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Utilizing Temporal and Frequency Features in Fault Detection of Electric Motor Bearings with Advanced Methods

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Abstract : The development of advanced technologies in the field of signal processing and vibration analysis has enabled more accurate analysis and fault detection in electrical systems. This research investigates the application of temporal and frequency features in detecting faults in electric motor bearings, aiming to enhance fault detection accuracy and prevent unexpected failures. The use of methods such as deep learning algorithms and neural networks in this process can yield better results. The main objective of this research is to evaluate the efficiency and accuracy of methods based on temporal and frequency features in identifying faults in electric motor bearings to prevent sudden breakdowns and operational issues. Additionally, the feasibility of using techniques such as machine learning and optimization algorithms to improve the fault detection process is also considered. This research employed an experimental method and random sampling. Vibration signals were collected from electric motors under normal and faulty conditions. After standardizing the data, temporal and frequency features were extracted. These features were then analyzed using statistical methods such as analysis of variance (ANOVA) and t-tests, as well as machine learning algorithms like artificial neural networks and support vector machines (SVM). The results showed that using temporal and frequency features significantly improves the accuracy of fault detection in electric motor bearings. ANOVA indicated significant differences between normal and faulty signals. Additionally, t-tests confirmed statistically significant differences between the features extracted from normal and faulty signals. Machine learning algorithms such as neural networks and SVM also significantly increased detection accuracy, demonstrating high effectiveness in timely and accurate fault detection. This study demonstrates that using temporal and frequency features combined with machine learning algorithms can serve as an effective tool for detecting faults in electric motor bearings. This approach not only enhances fault detection accuracy but also simplifies and streamlines the detection process. However, challenges such as data standardization and the cost of implementing advanced monitoring systems must also be considered. Utilizing temporal and frequency features in fault detection of electric motor bearings, along with advanced machine learning methods, offers an effective solution for preventing failures and ensuring the operational health of electric motors. Given the promising results of this research, it is recommended that this technology be more widely adopted in industrial maintenance processes.

Keywords : electric motor, fault detection, frequency features, temporal features
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