ANNALS of the ORADEA UNIVERSITY.
Fascicle of Management and Technological Engineering, Volume VII (XVII), 2008

HAMMER MILL'S NOISE ANALYZE USING NEURAL NETS

Mircea FENCHEA
Politehnica University of Timisoara, Mechatronics Department,
e-mail: mfenchea@yahoo.com

Keywords: rotating machines, frequency spectrum, neural nets

Abstract: Rotating machines such as hammer mill are the most important objects in his plant maintenance. Each abnormal vibration has its own characteristic feature in its frequency spectrum. The frequency spectrum of vibration signals is applied as inputs to the neural nets and the outputs shows the performances of the hammer mill's.

1. INTRODUCTION

There are necessary for checking hammer mill status regularly for draw conclusions on the technical state. In the time of function of hammer mill it is possible to appear some problems such as shocks, vibration, heat, friction, dusts, etc. For hammer mill, rotating shafts, unbalance, misalignment, shaft bending, are the common failure sources in the low frequency range. Bearing fault has vibration in the high frequency range. The vibration method is the most popular diagnosis methods for its economical and convenience reasons.

If a hammer mill has a fault component, the vibration signal contains some characteristics feature for this fault. The paper developing a diagnostic tool on the bases of the existence of faults, who has a spectrum of an abnormal vibration and this spectrum is used as inputs for neural network for diagnoses. I utilize for diagnoses of the Radial Basis Neural Network (RBNN).

2. RADIAL BASIS NEURAL NETWORK (RBNN).

The RBNN have two hidden layer by the shape y(x) where x Є R^n and y Є R. We can draw the model with two hidden layer:

$$f_j(x) = \sum_{i=1}^{10}\sum_{j=1}^{10} w_{ij} h_{ij}(x) \tag{1}$$

and the second hidden layer output

$$f_k(x) = \sum_{i=1}^{10}\sum_{j=1}^{10} w_{jk} h_{jk}(x) \tag{2}$$

where the first hidden layer to output weight w_{ij} and the second hidden layer to output weight $w_{jk.}$

The characteristic feature of RBNN is the radial nature of the hidden unit transfer functions, h_{ij} and h_{jk}, which depend only on the distance between the input x and the centre c_{ij} of each hidden unit, scaled by a metric R_j,

$$h_{ij}(x) = \varphi\left[\left(x - c_{ij}\right)^T R_j^{-1}\left(x - c_{ij}\right)\right] \tag{3}$$

and

$$h_{jk}(x) = \varphi\left[(x - c_{jk})^T R_j^{-1} (x - c_{jk})\right] \quad (4)$$

where φ is some function which is monotonic for non negative numbers. The distance between the computed value n and each value in the set of target values T is given by

$$T=\{1,2\} \quad (5)$$

where values 1 and 2 correspond to the training class and all other classes respectively. The class corresponding to the target value with the minimum distance is chosen.

Gaussian basis function so that the transfer functions can be written:

$$h_{jk}(x) = \exp\left(-\sum_{n=1}^{2} \frac{(x_n - c_{kn})^2}{r_{kn}^2}\right) \quad (6)$$

3. EXPERIMENTAL WORK

In the experimental investigation, an intelligent data acquisition, a microphone and PC was used, to collect the noise data during the two different hammer mills (with 24 hammers and 32 hammers). Also, feedforward neural network type is used to analyze engine noise. Fig. 1 shows schematic representation of neural network analyzer.

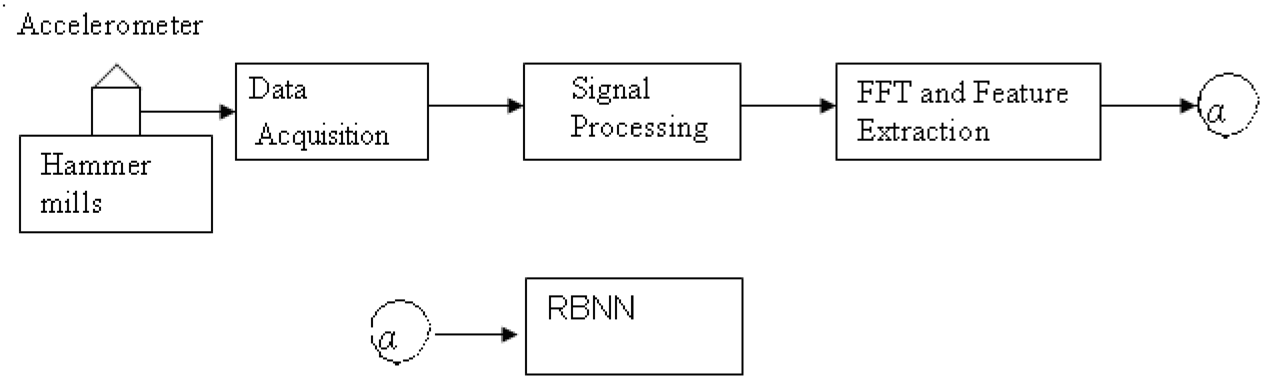
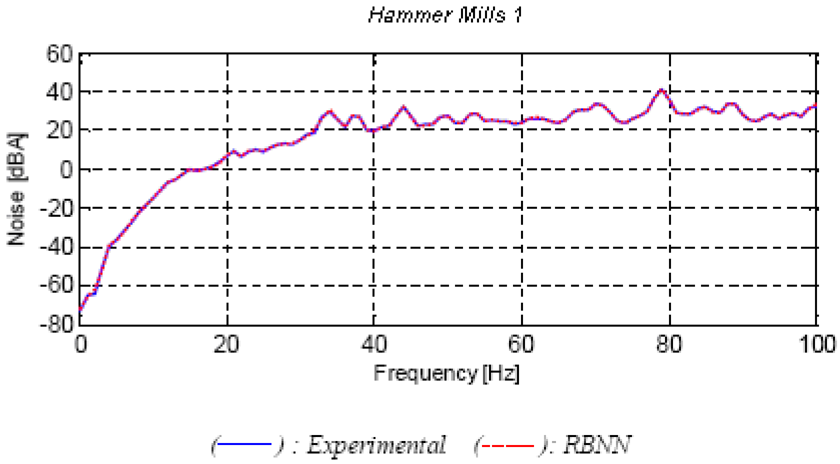


Fig. 1 Block diagram of diagnosis system



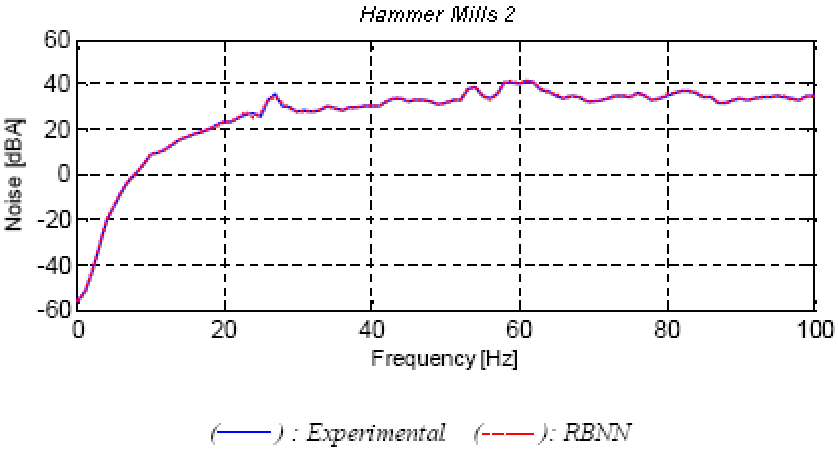


Fig. 2 Experimental and RBNN results for Hammer Mills with 24 hammers

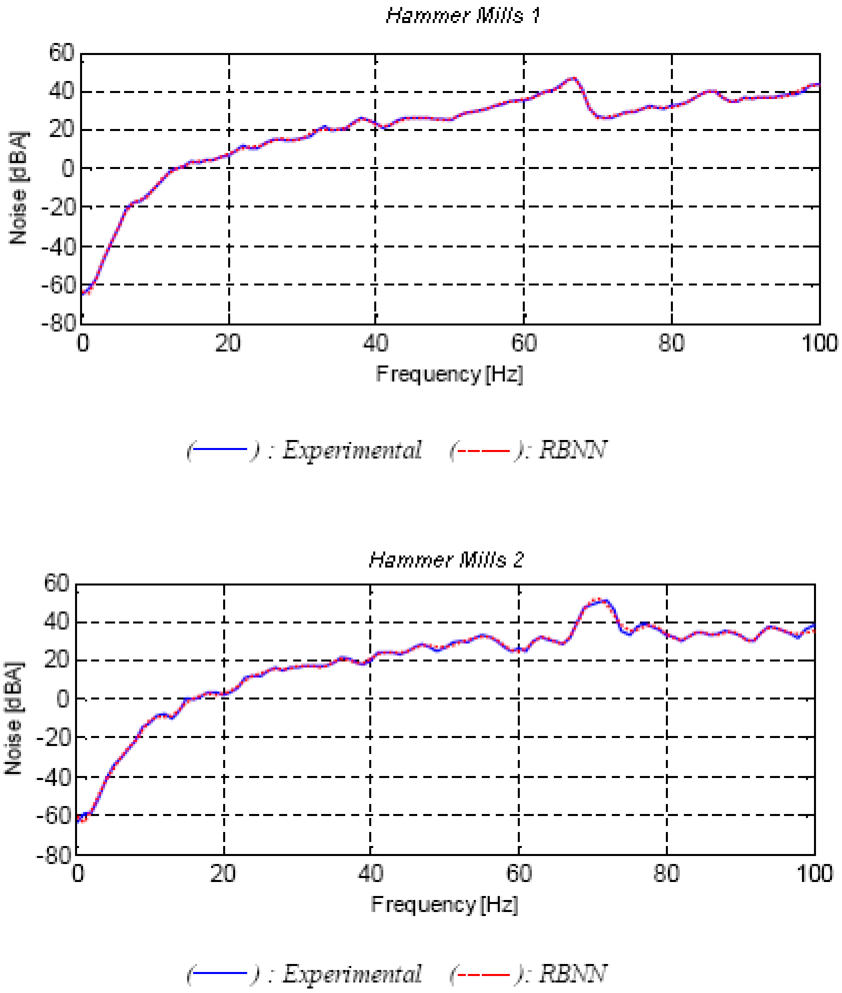


Fig. 3 Experimental and RBNN results for Hammer Mills with 32 hammers

2. CONCLUSIONS

This paper has presented a novel approach towards the development of a neural network predictor for analyzing noise of two hammer mills.

Figures 2 and 3 indicate the results of Radial Basis Neural Network (RBNN) approach for the case of two hammer mills with 24 hammers, respectively 32 hammers. It is clear to see from graphs, there are differences between experimental and neural network results for both cases and we could draw conclusions on the technical state depending of number of hammers which equipped the hammer mills.

References

[1] Hongbong K., (1995), *Object Recognition of One D.O.F. Tools by a Backpropagation Neural Network*, IEEE Trans. on Neural Networks, vol.6, no.2.
[2] Freeman J. A., Scapura D.M., (1991), *Neural networks, Algorithms, Applications and Programming Techniques*, Addison Wesley.
[3] Fenchea M., (2007), *Vibrodiagnosis of the Bent Shafts in the Mechanical Transmissions*, Romanian Academy, Institute of Solid Mechanics, SISOM 2007, Bucharest, 29-31 May.
[4] *** (1993), *DAS 1600, User's guide*, Keithley, Data Acquisition.