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OPTIMIZED PHOTOVOLTAIC-DYNAMIC VOLTAGE RESTORER (PV-DVR) SYSTEM FOR POWER QUALITY ADVANCEMENT IN GRID

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Abstract

The increasing penetration of power electronics in modern electrical systems has introduced significant power quality (PQ) issues, notably voltage sags, swells, flickers, and harmonics. These disturbances not only threaten grid stability but also result in energy inefficiencies and increased environmental burdens due to system losses. To address these challenges sustainably, this study presents an optimized Dynamic Voltage Restorer (DVR) topology powered by a photovoltaic (PV) system, offering a dual benefit: effective PQ enhancement and integration of clean, renewable energy. The proposed DVR employs a seven-level inverter with a reduced switch count to minimize component usage and switching losses. A Proportional-Integral (PI) controller is used for real-time regulation, and the system's response is evaluated under multiple fault conditions through MATLAB simulations. Results confirm superior voltage sag compensation, harmonic suppression, and power efficiency. The integration of PV not only reduces dependence on conventional grid sources but also contributes to a greener energy infrastructure, aligning power quality solutions with environmental sustainability goals.

Key words: dynamic voltage restorer, environmental sustainability, multilevel inverter, photovoltaic system, power quality

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