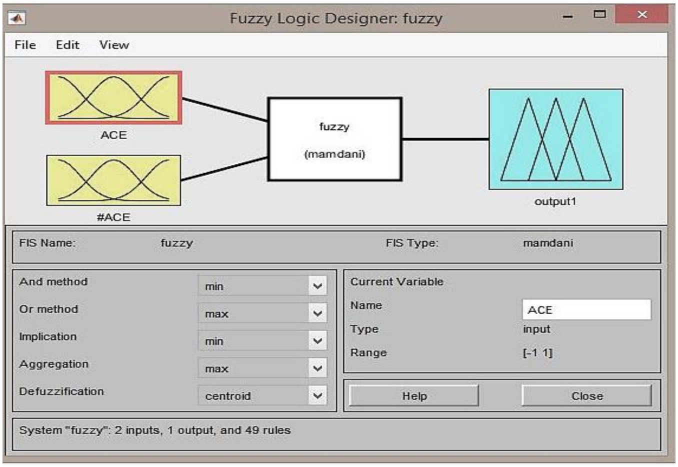


Figure 6. Mamdani fuzzy inference block.

ACE represents the difference between the actual and desired frequency deviations within a control area as shown in Figure 7. These membership functions play a pivotal role in translating precise numerical ACE values into linguistic terms, such as "Negative Big" (NB), "Zero" (ZE), or "Positive Small" (PS). Each linguistic term is associated with a membership function that assigns degrees of membership to ACE values based on their proximity to the linguistic term. This fuzzification process allows the FLC to operate using human-understandable linguistic variables instead of pure numerical data. Subsequently, these linguistic terms and their degrees of membership are utilized in the fuzzy rule base to make control decisions that aim to restore and maintain the desired frequency within the power system, contributing to its stability and reliability.

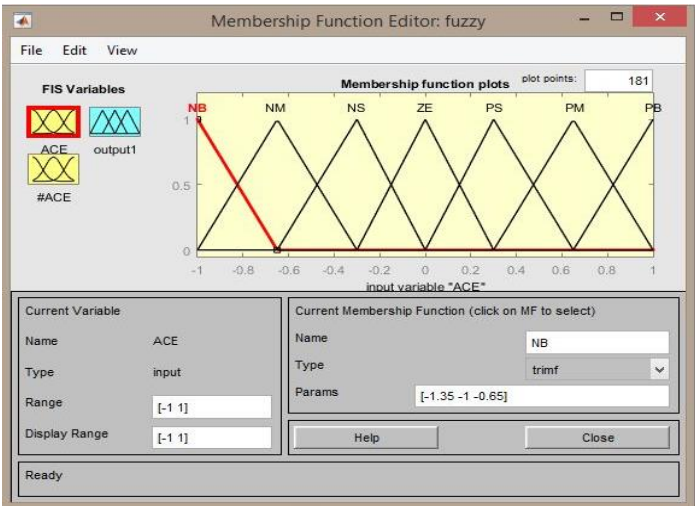


Figure 7. Membership functions of ACE.

The membership functions of ΔACE (ΔACE represents the change in Area Control Error) in a Fuzzy Logic Controller (FLC) are used to convert the rate of change in ACE values into fuzzy linguistic terms as shown in Figure 8. These membership functions help in fuzzifying ΔACE, allowing the FLC to work with linguistic variables to capture how fast the ACE is changing.

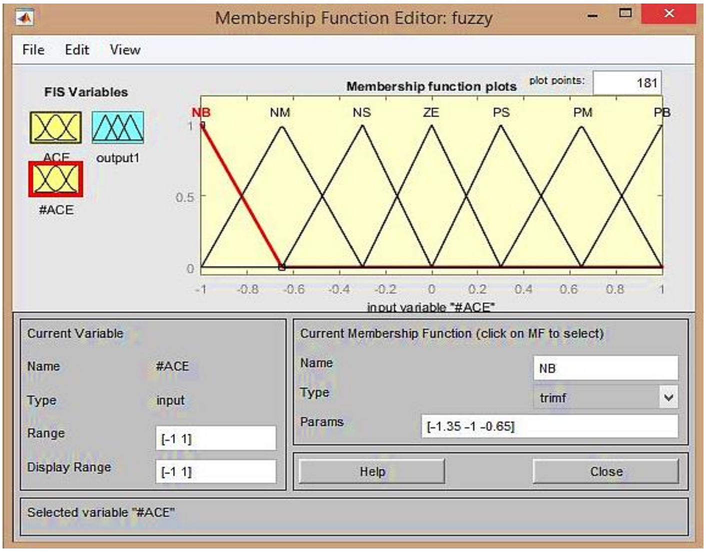


Figure 8. Membership functions of ΔACE

Triangular or trapezoidal, with the left side approaching 1 and the right side approaching 0. ΔACE is decreasing rapidly, indicating a significant decrease in the rate of change of ACE. Triangular or trapezoidal, peaking in the middle of the range. ΔACE is decreasing at a moderate rate, suggesting a moderate decrease in the rate of change of ACE. Triangular or trapezoidal, with the left side approaching 0 and the right side approaching 1. ΔACE is decreasing slowly, indicating a slight decrease in the rate of change of ACE. A narrow triangular peak centered at zero ΔACE. ΔACE is very close to zero, signifying that the rate of change in ACE is minimal. Triangular or trapezoidal, with the left side approaching 0 and the right side approaching 1. ΔACE is increasing slowly, indicating a slight increase in the rate of change of ACE. Triangular or trapezoidal, peaking in the middle of the range. ΔACE is increasing at a moderate rate, suggesting a moderate increase in the rate of change of ACE. Triangular or trapezoidal, with the left side approaching 1 and the right side approaching 0. ΔACE is increasing rapidly, indicating a significant increase in the rate of change of ACE. These membership functions allow the FLC to assign degrees of membership to each linguistic term based on the rate of change in ΔACE. These degrees of membership are then used in the fuzzy rule base to determine the appropriate control actions to regulate the power system based on how fast ACE is changing. The fuzzy logic controller leverages these linguistic terms and their associated membership functions to make control decisions that aim to stabilize the power system by responding to changes in ACE in a timely and effective manner.

Membership functions for the output of a Fuzzy Logic Controller (FLC) are pivotal in transforming the FLC's fuzzy output into meaningful linguistic terms. These membership functions serve as a bridge between numerical control signals and human-understandable interpretations. Common linguistic terms like "Low" (LO), "Medium" (MD), and "High" (HI) are associated with corresponding membership functions that depict the degree to which the control action aligns with each linguistic term as shown in Figure 9.

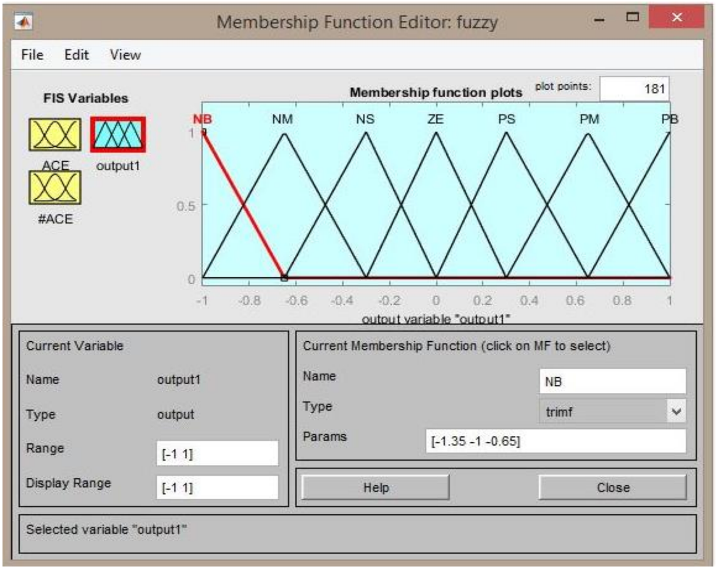


Figure 9. Membership functions of Output

This approach enhances the FLC's interpretability and adaptability, allowing control decisions to be made in a more intuitive and context-aware manner. By assigning degrees of membership to each linguistic term based on the fuzzy output's proximity to these membership functions, the FLC provides actionable insights and guides control actions effectively in a wide range of applications, contributing to optimized system performance and reliability.

3.2 Frequency Deviation Step Response with FLC Controller

From Figure 10 it is observed that the responses of steady state frequency deviation are zero, and the frequency returns to its nominal value in approximately 8.5 seconds. Here we can see that the oscillation is getting lower. So, we can say that using the controller has reduced the amount of oscillation and the responses became steady state.

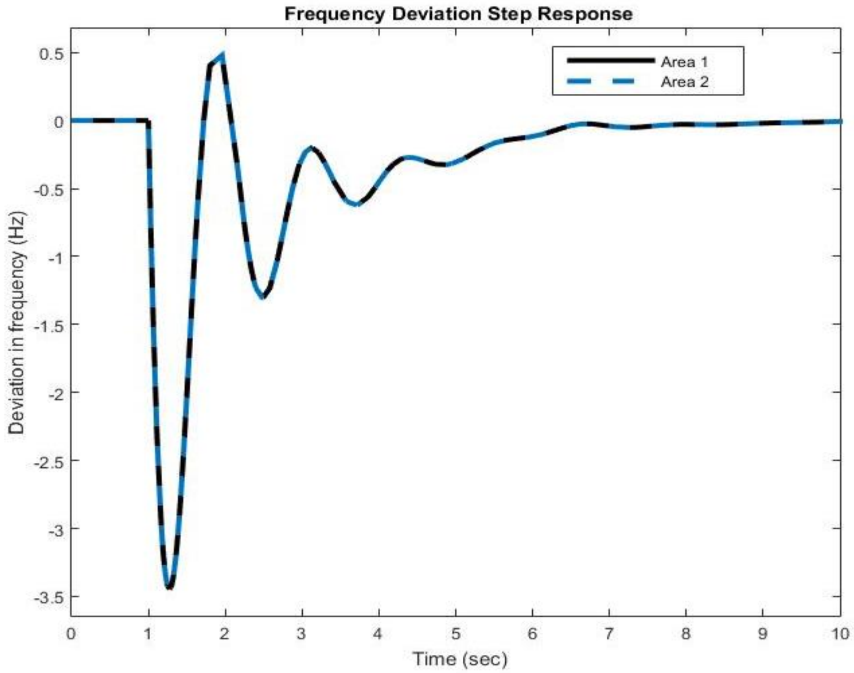


Figure 10. Frequency Deviation Step Response with FLC Controller

The system dynamic performance is observed for two different controller structures, PID and Fuzzy controller. The simulation results are shown in Table (1-2) in this study. All-purpose there are two situations where Compensation is essential. The first case is when the system is unstable. The second case is when the system is stable but the settling time is to reach faster. When no controller use, there are less overshoot and undershoot but the system is unstable. Later when we use PID controller overshoot and undershoot is more but after 9.5 sec, the system is stable. When we use Fuzzy Logic Controller, the oscillation is getting lower. Overshoot and undershoot is decreases. As seen from Table 1 & 2, we can conclude that Fuzzy Logic Controller provide better performance and response than PID.

4. Conclusion

In this paper work LFC problem related to two-area power systems is studied for uncontrolled situation and then with the application of the PID and FLC controller using MATLAB SIMULINK. In two-area power system, PID and FLC controller is used in both the areas to overcome system's steady state frequency errors and thereby enhancing system's dynamic performance. In this report, PID and FLC controllers in a two-area power system have been designed and implemented. The system performance was tested through both static and dynamic characteristics. When we used PID, the frequency deviation response displayed a drop in the frequency of both systems for a few seconds before the deviation was recovered to exactly zero error. Nevertheless, the dynamic response exposed an undershoot along with oscillations. Next, after using FLC to the system, steady state was reached in a less time range and the oscillations were eliminated. Up till now, the steady state error was not completely eliminated.

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