J Fail. Anal. and Preven.
DOI 10.1007/s11668-016-0080-7

TECHNICAL ARTICLE—PEER-REVIEWED

A Comparative Study of Various Methods of Bearing Faults Diagnosis Using the Case Western Reserve University Data

Adel Boudiaf · Abdelkrim Moussaoui · Amine Dahane · Issam Atoui

Submitted: 7 December 2015

Abstract Bearing is probably one of the most critical components of rotating machinery. They are employed to guide and support the shafts in rotating machinery. Therefore, any fault in the bearings can lead to losses on the level of production and equipments as well as potentially unsafe. For these reasons, the bearing fault diagnosis has received considerable attention from the research and engineering communities in recent years. The purpose of this study is to review the vibration analysis techniques and to explore their capabilities, advantages, and disadvantage in monitoring rolling element bearings.

Keywords Vibration analysis · Bearing fault diagnosis · Temporal analysis · Cepstrum analysis · Envelope analysis · Wavelet transform

Introduction

Nowadays, rotating machines and particularly induction motors present an important role in industrial systems and are probably one of the most critical equipments in many industrial applications such as petrochemical plants, aviation, chemical, and domestic appliances industries. These rotating machines are composed of several elements such as stator, rotor, shaft, and bearings. The bearings are the most important mechanical elements of rotating machinery. They are employed to guide and support the shafts in rotating machinery. On the other hand, several studies showed that the major source of most mechanical faults in rotating machinery is the bearing fault [1–3]. Therefore, any fault in the bearings can lead to losses on the level of production and equipments as well as potentially unsafe. For these reasons, condition monitoring and fault diagnosis of these bearings have become a fundamental axis of development and industrial research. The mechanical vibration signal is one of the most effective and rich sources of information for understanding phenomena related to bearing defects (BDs).

The main function of condition monitoring is to provide knowledge about the real working condition of the machinery at each moment without stopping the production line. This allows avoidance of the production losses and improves the availability and safety [4]. Recently, there have been many techniques which can be used to monitor the bearing health like noise monitoring, temperature monitoring, current monitoring, and vibration monitoring. [5–7], but the most effective technique of them all is the vibration monitoring. Because among the advantages of vibration monitoring is the ability to detect, locate, and distinguish different types of faults since its inception before they become critical and dangerous, these faults may be distributed or localized [8].

The work methodology of vibration monitoring of rotary machinery consists of a sensor which sends the fault signal to a data acquisition system which is connected to a computer [9]. However, the effectiveness of the vibration monitoring depends on the effectiveness of the applied

A. Boudiaf (✉) · A. Moussaoui
Laboratory of Electrical Engineering of Guelma (LGEG), University 8 May 1945 Guelma, P.O. Box 401, 24000 Guelma, Algeria
e-mail: a.boudiaf@csc.dz

A. Boudiaf · I. Atoui
The Research Center in Industrial Technologies, CRTI, P.O. Box 64, Cheraga, 16014 Algiers, Algeria

A. Dahane
Intelligent Systems Research Laboratory, University of Sciences and Technology, Oran, Algeria

Published online: 18 February 2016