

Power Quality Improvement in Micro Grid System Using Fuzzy-UPQC Controller

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Abstract: *This research proposes a micro grid based on a single stage converter to reduce the number of converters in a single ac or dc grid. Microgrids, characterized the ability to operate in both grid-connected and islanded modes has made devices an essential element for integrating renewable energy sources and enhancing local energy resilience. However, Issues with the intermittent nature of renewable energy sources like solar and wind creates power quality issues such voltage sags, swells, harmonics, and flickers. To deal with these challenges, this research proposes a new book approach for using power quality in microgrid systems using a fuzzy logic-based Unified Power Quality Conditioner (Fuzzy-UPQC) controller. The power system experienced distortions as a result of either non-linear load utilisation or variations in load. The Fuzzy-UPQC integrates to simultaneously reduce voltage and current disturbances, utilise a shunt and series converters. By reducing the output power aberrations, fuzzy logic controllers and the conventional proportional integral (PI) are used to improve power quality.*

known for their ability to handle nonlinearities and uncertainties, enable the UPQC to adjust dynamically its operation based on data received in real time from the microgrid, ensuring optimal performance even under fluctuating load and generation conditions. Simulation results demonstrate that the Fuzzy-UPQC controller effectively improves voltage stability and reduces harmonic distortion in a microgrid environment. The proposed system also shows robust performance in compensating for transient disturbances, making it a viable solution for improve the modern microgrid's electricity quality applications. Its study highlights the potential of fuzzy logic-based control systems in improving the reliability and efficiency of microgrids, paving the path for more sustainable and resilient energy systems..

Keywords: Microgrid, The Power Quality, Fuzzy Logic, Unified Power Quality Conditioner (UPQC), Renewable Energy, Voltage Stability, Harmonic Distortion.

