Fault diagnosis of rolling bearings using a genetic algorithm optimized neural network

Muhammet Unal, Mustafa Onat, Mustafa Demetgul, Haluk Kucuk

PII: S0263-2241(14)00360-1
DOI: http://dx.doi.org/10.1016/j.measurement.2014.08.041
Reference: MEASUR 2968

To appear in: *Measurement*

Received Date: 1 May 2014
Revised Date: 25 June 2014
Accepted Date: 20 August 2014

Please cite this article as: M. Unal, M. Onat, M. Demetgul, H. Kucuk, Fault diagnosis of rolling bearings using a genetic algorithm optimized neural network, *Measurement* (2014), doi: http://dx.doi.org/10.1016/j.measurement.2014.08.041

FAULT DIAGNOSIS OF ROLLING BEARINGS USING A GENETIC ALGORITHM OPTIMIZED NEURAL NETWORK

Muhammet UNAL [a], Mustafa ONAT [b], Mustafa DEMETGUL [c], Haluk KUCUK [c]

a) Department of Computer and Control Education, Technical Education Faculty, Marmara University, TURKEY
b) Department of Electrical and Electronics Engineering, Engineering Faculty, Marmara University, TURKEY
c) Department of Mechatronics Engineering, Technology Faculty, Marmara University, TURKEY
munal@marmara.edu.tr, monat@marmara.edu.tr, mdemetgul@marmara.edu.tr,

halukkucuk@marmara.edu.tr

Abstract

In rotary complex machines, collapse of a component may inexplicably occur usually accompanied by a noise or a disturbance emanating from other sources. Rolling bearings constitute a vital part in many rotational machines and the vibration generated by a faulty bearing easily affects the neighboring components. Continuous monitoring, fault diagnosis and predictive maintenance, is a crucial task to reduce the degree of damage and stopping time for a rotating machine. Analysis of fault-related vibration signal is a usual method for accurate diagnosis. Among the resonant demodulation techniques, a well-known resolution often used for fault diagnosis is envelope analysis. But, usually this method may not be adequate enough to indicate satisfactory results. It may require some auxiliary additional techniques. This study suggests some methods to extract features using envelope analysis accompanied by Hilbert Transform and Fast Fourier Transform. The proposed artificial neural network (ANN) based fault estimation algorithm was verified with experimental tests and promising results. Every test was initiated with a reference ANN architecture to avoid inappropriate classification during the evaluation of fitness value. Later, ANN model was modified using a genetic algorithm providing, an optimal skillful fast-reacting network architecture with improved classification results.

Key-Words: Rolling bearing, fault diagnostics, envelope detector, Hilbert Transform, Fast Fourier Transform artificial neural network, genetic algorithm, feed-forward algorithm,

1. Introduction

Rolling bearings are extensively used in moving or rotating parts of machinery. Bearing fault detection is still a classical problem in rotating machinery [1]. Bearing faults may cause personal injury, financial and time losses if the fault is not detected and diagnosed onset. Proper functioning or trouble-free operation of devices including rolling elements depends, to a great extent, on the smooth