Research Paper

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Health Monitoring and Predictive Maintenance System Using Acoustic Emission and Vibration Analysis

Engineering

KEYWORDS : Acoustic Emission, VLSI Processor, Fault Identification

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ABSTRACT

Recently, research on effective Acoustic Emission based methods for condition monitoring and fault detection has attracted many researchers. Due to the complexity of acoustic signals properties, the effective features of fault detection cannot be easily extracted from the raw acoustic signals; such a problem is solved by utilizing VLSI process. This method depends on the variations in frequency to distinguish different operating conditions of a machine. The intension in this study is to categorize the acoustic signals into faulty andhealthyclasses. Acoustic emission signals are generated from four different motor in both healthy and faulty conditions and various load conditions. It is implemented and configured using an FPGA-PC. There are three approach available for this experiments 1. Acoustic signal Data acquisition 2.Statistical relation between healthy and unhealthy signal 3.Comparisons .

I. INTRODUCTION

Rapid automobile and much industry growthhas made engine and motor maintenance to be of great importance. Therefore, it seems necessary to development accurate condition monitoring and fault detection systems for both reducing maintenance cost and alerting the operator about the Machines operating condition before severe damages occur. Stress wave travels through the materials and is caused by sudden release of strain energy. This stress wave is called an Acoustic Emission (AE) wave [1]. AE as a non-destructive testing method has been widely used by a lot of researchers in many industries [2]. For instance, fault detection and condition monitoring of mechanicalcomponents such as gearboxes [3], engines [4] and bearings [5] and heavy motors have been the target of AE based methodologies.

As well as all the other tools available to the condition monitoring engineer; such as Vibration Analysis, Oil Analysis, Thermal Imaging etc [6]. MMS can also provide Acoustic Emission Testing as part of a predictive maintenance program.As in all machinery failures, when components impact, lubrication fails or friction increases, noise i.e. high frequency acoustics will be emitted [7]. Because of the surrounding high level of noise in industry Acoustic Emission Technology is ideally suited for fault detection [8].It has particular benefit when trying to detect faults on very slow speed machinery (0.25RPM) where vibration signatures may be difficult to measure and thermal imaging is not suitable due to low temperatures [9].

Acoustic Emission Testing is cheap, easy to use, non intrusive to personnel or production and excellent at plant monitoring of low speed equipment [10] such as: Rollers, Bearings, Conveyors, Gearbox Outputs Often used along side vibration analysis, acoustic emission testingis another simple but effective condition monitoring tool that aids essential predictive maintenance [11].

Physical Acoustics Corporation (PAC) has completed Phase I and Phase II contracts for an Electric Power and Research Institute (EPRI) Tailored Collaboration project. Through this project, REACT has developed the technology and procedures for testing power transformers with Acoustic Emission (AE) to detect, locate and assess thermal and electrical faults inside gassing units. AE signals from transformers have been classified (using PAC Neural Network software) into classes corresponding to four major failure types, Partial Discharge (PD), Thermal noises, Electrostatic Discharge (ED) and Mechanical Noises.

II. TECHNOLOGY

Acoustic Emission signal is process by using VLSI Technology because of reduced device size, reduced power dissipation and increases the operation speed. Here data analysis operations are done in FPGA. Here we are using ALTERA DE1 Fpga Board. It is shown in Figure (1).

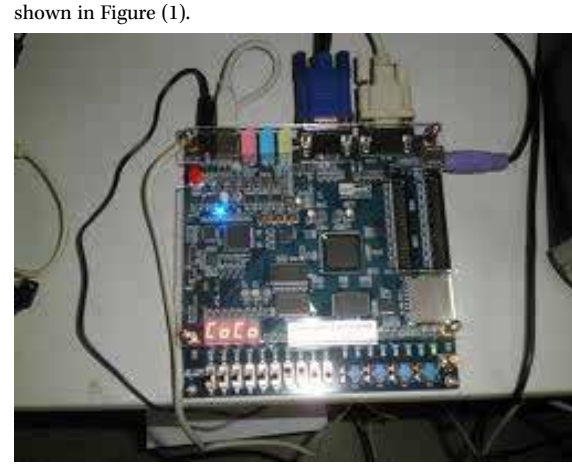

Figure 1. FPGA board

In this Reconfigurable Architecture main use are acoustic emission signal can access directly by this process and Sound can store in memory card.

III. METHODOLOGY

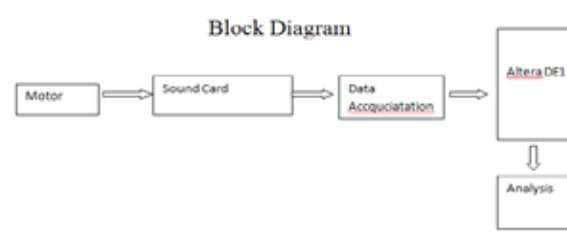

Figure 2. Block Diagram

From Figure(2) there are three approach are used for this project implementation. 1.Acoustic signal Data acquisition 2. Statistical relation between healthy and unhealthy signal 3.Analysis of signal.

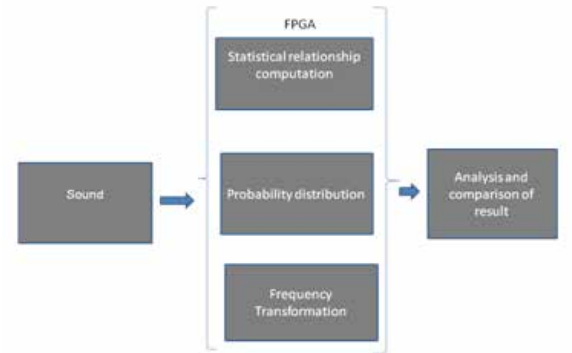

Figure 3. Xilinx Block Diagram

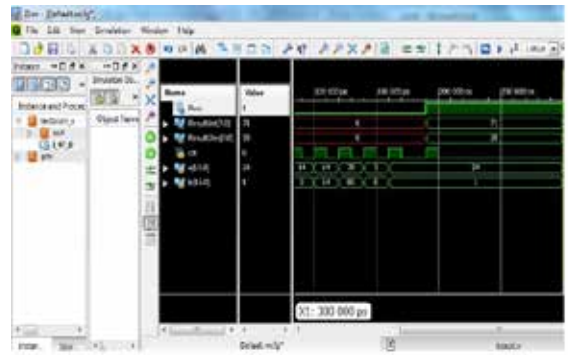

Figure 7. Experimental Result

IV. EXPERIMENT AND RESULT

The Figure (3) shows the algorithm using Xilinx. In this experiment I am taking Machineries acoustic emission signal by using SigviewSoftwre. It is nothing but Data Analysis software. PC can act as a CRO by using this Software. Generally sigview software is run by sound card. This connection is shown in Figure (4).

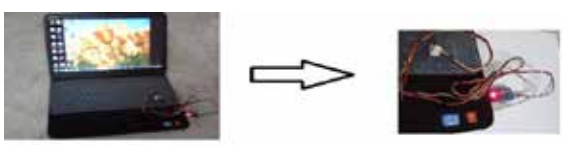

Figure 4. Sound card connection

Due to this process we measured different kinds of machineries running condition sound emission signal from various load and healthy Figure (5) and unhealthy condition signal Figure (6).

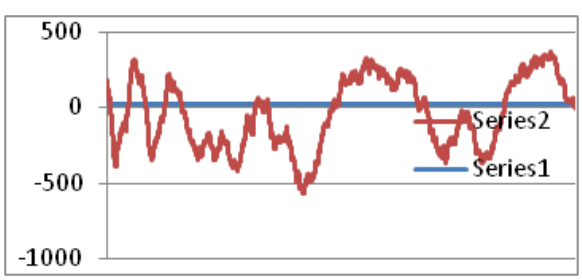

Figure 5. No load signal

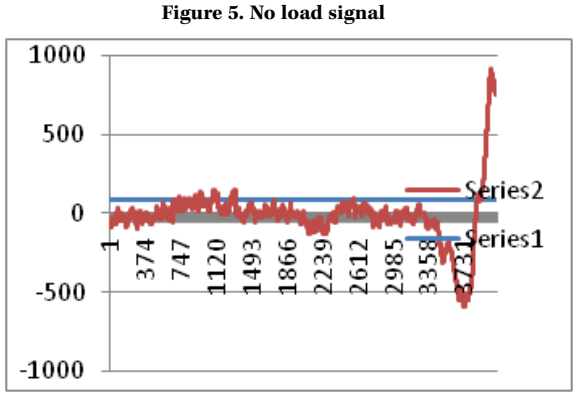

Figure 6. Full load Signal

We can compare number of different load value by graphical representation. Twenty value ASCII values compared by using with this method. 80% threshold value can be fixed.

From the experimental results Figure (7), correlation matching of signals more than 75% is suitable for differentiating the two sound signal. If the correlation percentage below 75% to 50% means the motor or machineries is faulty condition. Below 50% of correlation is heavy faulty condition or some equipment are faultier. Further the above classification of the correlation is obtained from 50 samples of sound emission signals.

V. CONCLUSIONS

This paper reports a work where AE signal analysis based on vlsi implementation is used to identify faulty combustion of an automobile engine and industries motor regardless of the type of automobile. Major noises are removed from the acoustic signals by listening to them. Methodology proposed in this paper is capable of dealing with the signals that contain environmental noises and are static during the recording time. For example, sound of a fan in operation. One can claim that the methodology used in this paper is suitable enough to be used for other types of automobile engines. Therefore, the proposed method proves to be automobile independent in its fault detection. The generalization capability of the proposed methodology is proven using only 10 percent of data for training and 80 percent for testing.

FUTURE WORK

Intention is to improve the classification results using more appropriate feature extraction and signal processing techniques. For example, using the time-frequency transforms to use both time and frequency characteristics of signals are in mind.

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REFERENCE

[1] Lavanya.G, Sneha Susan Abraham, Feb 2014, Modeling of maritime vehicles using gold coin codings technique and GPS, International Journal of Engineering Research and Applications, ISSN : 2248-9622, Vol. 4, Issue 2(Version 6), February 2014, pp.16-20 | | [2] E.J.A. Armarego, R.H. Brown, The Machining of Metals, Prentice-Hall Inc., | New Jersey, 1969. | | [3] M.Rahman, W.K.H. Seah, T.T. Teo, The machinability of Inconel 718, Journal ofMaterials Processing Technology 63 (1997) 199–204. | | [4] M.C. Shaw, Metal Cutting Principles, Oxford University Press, Oxford, 2005 | . | [5] E.M. Trent, Metal Cutting, second ed., Butterworths, London, 1984. | | [6] D.A. Axinte, P. Andrews, Some considerations on tool wear and work piece surface quality of holes finished by reaming or milling in a nickel base superalloy, Proceedings of the Institution of Mechanical Engineers, Part B:Journal of Engineering Manufacture 221 (2007) 591–603. | | [7] Machining Data Handbook, Machinability Data Center, Cincinnati, OH, 1980. | | [8] B.Bhuvaneswari, Dr.D.Dhanasekaran, M.Puthanyal, June 2014, Microstrip patch antennas-Survey and performance analysis, International Journal of Scientific Research, vol. 3, issue6, pp. 146-148. | | [9] Kim, Y.H., Tan, Andy. C.C., Mathew, J., Kosse, V. & Yang, B.S. (2007). A comparative studyon the application of acoustic emission technique and acceleration measurementsfor low speed condition monitoring, 12th Asia-Pacific Vibration Conference, HokkaidoUniv. Japan, August 2007. | | [10] Li, H., Zhang, Y. &Zheng, H. (2009). Gear fault detection and diagnosis under speed-upcondition based on order cepstrum and radial basis function neural network,Journal of Mechanical Science and Technology, Vol. 23, No. 10, (October 2009), pp.27802789,ISSN1738494X. | | [11] Kim, Y.H., Tan, Andy. C.C., Mathew, J. & Yang, B.S. (2005). Experimental study on incipient fault detection of low speed rolling element bearings: time domain statistical parameters, 12th Asia-Pacific Vibration Conference, Hokkaido Univ. Japan, August |