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A Comprehensive Review of Fault Detection Techniques in Induction Motors: Fast Fourier Transform and Discrete Wavelet Transform Approaches

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Abstract: *Induction motors constitute the backbone of industrial automation, accounting for approximately 70% of industrial electricity consumption worldwide. The reliable operation of these motors is critical for maintaining production efficiency and preventing catastrophic failures. This comprehensive review examines fault detection techniques in induction motors, with particular emphasis on Fast Fourier Transform (FFT) and Discrete Wavelet Transform (DWT) approaches. We analyze the theoretical foundations, implementation methodologies, comparative advantages, and practical applications of these signal processing techniques for detecting bearing faults, stator winding faults, rotor bar defects, eccentricity issues, and other common failure modes. The paper synthesizes findings from 50 peer-reviewed sources, highlighting recent advances in hybrid approaches that combine FFT and DWT with machine learning algorithms. Our analysis reveals that while FFT excels in steady-state frequency domain analysis, DWT provides superior performance for transient and non-stationary fault signatures. The review concludes with recommendations for practitioners and identifies promising directions for future research in intelligent fault diagnosis systems*

Keywords: Induction motors, fault detection, Fast Fourier Transform, Discrete Wavelet Transform, condition monitoring, predictive maintenance, signal processing