TOOL CONDITION MONITORING IN CONVENTIONAL LATHE USING VIBRATION ANALYSIS

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Abstract

This project work is mainly focused on monitoring tool wear and failure in lathe using vibration analysis techniques in dry condition atmosphere. Tool condition monitoring of machine is the sophisticated equipment which deals with the determination of a condition of machining and failure with respect to time. Many industries are upto reduce the human effort by using various conventional machines and advanced machine tool for achieving good quality products. But many conventional machines over a long period may face failure or error result in the condition of the machine tool, which might face wear and tear. The main purpose is to find the condition of the tool and the instant from which tool condition is considered unfit to use affecting machining process quality. After the analysis of our work's done, the main conclusion is that both the RMS and frequency amplitude ranges of certain spectrum bands are related to tool wear. Moreover, the FFT (Fast Fourier Transform) frequency spectra of signal and RMS value evolution, an online tool condition monitoring system were developed. Sensors were fixed on the tool post on the. The vibration technique is detected the tool and feeds data to the DSO (Digital Storage Oscilloscope). Moreover the wear occurs in the tool, changed vibration's frequency is detected and that particular machine is completely shut down. Finally the project work mainly suitable to control the machine and improve the system to stop and process in that particular machine is dismissed, before affecting and damaging both the product and the machine

Keywords:Lathe Machine,Tool Condition Monitoring, vibration

1. Introduction

In every machining industry is generally focusing on reducing maintenance costs, reliability, surface Equality and manufacturing efficiency. under the minimum human supervision, the automated tool condition monitoring system gives an idea about the identification of cutting tool condition without interrupting the manufacturing process operation. In the absence of a human operator, an ideal tool condition appropriate control action.

A machining system is the elastic structure of the machine tool and the interaction between the machining process. The cutting forces are created through the interaction between work piece and the cutting tool. A system could be defined as Automated Monitoring System if sensing, analyzing, knowledge learning, and error correction abilities, which are essential to machining tool condition monitoring, is incorporated. Hence, Tool condition monitoring system plays a crucial role in every manufacturing industry as its aim is monitoring the tool and process and wear of machine tool components.

Different types of wear occurring in tool and it's failure monitoring has raised quite a lot of interest among researchers and has consequently been studied in a number of research projects by a number of research organizations.

The reason for the interest is that tool condition monitoring is considered very important for the following reasons:

1. Production without human's supervision is possible only if there is a method available for tool wear monitoring and tool breakage detection.
2. Tool wear influences the quality of the surface finish and the dimensions of the parts that are manufactured.
3. The economical tool life cannot be benefited from without a means for tool wear monitoring because of variations in tool life.
4. Today tool changes are made based on conservative estimates of tool life which does not take into account sudden failures and at the same time leads to an unnecessarily high number of changes because the total lifespan of the tool is not taken into account and consequently valuable production time is lost.
5. As a consequence of the above, automated production control is not really possible without a means for tool wear monitoring.

The economical values involved in modern manufacturing are very high because the investment is high in the manufacturing equipment and naturally it would be in the interest of the industry to benefit from the equipment in an optimal way including automatic production(without human supervision) with high availability.

Measuring methods

One reason for measuring cutting speed and feed rate is the use of these as parameters in adaptive control systems. Torque, drift and feed force together with strain measurement, are all measures of cutting forces and are treated together in the subsequent study. The strain measurements are applicable for force category because strain as such is linked to the force: force transducers actually measure strain which then is transposed to force. Feed drive current and Spindle motor are closely related to the force ,i.e. they too measure the same cutting forces and phenomena, although through a longer measuring chain where also other factors influence the signals. Again feed drive current and spindle motor are treated together in the subsequent studies.

As we all are so familiar with these terms like Sound, vibration, Ultrasonic vibration, and Acoustic emission. They are actually all vibration measurements, although the frequency range in each of these differs and, in addition to that, sound is airborne vibration when all the others are mechanical vibrations of the structure. The frequency range of vibration measurements is typically from about 1 Hz to about 10 kHz (or 19 or 16 kHz is used as a limit); in sound measurements the range is from 20 Hz to 20 kHz, which is the range limit a human can hear; in ultrasonic vibration the frequency range is from 20 kHz to about 80 kHz; and acoustic emission starts where ultrasonic vibration gets finished and ranges to about 1 MH z. Again all these vibration related methods are treated together. In some cases, the measured vibration frequencies do not come into the limits defined above and if this is the case then both categories are marked with "×". This is the case e.g. for vibration and ultrasonic vibration which have both been marked when the band-passed frequency is from 0.6 kHz to 40 kHz.

Torque, drift force and feed force

It is more sensible to monitor forces in a cutting process in order to follow the development of cutting tool wear. It is commonly known that cutting forces will increase as tool wear increases. This is caused due to the increase in friction between tool and work piece. In drilling it is possible to monitor torque, drift forces and the feed force. The idea behind monitoring feed force and torque is very clear, i.e. change in forces is expected as the tool gradually wears. The thrust force is used as the only measured signal. The simultaneous monitoring of thrust force and torque is rather common and special electronics have been developed for this purpose. Drill wear differentiates itself to some extent from the wear of other cutting tools. Due to production tolerances a drill is slightly unbalanced, therefore it only wears atone lip until the height of both lips is equal. The 2nd lip, which is now more sharper starts cutting. This fluctuated process continues until neither lip has no more clearance at the margins. In the end the drill sticks into the work piece and breaks if the cutting process is not stopped, assuming this kind of wear progress gives reason to monitor the drift forces. In a series of tests, no consistent change of torque or feed force was observed but a change in the drift forces was recorded. This is explained again because first the cutting edge on one side and then on the other side wears.

The calculation of torque and thrust force have been linked to the waviness of the hole surface and especially the effect of tool wear to the waviness. In the analysis more importance has been given to thrust force than to the torque, i.e. thrust has been observed as a more reliable indicator of tool wear. Strain, feed force and torque of the table in two directions have been measured. The strain measurements and the measurement of drift forces serve the same purpose that is the strain measurements actually in their function correspond to the measurement of drift forces. Strain has also been measured, but in this case located in the spindle and corresponding to the measurement of thrust force. Torque, drift and feed force have been also measured and compared with the measurement of ultrasonic vibration. Also torque, drift and feed force have been measured simultaneously when comparing two different types of coatings(titanium nitride and zirconium nitride).

A new method for measuring torque is based on the measurement of eddy current. The sensor can be placed some 0.2–0.5 mm from the drill shank. This technique is affected due to the distance between the drill shank and the sensor and also the material of the drill has an effect on the measured torque. This method is suited for both dynamic and static torque measurements and consequently suited for both wear and failure monitoring. The method has been patented in Germany .Based on the tests with copper alloy and a model, formulas that define the thrust force and torque as a function of feed per revolution, drill diameter and flank wear have been developed and their application has also been tested. We should note that the tests indicated that the increase in cutting speed over the range we studied had no significant effect on work material strength, and hence it has no significant effect on cutting forces. In fact, the correlation of the regression formulas with the test data without the rotational speed of the spindle is very good as for feed force is R2=0.94 and for torque is R2=0.97. We come into a conclusion that tool wear can be properly estimated knowing the thrust force and other cutting parameters, especially for larger tool wear.

Based on tests with different work piece material's hardness, thrust force and formulas for torque have been developed as a function of Brinell hardness of work material, diameter of the drill, feed per revolution, radius at the cutting edge asssnd average flank wear .We conclude that the change in drill life is significantly influenced by the work piece hardness. It is contemplated that it could be so that the presence of a few random work pieces with a high hardness may influence the drill life much more than a large number of work pieces with a low hardness. Hence, in an industrial operation, drills may fail either in the early stage or after a long time, depending on the occurrence of a few work pieces with a high hardness. This explains the large variation in drill life observed in industrial conditions. The hardness of the work piece also affects the amplitudes of torque and thrust forces occurring in a drilling operation. If the changes in thrust force, on account of changes in flank wear, isto be significant that the changes in work piece hardness has to be kept within 5% of the MHV(mean hardness value) in order to be able to base the diagnosis of flank wear on the amplitude of thrust force or torque. This is hard to achieve in industrial castings. Hence, measurements like torque and thrust measured from monitoring drill wear should bed one only after a very close tolerance which has been obtained in the work piece hardness.

Vibration and sound

Vibration is commonly used for condition monitoring of rotating machinery. However, vibration as a method is rather sensitive to noise which is present in cutting processes and that is why it has not been used to the same extent in tool condition monitoring. The advantages of vibration measurement include ease of implementation and the fact that no modifications to the machine tool or the work piece fixture are required. However, the disadvantages reported in the literature include dependency of the vibration signals on work piece material, machine structure and cutting conditions. The development of vibration-based monitoring methods for detecting breakage of small size drills and wear of larger size drills. Vibration is measured in the both axial and transverse direction. It is believed that, vibration signals are considered to contain reliable features for monitoring drill wear and breakage because: the vibrating drill length in the transverse and axial modes does not change during drilling, thus maintaining a rather constant mode frequency; the natural frequencies of the transverse and axial modes of the work piece–drill system are basically insensitive to drill cross sectional size, thus simplifying monitoring for a wide range of drill sizes; vibrations in the directions Y and Zare influenced by the torque and thrust force which are the major excitation sources in drilling. The three accelerometers were used each measuring in the direction of one of the three axes. Both vibration and the use of sound measurements are discussed. Vibration measurement and thrust force has been used together. The aim of this tests is to obtain signal for the development of a diagnosis tool capable of identifying tool wear. Tool wear has been recorded in these tests with a vision system.

Based on the theory, same information are expected to be given by sound measurements as it can be detected using vibration measurements because in the structural boundary the mechanical vibration of the structure or tool or work piece contact is partly transferred to airborne vibration, i.e. sound. But also, large number of factors influences how the mechanical vibration is transferred and how it takes place at the different frequencies. And also there is a big difference when the influences of disturbances from outside sources are compared in sound measurement and vibration. The sound measurements ar more sensitive than vibration but also we should remember that the operators sometimes or perhaps actually rather often rely on what they hear when they define whether the tool is worn or not. A large number of methods including sound measurements and vibration together with a number of other methods have been tested and compared in drilling, with the result that vibration was the most successful method of all of the tested methods .A higher frequency range from 0.50 to 40 kHz for vibration measurements has been tested with very thin drills. The main reason for looking at this kind of frequency range is that the rotational natural frequencies fall in to the range since for a drill of 1 mm diameter the natural frequency could be about 25.00 kHz and for a drill of 3mm diameter it could be about 7.00 kHz. The indication of both tool wear and failure has given more clearly than the feed force signal by the band-pass filtered vibration signal.

Fig 1. Vibration

Acoustic emission and ultrasonic vibration

The use of ultrasonic vibrations in the frequency range from 20 to 80 kHz for tool breakage detection in various metal cutting processes including drilling. Practically the usage ultrasonic vibrations is explained when compared to other vibration techniques. Acoustic emission (AE) suffers from multi-path distortion and severe attenuation caused by bolted joints commonly found in machine tool structures and restricting the mounting location of the Acoustic emission transducer to somewhere very near to the tool or work piece. The signal used for UE analysis which is a lower frequency signal does not suffer such severe attenuation and distortion, and so the transducer can be placed fairly far from the chip forming zone. In the low vibration frequency range, i.e. below 20 kHz, structural modes are prominent. The strategy used here is to compare of remote transducer placement with the UE method but unfortunately is much more vulnerable to machine and tooling variations .Since structural modes change in complex ways with machine movement, temperature, loading and tooling ,this approach generally must be tuned empirically each time that the process is changed. In contrast, in the frequency range used for Ultrasonic Vibration analysis the structural modes are so closely spaced that they form a so-called pseudo-continuum. There are no individual resonances to shift out of the analysis band with machine loading, movement and so on.

The applicability of ultrasonic vibration measurement for the tool wear and failure detection. In the reference the frequency ranges in question, i.e. from 10 to 70 kHz, is defined as acoustic emission and the used sensor with non-linear frequency response is considered as an AE-sensor. However, the frequency range in question is in this context defined as the ultrasonic range. Theultrasonic vibration is compared with torque, feed and drift force measurement and proven to be a more effective means for tool wear and failure detection in drilling. For the measurements in the frequency range from 1kHz to 5 kHz the same sensor has been used, which normally is considered mechanical vibration .Acoustic emission is a phenomenon which occurs when, for different reasons, a small surface displacement of a material surface is produced. This happens due to stress waves generated when there is a rapid release of energy in a material, or on its surface. Acoustic emission with centre frequencies of 200 and800 kHz and also in a broader band from 100 to 1000kHz. The 200 kHz sensor was used in the test for tool wear and the 800 kHz sensor for tool breakage detection. For finding the best frequency range for further investigation broad band sensor was used. Also acoustic emission was recorded in a broad band from 100 to 1000 kHz in order to monitor tool wear.

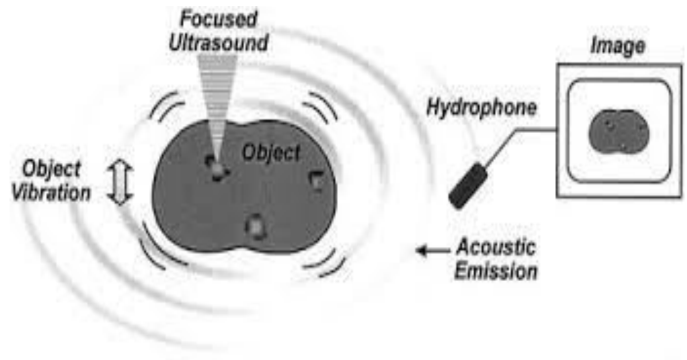

Fig 2.Acoustic Emission And Ultrasonic Vibration

Spindle motor and feed drive current

Spindle motor current is in the principle of measuring the same feature as torque, i.e. they both also enlightens the dynamics of cutting but mainly explains how much power is used in the cutting process Since the torque sensor is located close to the cutting tool it is fair to claim that torque is a more sensitive way to measure than is the spindle motor current. However, measurement of torque is more complicated than measurement of the current of the spindle motor and there for the measurement of the current has also been widely tested and used.

Similarly, feed drive current corresponds to the measurement of the thrust, force spindle current corresponds to torque. Again there is some similar difference in the sensitivity as mentioned above. The feed drive current as an indicator of tool wear and failure. Both feed drive and spindle current have also been measured. In these tests it has been possible to compare the measurement of thrust force to the measurement of feed current based on the use of strain gases. It is stated that typically for wear diagnosis, the strain gauge is a better sensor than the feed motor current sensor. No matter what, the current sensor was used to investigate whether the cost effective and easily implementable current sensors alone would suffice .The feed drive current and spindle power together with feed force and torque are quite similar. The measurement results show that all the quantities measured remain at an almost constant level during the entire tool lifespan until the hole in which the drill totally fails. It is impossible to successfully apply these measurements as tool-monitoring methods, stopping the machining after the increase in one or several signals above a particular limit value before actual tool failure. However, the measurements can be used for tool-breakage detection where the machining operation is barged in after tool breakage. Hence in this system, one work piece may be rejected because of the tool failure, but further damage is avoided.

2. Methedology

Existing system

The existing system presents the use of vibration analysis of the cutting process in milling to indicate the presence and progression of damage incurred by an end mill. A four-flute standard end mill is used during the experiments on a conventional milling machine and no coolant is used in order to accelerate damage to the cutter. The vibration of the cutting process is monitored at 160 mm cutting intervals and the cutting process is stopped occasionally to permit visual observation of both the damaged section of the tool and the resulting chips. It has been found that a very small section is chipped off from the tip of tooth during the first tool–work piece engagement. Besides, due to lack of coolant, a progressive fault (i.e. wear) is initiated on the cutting edges of the tool, developed gradually over the flank with time, but accelerated during the final phase of the test.

Moreover, severity of tool wear is significantly influential upon the properties of the resulting chips, such as size, shape, and color, and process temperature. Resulting vibration signals from the cutting process have been firstly analysed in the time and frequency domains to obtain general signal characteristics, and scalogram and its mean frequency variation (e.g. the first order frequency moment of a scalogram) are then calculated. It has been found that scalogram and its mean frequency are both capable of revealing the features of not only a localized, but a progressive fault more clearly in the presence of strong noise than conventional time and frequency domain analyses. Furthermore, the global average of the mean frequency variation provides auseful indicator signifying the progression of wear, whereas time domain statistics do not give any consistent trend.

It has been observed that the vibration of the cutting process in milling exhibits two dominant frequency activities clustered at relatively high and low frequency regions. The high frequency activities represent the damped natural frequency of the system, whereas tool-related condition-indicating information is revealed by the frequency components located at low frequency region. Beside these, another frequency activity becomes apparent around 850 Hz due to tool chattering after the initial stage of tool wear. It has also been found that a very small section from the tip of a tooth is chipped off during the first tool– workpiece engagement. Since the vibration of the cutting process contains much noise, the presence of this tip breakage cannot be clearly revealed in the filtered vibration signals during the early phase of wear. Similarly, it is quite difficult to distinguish from the vibration waveforms any change signifying the development of wear until the medium stages of wear development. However, the amplitude of vibration signal considerably rises when the flank is severely damaged by wear and the resulting fault symptoms manifest themselves in the form of one per tooth error.

Vibration of the cutting process is analyzed by the scalogram and its mean frequency and found that they are both capable of featuring the presence of a tip breakage as early as possible.

When the wear is pronounced the amount of vibrational energy is raised, particularly around the cutting frequency components. This therefore obscures the symptoms of tip breakage in both the scalogram and its corresponding mean frequency variation. It has also been found that the average mean frequency values of the scalograms yield a more consistent trend which reflects the progression of wear than considered time domain statistics.

Disadvantages

- Tool condition monitoring is an essential part of the machining system. Its main aspect is to monitor the condition of the tool regularly. Since machine works continuously in all the industries, so does its tool. So it's important to monitor its condition regularly as it works continuously it has higher chances of wear and damage.
- Due to this production gets affected and so does the companies turnover. In order to avoid this tools have been monitored regularly between their working periods. So if there is any damage it can be repaired or replaced before it affects the company's turnover and production. This has been done manually by machine operators.

Proposed system

Test in this work have been performed on a Pinacho 594 C/225 lathe provided with Fagor CNC 800T. Machined material was F1140 steel. In each dry cylindrical turning pass, cutting parameters remain constant(cutting speed Vc=200 m/min, feed rate fn=0.2 mm/rev, depth of cut ap=1 mm and length of cut L=100 mm). The specific tests are noted in Table (1), specifying which ones have been carried out under the same diameter, with the purpose of comparing several statistical procedures afterwards. The processing and comparison of sets of signals which are related to the same diameter, avoids diameter effect on cutting forces and, therefore, on vibration. During experiments, inserts used were

Sandvik Coromant CNMG 12 05 08-PM. Signals were obtained by a triaxial accelerometer (Kistler K-Shear 8793A), connected to low impedance sensor couplers (Kistler 5108A). AnDBK-40 (IOtech) digitalizes the analogical signal, which is processed in a 1.79 GHz 256 MB RAM PC featuring an IOtech Daq 2000 data acquisition card. The most suitable sample rate for the frequency of intrest is 30Khz.

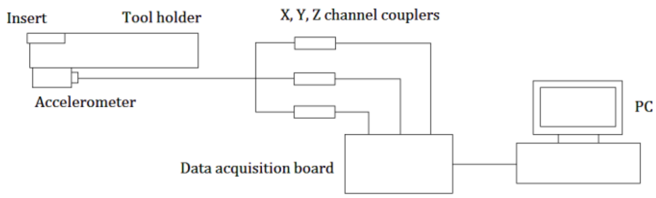

Fig. 3: Scheme of experimental devices arrangement.

FFT and RMS processing

Fifty signals were captured in a total cutting time of 22.08 minutes, machining three different F1140 steel workpieces. Since vibration signal levels where strong workpiece diameter dependents (descending with lower diameters), we proceeded to perform a statistical signal treatment for the same diameter passes, so it was possible to collect similar data at different tool wear stages and compare them. Based on the results of machining the 3 workpieces, 3 differentiable tool wear condition patterns were clearly detected:

workpiece related to LW(low tool wear signals),

(i) workpiece related to IW(intermediate tool wear signals) and

(ii) workpiece related to HW(high wear signals).

The main purpose is to determine the instant from which the tool condition becomes unacceptable, affecting the machining quality and resulting in a poor surfac finish. Tool is considered worn if VBb value is between 0.2-0.3 mm, depending on the process nature (rough or finish).

Signal recording and processing were carried out by means of DASYLab 8.0 software. Circuit's design is set by a high pass-filter (5 Hz) and a low-pass filter (15 kHz). Data window module forces signal conversion to periodic within the time record avoiding leakage phenomenon. Windowing process employed Hanning window, amplitude correction features and overlap obtaining an output vector of the same length as the input. Signal sampling time was set to ten seconds considering the possible existence of transient events. The 3 types of used signal analyzing methods are presented below:

a) Frequency spectra
b) Frequency amplitude evolution and ;
c) RMS value.

Frequency spectra

The gathered data were arranged in input block length in vectors of 16384 elements, so after FFT algorithm processing, the output block length was 8192. Through FFT processing of each test, 19 vectors were collected(the number of output vectors is sample time related), so for each signal the same number of frequency spectra can be placed, showing the acceleration amplitude at each frequency characterizing each pass. From FFT spectra at each frequency, gathered data, average and median amplitude values are calculated. Thisprocedure enables the identification of interest frequencies and their amplitude during cutting process.

Frequency amplitude evolution

Another one analysis was also performed by means of FFT spectrum vectors, consisted on the study of the change of maximum amplitude values within four band frequencies: band 1 (0-3786 Hz), band 2 (3798-7574 Hz), band 3(7575-11362 Hz), band 4 (11363-15151 Hz). This method is applied to x, y and z axis, the last being the most representative (tangential axis).

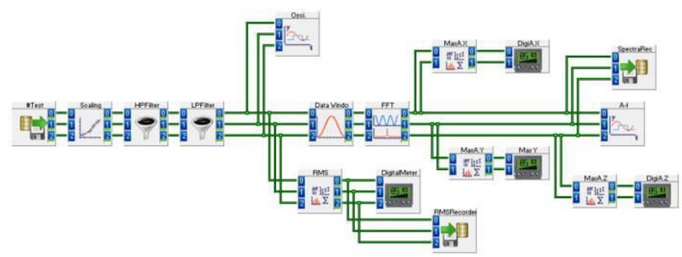

Fig. 4:DASYLab circuit scheme

RMS value

Each axis's signal RMS value was also stored during time record, obtaining 18 element vectors that contain RMS values of each sampled block calculated each 500 ms (the number of output vectors is input block length dependent). In order to identify tendency and contrast between different tool condition stages analysis was performed for the same diameter trials.

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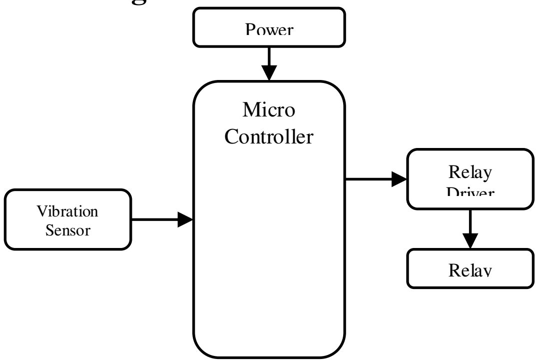
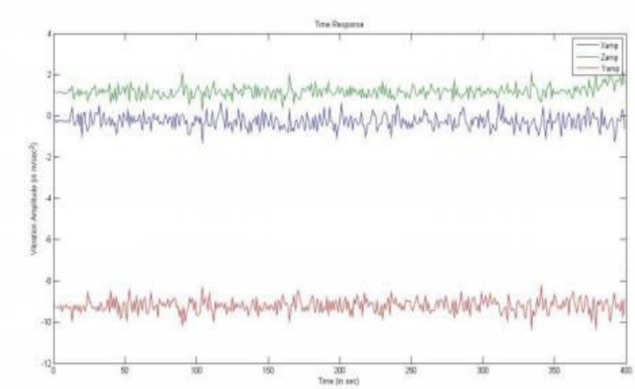
Block diagram



3. RESULTS AND DISCUSSION

Serial Meter Display of Readings

Choose the serial meter from the tools which are responsible for the displaying the accelerometer reading in the serial monitor in the x, y and z direction after a proper validation and aggregation of data, in the Aurdino UNO

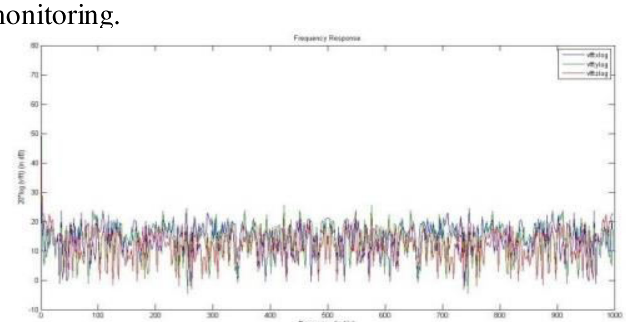


(a)

The above figure shows the Vibrational amplitude of Brass with respect to time in m/sec^2 and a speed of 280 rpm. Here the variation of the Vibrational analysis in z amp is shown in the upper most curve, the x amp is shown in the next curve and the y amp is represented in the third curve which shows a greater difference as compared to the rest of the curves.

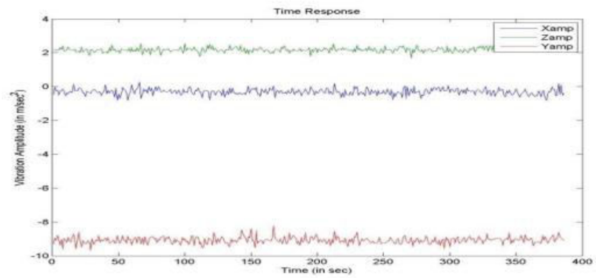
Hence it can be understood that the processing time of all the 16 slots with the same parameters takes a time of 39 minutes along with the power increment taken into consideration. It can be inferred that power increment graph is consistent with the curve of the Taylor tool without showing huge variations. This alignment of the curves however shows the possibility of tool monitoring. Initially, there is a rapid increase of power in the initial 5 minutes of the machining chart.

The interval corresponding to the process is considered to be *a*. This working is entirely restricted to the initial stage of the tool wear which has shown a drastic initial rapid stage. The increment gets reduced in the next stage of the tool wear which is relatively a stable one as compared to the previous stage which has shown a rapid increase. Due to the insufficient processing time of experiments, the accelerated stage of tool wear, however, has not been reflected in the graph. Despite this, the graph of the power increment power is aligned with the Taylor curve. It confirms the system provides feasible tool wear monitoring.

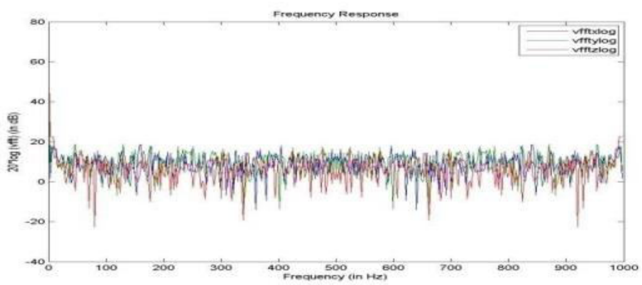


(b)

The above figure b shows the frequency response of Brass and the rotor speed of the concerned device used here is 280 rpm which provides a feasible result. Here the graph shows that an entangled graph of the concerned curves.



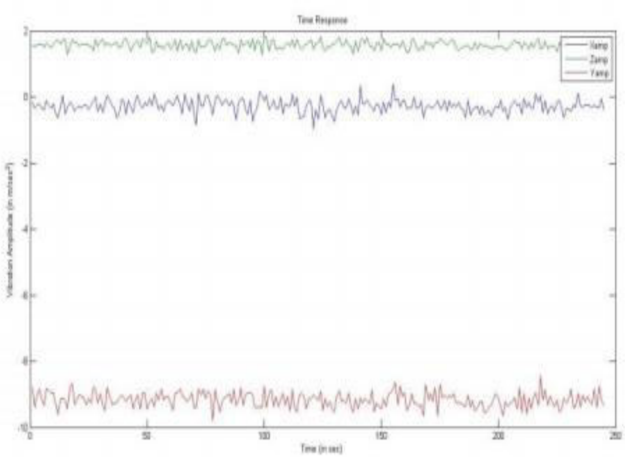
(c)



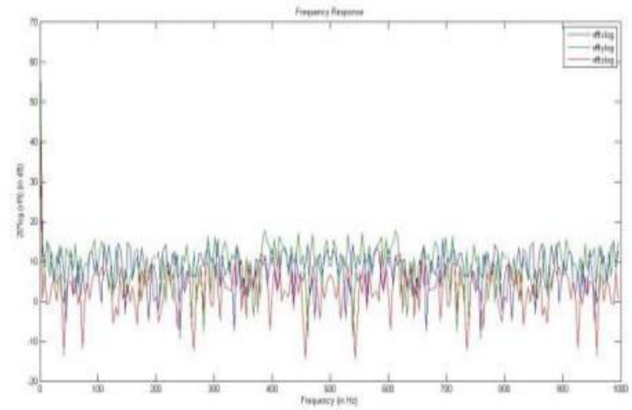
(d)

The above figures shows the Time (fig.c) frequency (fig.d) responses of mild steel and the rotor speed of the concerned device used here is 280 rpm which provides a feasible result. Here the variation can be seen in the z, x and y values.

Fig.5 (a) and (c) Time response of brass and mild steel at 280 rpm respectively.
Fig.5 (b) and (d) Frequency response of brass and mild steel at 280 rpm respectively.

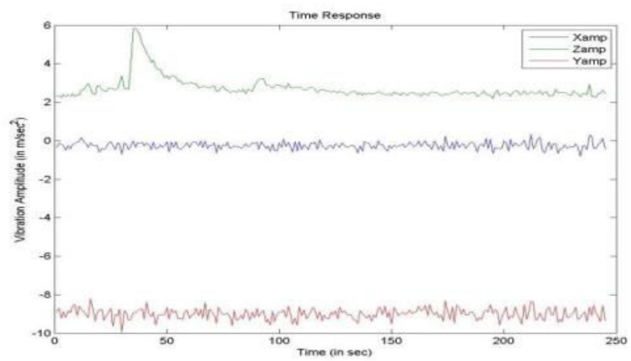


(a)



(b)

The above figures shows the time (fig.a) and frequency (fig.b) responses of Brass which is measured with respect to time (fig.a) and frequency (fig.b) at a rotor speed of 450 rpm which shows the curves segregated with colors to know the variation. Here the variation can be seen in the z, x and y values



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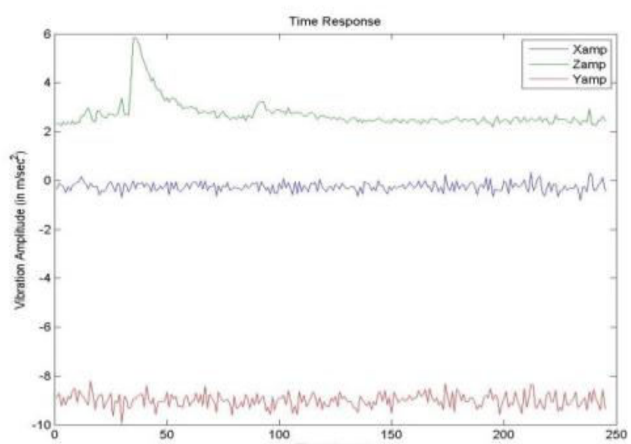
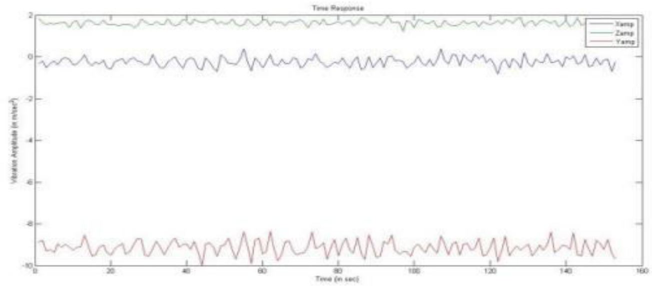


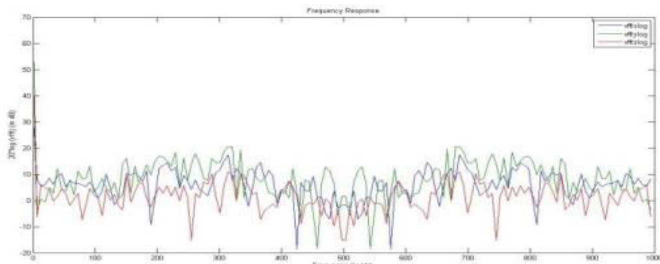
(d)

The above figures shows the time (fig.c) and frequency (fig.d) responses of mild steel which is measured with respect to time (fig.c) and frequency (fig.d) at a rotor speed of 450 rpm which shows the curves segregated with colors to know the variation. Here the variation can be seen in the z, x and y values.

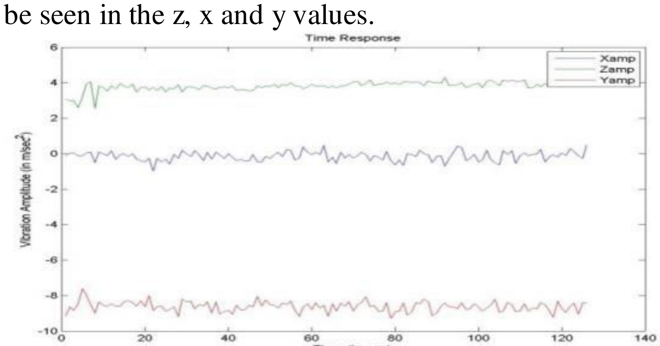
Fig.6 (a) and (c) Time response of brass and mild steel at 450 rpm respectively.
Fig.6 (b) and (d) Frequency response of brass and mild steel at 450 rpm respectively.



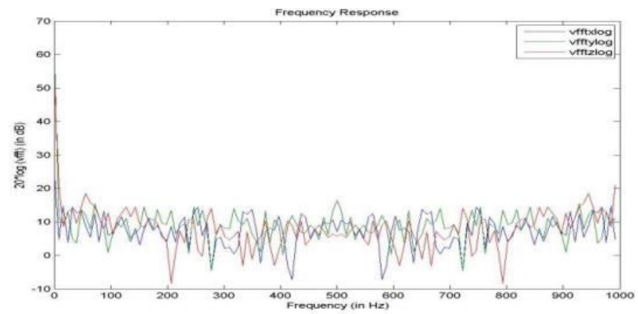
(a)



The above figures shows the time (fig.a) and frequency (fig.b) responses of Brass which is measured with respect to time (fig.a) and frequency (fig.b) at a rotor speed of 710 rpm which shows the curves segregated with colors to know the variation. Here the variation can be seen in the z, x and y values.



(c)



(d
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The above figures shows the time (fig.c) and frequency (fig.d) responses of mild steel which is measured with respect to time (fig.c) and frequency (fig.d) at a rotor speed of 710 rpm which shows the curves segregated with colors to know the variation. Here the variation can be seen in the z, x and y values.

Fig.7 (a) and (c) Time response of brass and mild steel at 710 rpm respectively.
Fig.7 (b) and (d) Frequency response of brass and mild steel at 710 rpm respectively
For time response, the graph between the time (in sec) on x-axis and the vibration amplitude (in m/sec^2) on y-axis is plotted. In the same manner, for frequency response the graph between frequency (in Hz) on x-axis and 20*log (vfft) (in dB) on y-axis is plotted. The fig.5 shows the cutting tool vibration signal of brass and mild steel at a cutting speed of 280 rpm, feed rate of 0.05 mm and a cut of depth 1.0 mm. The graphical results show that in the case of time response, the vibration of mild steel is marginally greater than Brass and in the case of frequency time response, the number of peaks is high for brass and mild steel. As the results are shown in fig. 6, the vibration amplitude has a sudden peak in mild steel in comparison to that of brass. In the case of the frequency response, the initial vibration of mild steel is marginally higher than that of brass. In the case of fig. 7, it is evident that the time response of mild steel shows constant vibration amplitude throughout the time period and brass shows a slight rise and then becomes constant. In the case of the frequency response of brass, in certain frequencies, the vibration amplitude gets reduced

SUMMARY

In this project, the analysis and monitoring of vibration signal is done with regard to time and frequency domain. As per the results, the output graphs show that by ensuring the feed rate and the depth of cut as constant for brass and mild steel, the intensity of vibration increases with the rise in cutting speed. This paper can further be widened by changing the various parameters of materials used in the study.

4. CONCLUSION

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I.N. Tansel, C. Mekdeci, O. Rodriguez, B. Uragun, Monitoring drill different insert wear conditions, several tool wear related parameters has been determined through RMS and FFT spectral analysis. Described experimental procedures led to the following conclusions:

- Frequencies which present higher amplitude values have been clearly identified through spectral analysis. Transitions and interest frequency levels are tool wear related. Through FFT (Fast Fourier Transform)analysis it was determined that acceleration level at some frequencies increases with tool flank wear. To add on with it, amplitude level increase will occur for the most frequencies along the spectra, being more evident for 0-4 kHz and 5-8 kHz frequency bands.
- Signal amplitude level is strongly influenced by workpiece diameter. Keeping constant cutting parameters (feed rate, depth, speed and length of cut), acceleration amplitude levels in the whole frequency spectra decreased with smaller diameters.
- FFT spectra shape varies as tool undergoes increasing wear levels.

RMS signal value increases with tool wear. Initial and intermediate wear passes gives approximately equal RMS value while high wear passes

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