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CONDITION MONITORING OF SINGLE POINT CUTTING TOOL USING ACOUSTIC SIGNAL BY DECOMPOSITION

[1]Anil Taneja, H.C.T.M., Kaithal.

[2]Manpreet Bains, H.C.T.M., Kaithal.

[3]Jasbir Mor, H.C.T.M., Kaithal.

[4]Arvind Dewangan, H.C.T.M., Kaithal.

[1]Department of Mechanical Engineering, HCTM, Kaithal-136027, Email: anil_taneja09@yahoo.com
[2]Department of Mechanical Engineering, HCTM, Kaithal-136027, Email:bainscoolbains@yahoo.com
[3]Department of Mechanical Engineering, HCTM, Kaithal-136027, Email: Jasbirmor@gmail.Com
[4]Department of Mechanical Engineering, HCTM, Kaithal-136027, Email: arvinddewangan237@gmail.com

ABSTRACT:
Condition of wear of tool in the machining has a great impact on surface finish. . We have implemented methods based on acoustics to identify defects due to wear The proper methodology is selected for this experimental work. The analyses are done on machine tool under varying wear conditions.. A mike is used to record the acoustic signals generated by the machine assembly. The acoustic signals generated by the set-up are recorded by placing the mike in front of the rotating job . In this way we are analyzing the effect of wear on the spectrum of acoustic signals and developed a method to identify such defects.

KEYWORDS: DECOMPOSITION, ACOUSTICS SIGNAL, FREQUENCY
Sub Area: Condition Monitoring
Broad Area: Mechanical Engineering

1. INTRODUCTION

Condition monitoring using acoustic signal is widely used in machinery diagnostics. There are many analytical techniques, which have been fully developed and established over the years for processing vibration signals to obtain diagnostics information about processing bearing faults. Time-frequency is one of the methods. The fault detection procedure for time-frequency methods is usually based on visual observation of the contour plots. The propagation of fault can be monitored by observing changes in the features of the distribution in the contour plots proposed. In our study acoustic signal with the help of mike is recorded and then stored in the computer. The recorded signal is processed in the Matlab environment.. Energy maps are shown for the proper analysis and correlation of defects in terms of amplitude and frequency of operation. Results suggested that vibration analysis by acoustic signals are very effective for the early detection of faults and may provide a powerful tool to indicate the various types of progressing faults in bearing and in predictive maintenance.

2. FAULT DIAGNOSIS OBJECTIVE

In our work we shall develop a technique to diagnose the faults in rotating components of machine. An experimental setup is being developed to acquire the acoustic signal of rotating components. Wear will be introduced in tool and acoustic signal corresponding to the fault will be recorded. These signals will be processed using digital signal processing techniques in Matlab environment. Depending on the characteristics of the raw acoustic signal obtained from experiment, conventional filters based on decomposition will be used to extract the useful information. By decomposition one signal is broken down into many lower resolution components One of the great advantages of using wavelet transform is that the time information is not lost. The problem undertaken has practical importance in operation, on-line inspection, failure prediction and maintenance of rotating components.

3. ACCOUSTIC SIGNAL

Acoustics is the interdisciplinary science that deals with the study of sound, ultrasound and infrasound (all mechanical waves in gases, liquids, and solids). The science of acoustics spreads across so many facets of our society - music, medicine, architecture, industrial production, warfare and more. Art, craft, science and technology have provoked one another to advance the whole, as in many other fields of knowledge. Acousticians had extended their studies to frequencies above and below the audible range, it became conventional to identify these frequency ranges as "ultrasonic" and "infrasonic" respectively, while letting the word "acoustic" refer to the entire frequency range without limit.

3.1 DECOMPOSITION

The decomposition process can be iterated, with successive approximation being decomposed in turn, so that one signal is broken down into many lower resolution components. This is called the wavelet decomposition tree.

Fig 3.1: Decomposition Tree

4. METHODOLOGY

4.1 Design the system for acquisition of acoustic signal. A system has to be developed to record the audio signal in the frequency range of 20Hz to 20KHz. MIKE will act as sensor and will be interfaced with the computer. The acoustic signal will be recorded and stored in the computer for the different conditions.

4.2. **Processing of acquired acoustic signal.** The acoustic signal will be processed in MATLAB environment in order to improve the signal–to-noise ratio. Information of the fault like wear on the tool will be extracted from the signal by performing the decomposition of the signal

4.3 Analysis of processed signal . The processed signal will be analyzed for fault detection in rotating components. A correlation of defects in terms of energy or operational frequency of rotating components can be our outcome

5. EXPERIMENTAL SET UP

The setup consists of rotating work piece on lathe and condition monitoring is done for different wear condition of the tool. The signal is recorded by placing mike 2cm away from the tool. The signal is recorded for different condition of the tool after recording the signal processing is done on the mat lab. Decomposition is done up to 6^{th} level and from the decomposition tree condition is monitored

Fig 5.1 Experimental Representation

6.0 RESULT

After recording the signal in computer a decomposition is done up to 6^{th} level using db4 wavelet. The following result has been taken by the experiments. These results are totally processed through the Matlab environment. These are mainly the graphs of raw signals and processed signals respectively. The decomposition for the experimental arrangement is shown in figure below .

Fig 6.1: Decomposition of signal at 6^{th} level when no wear in the tool

Fig 6.2: Decomposition of signal at 6^{th} level when slight wear in the tool

Fig 6.3: Decomposition of signal at 6^{th} level when more wear in the tool

Fig 6.4: Decomposition of signal at 6^{th} level when much wear in the tool

From the decomposition diagram as the intensity of the wear is increasing the peak of energy is also increasing. Thus it give indication of deteriorating condition of tool.

7.0 CONCLUSION

I. It is demonstrated that, although the environment influences acoustic signal for condition monitoring, it does not significantly reduce the extraction of useful diagnostic information. It has been demonstrated that acoustic condition monitoring can effectively be used for condition monitioring

II. It is clear that the wavelet representation of the acoustic signals reveals the faults more precisely.

III. In condition monitoring using acoustic signal have certain advantages over the conventional measuring techniques. Firstly in this sensors do not alter the behavior of the machine due to its non contact nature and time based information is not lost in wavelet based method of diagnosis.

IV. The method developed in the project can be used for the condition monitoring and for predictive maintenance of the many components.

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