Condition Monitoring of Single Point Cutting for Lathe Machine Using FFT Analyzer-A Review

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Abstract: ***Machine tool vibration plays a important role in the surface finish, dimensional and geometrical tolerances of the machined work. Condition monitoring of the lathe machines includes collecting data, such as vibration analysis. Out of these the vibrations occurs due to single point cutting tool have been measured and its effect has been studied. In this paper a preliminary estimation of the most common analysis methods of the vibration signals on 1st and 2nd bearing of a head stock is tried. The tested methods are the typical statistic and analytical analysis method, the Fourier transform, the frequencies spectrum analysis and the Wavelet method. Further testing under variable and/or radial loads is under investigation by the present research paper before a final conclusion can be made. The predicted results obtained from the developed models are compared with the experimental one. Single point cutting tool vibration in lathe machine is an important which influences dimensional precision of components machined, life of the cutting tool is very important. Cutting tool vibration are mainly produced cutting parameters like cutting speed, depth of cut and tool feed rate. In this work, the cutting tool vibrations are controlled in lathe machine where the tool holder is supported with and without damping pad. The cutting tool vibration signals were controlled through FFT analyzer.***

Keywords: FFT analyzer, vibration analysis, Single point cutting tool (SPCT), Lathe machine

1. Introduction

New generation of machine tools are capable of manufacturing the goods with higher accuracy, due to their inherent capabilities. But the old machine tools may not be fulfill the same functional requirements, due to many reasons. The major problem is machine tool vibrations during condition monitoring. Turning, the most versatile machining process, covers around 70% share of the machining on lathe machine. DOE is an experimental strategy in which effects of multiple factors are studied simultaneously by running tests at various levels of the factors. Machinery must become increasingly flexible and automatic. In order to increase productivity, enhance quality and reduce cost, machine tools have to work free of any failure. When a failure occurs in a machine tool, it is

necessary to identify the causes as early as possible Condition monitoring is very important to achieve this goal. Condition monitoring is generally used on the critical subsystem of any machine tool. This technique endeavors to focus on the condition monitoring aspects on the machine tool element. Machine tool vibration plays a dominant role in the surface finish, dimensional and geometrical tolerances of the machined work piece. Condition monitoring techniques of a single point cutting tool for lathe machine by FFT Vibration analysis consists in analyzer .Listening inside the machine. Each component vibrates differently and generates a characteristic noise that leaves a typical fingerprint in the spectrum in the form of a linear pattern. If damage is present, the pattern stands out from the floor noise. This allows the specialist to recognize, for example, whether the problem comes from unbalance, misalignment. In addition to an accurate diagnosis it is generally also possible to determine whether urgent action is necessary or whether it can wait until the next scheduled servicing. The most common technique in frequency analysis is done usually by FFT (Fast Fourier Transform). Fault diagnosis of such systems is of particular importance in several industries. The success in vibration analysis of these systems depends largely on the techniques used in processing the vibration signals. By using an appropriate analytical signal processing method, it is possible to detect changes in vibration signals caused by faulty components and to judge the conditions of the machinery. Traditional analysis has generally relied upon spectrum analysis based on Fast Fourier Transform (FFT). Fourier analysis is suitable for stationary signal processing, but provides a poor representation of signal well localized in time and so it is unsuited for non-stationary, transient signal analysis, typically seen on defect induced machine vibrations,so their effectiveness in accurate machine condition monitoring and assessment is limited. This limitation of the Fourier transform therefore led to the introduction of time–frequency signal processing tools.

2. Problem Identification

2.1Vibration Due to in homogeneities in the Work piece

Hard spots or a crust in the material being machined impart small shocks to the tool and work piece, as a result of which free vibrations are set up. When machining is done under conditions resulting in discontinuous chip removals, the segmentation of chip elements results in a fluctuation of the cutting thrust. If the frequency of these fluctuations coincides with one of the natural frequencies of the structure, forced vibration of appreciable amplitude can be excited. However, in single edge cutting operations, it is not clear whether the segmentation of the chip is a primary effect or whether it is produced by other vibration, without which continuous chip flow would be encountered. The breakage of a built-up edge from the tool face also imparts impulses to the cutting tool which result in vibration. However, marks left by the built-up edge on the machined surface are far more pronounced than those caused by the ensuing vibration; it is probably for this reason that the built-up edge has not been studied from the vibration point of view.

2.2 Vibration Due To Cross-Sectional Variation of Removed Material

Variation in the cross-sectional area of the removed material by single point cutting tool may be due to the shape of the machined surface or to the configuration of the tool. In both cases, pulses of appreciable magnitude may be imparted to the single point cutting tool and to the work piece, which may lead to undesirable vibration. The pulses have relatively shallow fronts for turning of no round or eccentric parts, and steep fronts for turning of slotted parts and for milling broaching. These pulses excite transient vibrations of the frame and of the drive whose intensity depends on the pulse shape and the ratio between the pulse duration and the natural periods of the frame and the drive. If the vibrations are decaying before the next pulse occurs, they can still have a detrimental effect on tool life and leave marks on the machined surface. They may be eliminated by closing the recess with a plug or with filler. When the transients do not significantly decay between the pulses, dangerous resonance vibrations of the frame or the drive can develop with the fundamental and higher harmonics of the pulse sequence.

3. Experimental Procedure

Accelerometers were mounted at locations 1 and 2 to receive the bearing vibration. The overall vibration levels and vibration spectrums were recorded in FFF Analyzer for all the cutting conditions, The acoustic emission hydrophone SEH receives the acoustic waves through a jet of cooling lubricant which is connected directly to cutting zone. The measuring jet was made as short as possible since this has better characteristics with respect to ground noise and damping. The flow quantity was also kept as low as possible to minimize the impact noise. The shock pulse measurements were carried out on test bearings to ensure that the bearing fault due to contaminated lubrication condition existed. Surface roughness measurements of a turned workpiece was carried out as an offline monitoring method. Talysurf-6 (Taylor Hobson) was used for this purpose. To minimise the effect of cutting tool wear and breakage on acoustic emission and surface roughness, care was taken to en- sure cutting tool sharpness. For each set of experiments a fresh single point cutting tool insert was used; i.e., the tool was not allowed to wear more than a standard specification.

4. Conclusion

Vibration analysis of single point cutting tool in lathe machine, as all the machine elements have a characteristic natural frequency vibration. At the same time however we can also calculate the frequencies by using fft analyzer with which their components are vibrating, as the exterior ring, the internal ring or their balls. With the Fourier transformation as well as with the calculation of spectrum of frequencies we can distinguish the frequencies of bearing's elements and conceive if there is any damage in the particular component, so that the interruption of machine's operation will happen timely. The statistical treatment of signals presented an increase of the level of vibrations via the increase of the average and the mean square deviation of individual signals. The studying of statistical indicators of Fourier transformation for all signals presented an increase in the width of transformation of all signals. At the same time, the study of statistical prices of continuous transformation showed a change in the frequency via the increase of prices of average and mean square deviation as well as increase of range of factor prices. The above clue was distinguished more easily in the graphic representations of factors transformation. Interrelation FFT anyzer which helps in the obliteration of phenomena as that of leaking. This is the main reason why such distribution of energy in the particular spectrum of frequencies is distinguished. Further testing under variable and/or radial loads is under investigation by the present research team before a final conclusion can be made.

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