Public Abstract
First Name:Kaptan
Middle Name:
Last Name:Teotrakool
Adviser's First Name:Michael
Adviser's Last Name:Devaney
Co-Adviser's First Name:
Co-Adviser's Last Name:
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Adjustable Speed Drives (ASD's) are increasingly used for process control and energy conservation in many commercial and industrial applications. Like other electrical rotating machines, a major cause of ASD failures is bearing failures. Though bearings are very inexpensive to replace, their problems are among the most difficult to detect. This dissertation presents a novel method to detect bearing defects in ASDâ€™s.

Motor current signature analysis is a non-intrusive machine condition monitoring method. It analyzes changes in the motor stator currents using frequency spectral analysis. The method relies on wavelet packet decomposition due to the non-stationary nature of ASD loads, which affect both current and speed.

Most modern ASD systems accomplish their variable speed by utilizing pulse-width-modulation (PWM) inverters to vary the fundamental frequency of the input voltage waveforms to their motors. Since the input voltage is PWM, it contains a significant number of harmonic components. When these harmonics are modulated by the mechanical bearing frequencies, more harmonics are introduced. As a result of this modulation, a substantial number of additional frequencies are introduced into the current waveform. In addition, the ASD elevates the level of EMI noise and further complicates the detection of the defective bearing frequency components. Thus, detecting bearing problems by simply comparing the rms values of the wavelet packet coefficients of those frequencies is not feasible.

The proposed method combines MSCA, wavelet packet decomposition, a genetic algorithm, and a support vector machine to accomplish bearing fault detection in adjustable speed drives. The Support Vector Machine (SVM) in conjunction with the Genetic Algorithm (GA) is applied to the rms values of the wavelet packet coefficients to obtain optimal classifiers for classifying both healthy and defective bearings in ASD systems. The SVM is a method to find an optimal classifier for both linearly separable and linearly non-separable data. For linearly non-separable data, the SVM maps the data into higher dimensions before finding a classifier. With the SVM, a classifier for high-dimensional wavelet packet current data can be obtained. The GA works to select significant frequency bands and eliminates those less relevant. The SVM, using selected frequency bands from the wavelet packet decomposition, can find a classifier that can separate healthy and defective bearings more effectively.