Florence, Italy 12-16 July 2015
ICSV22
The 22nd International Congress on Sound and Vibration

DIAGNOSIS OF TWISTED BLADE IN ROTOR SYSTEM

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This paper studies the diagnosis of twisted blade in a multi-stages rotor system using vibration analysis. Experimental study was undertaken to simulate twisted blade conditions in a three stages rotor system. The feasibility of vibration analysis as the technique to detect twisted blade was investigated in this study. Vibration signals were analyzed with both Fourier and Wavelet transforms for comparison purposes. Experimental results showed that twisted blade can be detected by comparing the pattern in both the vibration spectrum and wavelet map. The feasibility and effectiveness of wavelet analysis as compared to vibration spectrum to detect twisted blade was also discussed and presented in this paper.

1. Introduction

For decades, blade faults and blade related failures are major causes of concern for turbo machinery operators in the industry. Over the years, researches on the characteristics of blade faults and the specific techniques to diagnose various types of blade faults (e.g. blade rubbing, blade fatigue failure, blade deformation, blade fouling and loose blade) have been widely available in the open literatures. A summary and literature review on this subject has been published by the present Authors [1]. Techniques commonly used for blade faults detection and diagnosis are such as vibration analysis, pressure analysis, temperature analysis, acoustic analysis, among others. Among all these techniques, the most widely deployed method in the industry for blade faults diagnosis is still the vibration spectrum analysis. Classical papers in blade fault detection by Simmons [2,3] and Parge et al. [4] found that the relative change in blade passing frequency (BPF) and its harmonic amplitude in the vibration spectrum could be used to detect severe blade rubbing and blade deformation. It was however, minute blade deformation and early blade faults could not be easily detected due to its subtle effect on the machinery vibration signal. Kuo [5] applied artificial neural network (ANN) and fuzzy logic for turbine blade faults diagnosis. He proposed an algorithm to extract feature from vibration spectrum as the inputs for ANN. The present Authors, Lim et al. [6, 7] proposed various methods to improve the vibration analysis techniques for blade rubbing detection in a single stage rotor system. It was found that the severity of rubbing and the position of the rubbed blade in the rotor could be reasonably estimated based on the magnitude and pattern of the vibration spectrum.