Available online at www.sciencedirect.com

SciVerse ScienceDirect

Procedia Engineering 16 (2011) 18 – 26

Procedia Engineering

www.elsevier.com/locate/procedia

International Workshop on Automobile, Power and Energy Engineering

Fault Diagnosis of Motor Bearing Based on the Bayesian Network

Zhongxing Li[a], Jingjing Zhu[a*], Xufeng Shen[a], Cong Zhang[a], Jiwei Guo[a]

[a]*School of Automotive and Traffic Engineering, Jiangsu University*
Zhenjiang, Jiangsu, 212013, P.R.China

Abstract

On the basis of the analysis of vibration characteristics of motor bearing faults and the influence from testing noise on site, calculation of the symptom parameters representing the vibration signals according to the measured vibration signals is proposed, and the sensitivity analysis is carried out to these parameters which can refine effective symptom parameters. As there are limitations for motor bearing fault intelligent diagnosis methods based on genetic algorithm and neural network, while Bayesian network has a good learning, inference and astringency. Therefore, the effective combination of the symptom parameters and Bayesian network is made and a new intelligent diagnosis method is posed.

Key Words: Bayesian Network, fault diagnosis, symptom parameters

1. Introduction

The motor bearing fault diagnosis technology is a comprehensive technology containing a lot of new science and technology contents in the recent[1]. The fundamental principle is to distinguish whether the motor is in faults or runs well according to the various messages generated by the equipment as mechanic and electric in the course of operation. So it can be realized the function that after the detection and analysis of its state parameters, the existing of abnormal is made sure of, the position and cause of fault is

* Corresponding author. Tel.: +86-0-13862459252 .
E-mail address: zhujingjing@126.com .

1877-7058 © 2011 Published by Elsevier Ltd.
doi:10.1016/j.proeng.2011.08.1046

judged and the future state of motor is forecasted. All these take place in the situation that the motor is in load or without load[2].

Rolling bearing fault is one of the main faults of the motor. Statistics have shown that rolling bearing faults are about the 30%~40% of the total motor faults. The accurate diagnosis of rolling bearing faults can reduce or prevent the accidents[3]. The past bearing fault diagnosis methods such as genetic algorithm and artificial neural network are used to classify the faults effectively. But there are some deficiencies of them. When the scale of problem is large, the performance of genetic algorithm will become worse and time-consuming of the large amount of calculation; motor bearing fault diagnosis based on neural network may affect the results of judgment because it depends on the selection, excessive or inadequate training and slow convergence rate of neural network[4][5]. Therefore, a bearing fault diagnosis method based on Bayesian network is put up. Firstly, the effective parameters which are analyzed from the bearing fault are selected, these parameters are considered as input nodes of Bayesian networks, Secondly, the other nodes and their probability tables of net are set so that the Bayesian network would learn and infer. Finally, faults are determined by the probability of the output nodes of Bayesian network.

2. Selection and extraction of effective parameters of motor bearing faults

After measuring the vibration generated by the rolling bearing, the characteristics of vibration signals could be used to infer the state of rolling bearing. Then the symptom parameters are calculated from the vibration signal. Symptom parameters contain two kinds such as time-domain parameters and frequency-domain parameters. Faults can be judged in the light of symptom parameters with the knowledge of fault diagnosis. And parameters used by fault diagnosis can be divided into dimensional symptom parameters and non-dimensional symptom parameters.

Dimensional symptom parameter is a physical quantity with unit representing the signal amplitude of the average, the valid and the peak values of signals. Non-dimensional symptom parameter is a physical quantity without unit representing the signal size and shape of Skewness and Kurtosis used in statistics. Calculate the following dimensional symptom parameters and non-dimensional symptom parameters according to the measured time-domain signals $x_i(i = 1 \sim N)$.

2.1. The proposition of distinguishing index (DI)

It is evaluated to identify arbitrary characteristics parameter *p* of the two states according to the size of *DI* in the follow formula.

$$DI = \frac{|u_1 - u_2|}{\sqrt{\sigma_1^2 + \sigma_2^2}} \tag{1}$$

Here, u_1、 u_2 represent the average value correspond to the state 1 and state 2 of every *p* and σ_1 、 σ_2 represent the corresponding standard variance. The larger the size of *DI*, the higher the sensitivity of *p* to distinguish state 1 and state 2.

2.2. Derivation of DI

The obtained values of symptom parameter p based on the state 1 and state 2 are x_1 and x_2, respectively. And they follows the normal distribution $N(u_1, \sigma_1^2)$ and $N(u_2, \sigma_2^2)$, respectively. Since that if $|x_2 - x_1|$ becomes larger, the difference between state1 and state 2 will be more evident. So that $z = x_2 - x_1$