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Design and development of a modular vibration test rig for combination types of fault in rotating machinery health diagnosis

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ABSTRACT

As a basis to real application of rotating machineries operation, a test rig imitating the operation is designed for the research environment. The purpose of this study is to design a modular test rig which is able to facilitate different fault component combinations and evaluate the deformation pattern of the fabricated test rig. Rotating machineries face the probability of having simultaneous different faults and the study of this condition is limited. The designed test rig could be arranged into multiple configurations by adding or excluding desired components due to its modularity. This will be useful to study the response of each component during operation as well as the response of combinations of fault components. Included in this study is the analysis of the design where the maximum possible operating condition at 60Hz speed was considered. The final test rig design was included as well as the experimental displacement data results of the fabricated test rig showing 17.5% measurements to exceed 1mm displacement. This test rig is beneficial for understanding the vibrational behavior of components and is designed for educational environment.

Keywords: Rotating machine; vibration test rig; fault diagnosis; modular.

INTRODUCTION

All systems possess their own natural frequency in which, if fault frequency coincides with the natural frequency of the system, resonance occur [1]. This phenomenon leads to disastrous event if left unattended. Health conditions of the components specifically in rotating machines systems can be attained through condition monitoring. Periodic condition monitoring of machineries is widely used to help schedule efficient maintenance as well as early fault detection [2]. It is able to determine the reliability of machineries, prolong their life expectancy, reduce maintenance costs while assuring safe operation of critical machines [3].

The vital components of machines need to be well investigated. Rotating machine includes fundamental components such as bearings, gears, shafts, rotor, etc. All these components are prone to defect throughout their operation. Several common types of faults in rotating machineries include bearing fault, gear fault, misalignment and imbalance fault