

Abstract

An Investigation into the Use of the Wavelet Transforms and the Fast Fourier Transform for Vibration-based Fault Detection and Isolation of Turbo-Machines

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Many techniques have been developed to monitor the working condition of turbo-machines and to detect and diagnose the occurrence of faults. Despite this, there remains some difficulty in obtaining the information necessary to diagnose some types of machine faults. Research has indicated that this is a consequence of the mathematical techniques utilised in the analysis procedure. The most commonly used techniques are based on the well-known Fourier methods and the more recent Wavelet methods, each having features and advantages characteristic of its approach.

This thesis sought to investigate how these differences would affect the analysis capabilities of each method by comparing them over a series of different types of experiments designed to test their responses to varying configurations of local machine faults. These included tests of transient signal responses for various local faults, analysis of operational frequency response magnitudes of steady state signals for varying positions of a rotating unbalance and the analysis of transient signal responses for variations in frequency arrival time and frequency value of a

system's operational and natural frequencies for varying positions of an unbalance. The most significant findings of these investigations showed that there is a relationship between the frequency value of a system's natural frequencies and the position of an unbalance in the system, based on a discrete vibration model of the system. This knowledge was used to develop a generic FDI approach called the Added Mass Method, which allows one to approximate the position of an unbalance in a machine and which could be adapted for use in different types of machines.

Keywords: Renique Murray; Turbo/rotating machines; Wavelet transforms; Fourier transforms; Fault detection and isolation.