

## Synchronous Reference Frame and Instantaneous P-Q Theory Based Control of Unified Power Quality Conditioner for Power Quality Improvement of Distribution System

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**Abstract :** Context: The paper explores the use of synchronous reference frame theory (SRFT) and instantaneous reactive power theory (IRPT) based control of Unified Power Quality Conditioner (UPQC) for improving power quality in distribution systems. Research Aim: To investigate the performance of different control configurations of UPQC using SRFT and IRPT for mitigating power quality issues in distribution systems. Methodology: The study compares three control techniques (SRFT-IRPT, SRFT-SRFT, IRPT-IRPT) implemented in series and shunt active filters of UPQC. Data is collected under various control algorithms to analyze UPQC performance. Findings: Results indicate the effectiveness of SRFT and IRPT based control techniques in addressing power quality problems such as voltage sags, swells, unbalance, harmonics, and current harmonics in distribution systems. Theoretical Importance: The study provides insights into the application of SRFT and IRPT in improving power quality, specifically in mitigating unbalanced voltage sags, where conventional methods fall short. Data Collection: Data is collected under various control algorithms using simulation in MATLAB Simulink and real-time operation executed with experimental results obtained using RT-LAB. Analysis Procedures: Performance analysis of UPQC under different control algorithms is conducted to evaluate the effectiveness of SRFT and IRPT based control techniques in mitigating power quality issues. Questions Addressed: How do SRFT and IRPT based control techniques compare in improving power quality in distribution systems? What is the impact of using different control configurations on the performance of UPQC? Conclusion: The study demonstrates the efficacy of SRFT and IRPT based control of UPQC in mitigating power quality issues in distribution systems, highlighting their potential for enhancing voltage and current quality.

**Keywords :** power quality, UPQC, shunt active filter, series active filter, non-linear load, RT-LAB, MATLAB

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