ABSTRACT

This function of wavelet packet decomposition and the energy of each band to strike is achieved within the Labview module. Signal energy in different frequency bands within the change reflects a change in the operating state. Extract wavelet packet energy spectrum of each band, making it as a feature vector. Finally the fault are classified by SVM. The two Parameters, the kernel function parameters $g$ of radial machine support vector machine and penalty factor $C$ of the radial machine support vector machine, are optimally chosen, automatically and rapidly, by using the method of particle swarm algorithm, avoiding the blindness of artificial selection parameters. The Matlab program of support vector machines based on particle swarm optimization are made into COM components. Mixed programming, Labview call COM component, generated by the M file, is implemented, which is divorced from the MATLAB environment, making it good for expanding the function of Labview. The effectiveness, wavelet packet energy spectrum - PSOSVM model of the bearing fault diagnosis, is verified.

Keywords: COM Components, Fault Diagnosis, Labview, PSO, Support Vector Machine (SVM), Wavelet Packet Energy Spectrum

1. INTRODUCTION

Rolling bearing is one of the common components, most widely used in all kinds of rotating machinery. Its running state often affects the performance of the whole machine directly. According to the vibration signals of rolling bearing online real-time, monitoring the running state and fault diagnosis, is universal and effective. Wavelet packet for low and high frequency signals are decomposed, making it possible to extract accurate feature from non-stationary and transient signals, effectively reflect the time-frequency characteristics of the signal. SVM (Support Vector Machine, SVM) is a kind of novel Machine learning method based on statistical learning theory. It shows many unique advantages in solving the problems of the small sample, nonlinear and high dimensional pattern recognition, which make the fault diagnosis significant.

DOI: 10.4018/IJAPUC.2015070103
Generally make Labview and MATLAB mixed programming by using MATLAB Script node or the method to call the server of MATLAB ACTIVEX directly. Its essence is that making it sense that MATLAB functions are called indirectly in Labview by the communication between Labview and MATLAB SERVER. The disadvantage is that this method cannot be edited from the MATLAB environment. There is also a certain lack of operational efficiency and independent programming. In this paper, Labview calls the COM component generated from M files to achieve a mixed programming, which make it out of MATLAB environment and make up for the shortcomings of the above two methods.

2. THE PRINCIPLE OF WAVELET PACKET AND CALCULATE THE ENERGY SPECTRUM

2.1 The Principle of Wavelet Packet

The algorithm of Wavelet packet decomposition is

\[
\begin{align*}
    d_{k,j,2m} &= \sum_{n \in \mathbb{Z}} h_{n-2k} d_{n,j+1,m} \\
    d_{k,j,2m+1} &= \sum_{n \in \mathbb{Z}} h_{n-2k} d_{n,j+1,m},
\end{align*}
\]

Wavelet reconstruction algorithm is as follows:

\[
d_{k,j+1,m} = \sum_{n \in \mathbb{Z}} d_{n,j,2m} h_{k-2n} + \sum_{n \in \mathbb{Z}} d_{n,j,2m+1} g_{k-2n},
\]

Where \(d_{k,j,m}\) is said the first K coefficient of m-th sub-band, j-th layer of wavelet packet decomposition. With the above signal wavelet packet decomposition algorithm, when the layer of wavelet packet decomposition is N, we can obtain 2N sub-bands.

2.2 Distribution of Energy Based on Wavelet Packet Decomposition

The algorithm of wavelet packet energy distribution algorithm is as followings [6]:

1. Three-layer wavelet packet decomposition of vibration signal, get Wavelet packet coefficients from low to high frequency sub-bands 8 in layer 3.
2. Reconstruction of the wavelet coefficients. Extracting each sub-band range signal \(S_3^j\) (j = 0, 1, ..., 7).
3. Calculate the sub-band signal energy. \(S_3^j\) (j = 0, 1, ..., 7) represents the reconstructed signal of the third layer of each node, the corresponding energy \(E_3^j\) is the amplitude of the reconstructed signal \(E_3^j\) at discrete points.
4. Structural feature vectors. T eigenvectors constructed as follows:

\[
T = \begin{bmatrix}
    E_3^0, E_3^1, E_3^2, E_3^3, E_3^4, E_3^5, E_3^6, E_3^7
\end{bmatrix}.
\]
Related Content

Privacy Automation in Context-Aware Services
www.igi-global.com/chapter/privacy-automation-context-aware-services/7126?camid=4v1a

Mining Data Streams with Skewed Distribution based on Ensemble Method
www.igi-global.com/article/mining-data-streams-with-skewed-distribution-based-on-ensemble-method/79910?camid=4v1a
Beyond 3G Techniques of Orthogonal Frequency Division Multiplexing and Performance Analysis via Simulation
[www.igi-global.com/article/beyond-techniques-orthogonal-frequency-division/64313?camid=4v1a](www.igi-global.com/article/beyond-techniques-orthogonal-frequency-division/64313?camid=4v1a)

Ubiquitous and Pervasive Application Design
[www.igi-global.com/chapter/ubiquitous-pervasive-application-design/37787?camid=4v1a](www.igi-global.com/chapter/ubiquitous-pervasive-application-design/37787?camid=4v1a)