Electric Power Systems Research 80 (2010) 915–924

Contents lists available at ScienceDirect

Electric Power Systems Research

journal homepage: www.elsevier.com/locate/epsr

Wavelet and PDD as fault detection techniques

J. Cusidó*, L. Romeral, J.A. Ortega, A. Garcia, J.R. Riba

MCIA Research Group, Universitat Politècnica de Catalunya, C/Colom 1, 08222 Terrassa, Catalunya, Spain

ARTICLE INFO

Article history:
Received 28 July 2008
Received in revised form
22 September 2009
Accepted 31 December 2009

Keywords:
Rotating machinery
Current analysis
Fault detection
Signal processing
Wavelet transform

ABSTRACT

Motor current signature analysis has been successfully used for fault diagnosis in induction machines. However, this method does not always achieve good results with variable load torque. This paper proposes a different signal processing method, which combines wavelet and power spectral density techniques giving the power detail density as a fault factor. The method shows good theoretical and experimental results.

1. Introduction

Induction motor is the most common way to convert electrical power to mechanical power in the industry. Typically the induction machines were considered as a robust machines, however these conception began to change on finals of last decade since low cost motor appear in the market. Nowadays the typical used induction motor in the industry is a machine which works in the border of them mechanical and physical properties. To ensure the proper behavior in operation a good diagnosis system is mandatory.

The history of fault diagnosis and protection is as outdated as the machines themselves. The manufacturers and users of electrical machines initially relied on simple protection against, for instance, overcurrent, overvoltage, earth-fault ... to ensure safe and reliable operation. However as the tasks performed by these machines became more complex, improvements were also sought in the field of fault diagnosis. It has now become very important to diagnose faults at their very inception; as unscheduled machine downtime can upset deadlines and cause large financial losses.

The major faults of electrical machines can broadly be classified as follows:

Electrical faults [1]:

1. Stator faults resulting in the opening or shorting of one or more stator windings;
2. Abnormal connection of the stator windings

Mechanical faults:

3. Broken rotor bars or rotor end-rings;
4. Static and/or dynamic air-gap irregularities;
5. Bent shaft (similar to dynamic eccentricity) which can result in frictions between the rotor and the stator, causing serious damage to the stator core and the windings;
6. Bearing and gearbox failures.

However, as is introduced in the basic bibliography by Devaney in 2004 [2], the effect of bearing faults is in most cases similar to eccentricities and has the same effects on the motor.

The operation under faults generates at least one of the following symptoms:

1. Unbalanced air-gap voltages and line currents
2. Increased torque pulsations
3. Decreased average torque
4. Increase in losses and decrease in efficiency
5. Excessive heating
6. Appearance of vibrations

For the purpose of detecting such fault-related signals, many diagnostic methods have been developed so far. These methods of identifying the above faults come from different types and areas

* Corresponding author at: Electronic Engineering Dept., UPC, Campus Terrassa, C/Colom 1, 08222 Terrassa, Barcelona, Catalunya, Spain. Tel.: +34 93 739 81 94; fax: +34 93 739 8016.
E-mail address: jcusido@eel.upc.edu (J. Cusidó).

0378-7796/$ – see front matter © 2010 Elsevier B.V. All rights reserved.
doi:10.1016/j.epsr.2009.12.017