

# Comparative Analysis of Disturbance Observer, Active Disturbance Rejection Controller, and Fuzzy Logic Controllers for Load Frequency Control

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## Abstract

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### Abstract:

Load Frequency Control (LFC) is essential for maintaining the stability and reliability of modern power systems by regulating system frequency and tie-line power flow under varying load conditions. This paper presents a comparative analysis of three advanced control strategies—Disturbance Observer (DOB), Active Disturbance Rejection Control (ADRC), and Fuzzy Logic Controller (FLC)—implemented in a single-area LFC system. The DOB approach enhances system robustness by accurately estimating and compensating for external disturbances in real time. ADRC improves dynamic performance through its Extended State Observer (ESO), which effectively rejects total disturbances and ensures rapid stabilization. Meanwhile, the FLC provides an intelligent, model-free control mechanism capable of handling nonlinearities and uncertainties within the system. Simulation results demonstrate that all three advanced controllers achieve excellent frequency regulation and improved transient performance. Among them, the DOB-based controller attains the lowest settling time and minimal overshoot, confirming its superior robustness and response speed. Overall, the findings indicate that the DOB offers the most effective and balanced solution for Load Frequency Control applications, while ADRC and FLC exhibit notable advantages in adaptability and dynamic performance.

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