A Review Paper on Vibration Monitoring of Lathe

Hardik Prajapati

Swarrnim Institute of Technology, Gujarat, India

Abstract

In any machining operation vibration is frequently problem, the vibration signatures for different arrangement are recorded to determine the dynamic characteristics of the system,. These vibration signatures are analyzed to determine causes of inaccuracy in the manufacturing process and faulty components. Many condition monitoring techniques are available to monitor the machine experimentally. Among these techniques vibration monitoring is the most widely used technique because most of the failures in the machine tool could be due to increased vibration level. Experimental vibration analyses are conducted for a lathe system to detect the possibility of faults and to develop accurate cutting process. Experiments are carried out using the condition monitoring instrument Accelerometer to measure vibration severity for different cutting speed, depth of cut, feed rate for different work piece material.

Keywords: *Machine conditioning monitoring, Accelerometer, DAQ, Lab view.*

I. INTRODUCTION

Approximately half of all operating costs in most processing and manufacturing operations can be attributed to maintenance. This is ample motivation for studying any activity that can potentially lower these costs. Machine condition monitoring is one of these activities Condition monitoring of machinery is the measurement of various parameters related to the mechanical condition of the machinery (such as vibration, bearing temperature, oil pressure, oil debris, and performance), which makes it possible to determine whether the machinery is in good or bad mechanical condition. If the mechanical condition is bad, then condition monitoring makes it possible to determine the cause of the problem. The modern trend of machine tool development is required to produce precise, accurate and reliable product which are gradually becoming more prominent features. In a machining operation, vibration is frequent problem, which affects the machining performance and in particular, the surface finish and tool life. Severe vibration occurs in the machining environment due to a dynamic motion between the cutting tool and the work piece. The monitoring of manufacturing processes and equipment conditions are the essential part of a critical strategy that drives manufacturing industries towards being leaner and more competitive. Many sensors were used for tool condition monitoring system namely; touch sensors, power sensors, vibration sensors, temperature sensors, force sensors, vision sensors, flow sensors, acoustic emission sensors and so on. All operating machines, having rotary and/or reciprocating parts give rise to vibration. Machine tools are liable to deterioration in their performance level. With respect to time due to various causes such as wear and tear, ageing, unbalance, looseness of parts etc., and produce a corresponding increase of the vibration level. Machine tool vibration, if uncontrolled, can adversely affect the surface finish, dimensional accuracy and tool life. About 70% of the failures in the machine tool could be due to increased vibration level of the machine. Lathe is one of the most important machine tool in manufacturing industries. The extraction of vibratory signatures can be a valuable diagnostic tool to predict impending failures of the bearing and tool post. In all the cutting operations like turning, boring and milling, vibrations are induced due to the deformation of the work piece, machine structure and cutting tool. Today, the standard procedure adopted to avoid vibration during machining is by careful planning of the cutting parameters and damping of cutting tool.

II. TYPES OF CONDITIONING MONITORING TEQNIQUE

There are two types of Conditioning Monitoring System.

1) Periodic monitoring
2) Permanente monitoring

A. Periodic monitoring

In a periodic monitoring system (also called an off-line condition monitoring system), machinery Vibration is measured (or recorded and later analyzed) at selected time intervals in the field, then an analysis is made either in the field or in the laboratory. Intermittent monitoring provides information at a very early stage about incipient failure and usually is used where,

1) Very early warning of faults is required,
2) Advanced diagnostics are required,
3) Measurements must be made at many locations on a machine,
4) Machines are complex.

B. Permanent monitoring

In a permanent monitoring system, transducers are mounted permanently at each selected measurement point. For this reason, such a system can be very costly, so it is usually used only in critical applications where:
No personnel are available to perform measurements (offshore, remote pumping stations, etc.).

1) It is necessary to stop the machine before a breakdown occurs in order to avoid a catastrophic accident,
2) An instantaneous fault may occur that requires machine shutdown, and
3) The environment (explosive, toxic, or high- temperature) does not permit the human

   Involvement required by intermittent measurements.

III. CONDITION MONITORING TECHNIQUE

1) Vibration monitoring – this is the most commonly used and effective technique to detect internal defects in rotating machinery.
2) Acoustic emission monitoring – this involves detection and location of cracks in bearings, structures, pressure vessels and pipelines.
3) Oil analysis – lubrication oil is analyses and the occurrence of certain microscopic particles in it can be connected to the condition of bearings and gears.
4) Particle analysis – worn machinery components, whether in reciprocating machinery, gearboxes or hydraulic systems, release debris. Collection and analysis of this debris provides vital information on the deterioration of these components.
5) Ultrasonic monitoring – this is used to measure thickness of corrosion or crack on pipelines, offshore structures, pressure vessels.
6) Thermography – this is used to detect thermal or mechanical defects in generators, overhead lines, boilers, misaligned coupling and cell damage in carbon fiber structures on aircrafts.
7) Performance monitoring – this is used to determine the performance problems in equipment. The efficiency of machines provides a good inside on their internal conditions

In this review paper mainly focused on Vibration monitoring on lathe machine.

LITERATURE REVIEW

Nidhi gupta, sawan arya, nitin rai [1] were carried out experiment on center lathe machine measured vibration using conditioning monitoring instrument vibrometer. They were measure vibration in axial and tangential direction at three level of cutting speed, feed rate, and depth of cut. then they were plotted Graff between R.M.S value and feed rate at different cutting speed for different depth of cut in both the direction for two different tool material carbon tool and diamond tool and indicate that increase in above parameters, there is a continuous increase in cutting tool vibration value. With the help of vibration data the optimum condition of parameter for running the machinery can be identify and increased tool life by reducing vibration. They were also concluded vibration level is increased in diamond tool as compare to carbon tool.

Dr.Pratesh jayaswal, Nidhi gupta [2] in this paper they were carried out experiment on center lathe machine measured vibration using vibrometer. they were measure vibration in axial and tangential direction at tool post and Bering, vibration signal collected through vibrometer data acquisition system they were varied parameter at four level and plotted graph between r.m.s value verses feed rate at different spindle speed and at depth of cut finally they were conclude that the parameter which is highly affect the vibration is cutting speed then depth of cut and then feed rate. The optimal condition for working on centre lathe machine is cutting speed of 230-350 rpm, feed rate of 0.1-0.2 mm/rev and depth of cut up to 1 mm so it is not advisable to work on high cutting speed, feed rate and more depth of cut because it directly affect the tool life it also shows that vibrations at bearing and in tangential direction are highly occurred comparatively at tool post and in axial direction.

Jagdish.M.S,H.VRavindra[3] studied that the Finite Element Method to study the effect of defective spindle bearing and unbalance forces on the vibration characteristics of the lathe structure by performing Eigen value, frequency response and transient dynamic analysis. Experiments were carried out to determine the vibration velocity level on the headstock both at the front and rear bearing. plot the graph vibration velocity verses spindle speed and then Experimental results were compared with the theoretical results and conclude that Transient dynamic analysis showed that the vibration velocity level increases as the damage in the outer race increases. It was also found that the vibration velocity level depends upon the location of the defect. The value of vibration velocity obtained from frequency response analysis considering unbalance force is lower compared with the experimental value because in actual practice, the various effects like vibration due to belt tension fluctuations, gear tooth frequencies at the mating gears, defects in bearing and due to unbalance rotors were also included. From the experimental analysis, it was found that vibration velocity increases with the increase of spindle speed. Hence the theoretical results are agreement with experimental results. The present work shows that the FEM is a valuable tool in finding sources of increased or undesirable vibrations from various defects. Thus Finite Element Analysis is not only helpful during the development of new structures but also helpful to analyze the existing lathe structure under given circumstances.

S.s abhutakeer p.v mohnram g.mohan kumar[4] In this paper, Experiments were conducted on CNC lathe using CCGT-0930FL carbide turning insert, machining variables such as cutting tool vibration in tangential and axial direction were measured in CNC machining processes based on the vibration signal collected through a Lab VIEW data acquisition system and controlled by using Viscoelastic material (VEM) neoprene. The effect of cutting parameters such as cutting speed, depth of cut and feed rate on machining variables is evaluated. The testing result showed that the developed method was successful.

Julie and Joseph [5] have been trying to demonstrate tool condition monitoring approach in an end-milling operation based on the vibration signal collected through a low-cost, microcontroller-based data acquisition system.

Marlon C. Battery and Hamid R. Hamidzadeh [6] has done analytical and experimental vibration analyses for a lathe system to detect the possibility of faults and to develop an accurate cutting1process.the vibration signatures were analyzed to determine cause of inaccuracy in the manufacturing process and faulty components. Problem causing components for several case studiers (different speeds feed rate and tool lengths) were identified.

Kirby and Chen [7] the researchers determine mean amplitude of vibration using accelerations in both directions along the axes.

Tasks [8] have proposed the On-line vibration control system for turning operation uses a closed loop Feedback circuit which measures the relative vibration between the cutting tool and the work piece. There have been many investigations on vibration prediction and controlling based on periodic measurements of various machining conditions using accelerometer and active vibration controller.

Choudhury et al [9].has developed a computer program using Visual Basic programming language in order tana-alyze one and two degree of freedom of machine toolch-atter vibrations.

Vinay.V.N [10] was studied that The mass correction effected on the Motor-spindle assembly for the purpose of unbalance correction should not be altered in any manner. Doing so would alter the balance quality achieved. Any change in the rotating mass of Motor-spindle assembly will change the balance quality achieved.

S.Saravanan, G.S.Yadava and P.V.Rao [11] In this study, critical subsystems and components have been identified for lathes using failure data. The application of condition monitoring techniques like vibration, acoustic emission (AE) and surface roughness monitoring have been successfully implemented for diagnosing faulty bearings in a lathe. they were conclude that Headstock subsystem is critical because it faces a longer downtime and frequent failures of components like spindle bearings and gears For defective bearing conditions, overall vibration levels at headstock spindle beatings are higher than those in defect free lathes. This increase in vibration level is much greater at higher feed and depth of cut values. For defective beating conditions, significant peaks at the beating fault frequencies are observed. Larger sized contamination particles increase surface waviness considerably. As a result, the vibration level increased considerably at larger particle sizes. AE levels show an increasing trend with an increase in feed rate and depth of cut. For defective bearing conditions, AE levels are higher than those measured under healthy conditions. The increase in AE levels is much greater for higher values of feed and depth of cut. For defective bearing condition, surface roughness value increases sharply.

Robert X. Gao[12] Extensive research over the past decade has turned neural networks into an indispensable tool for solving a wide range of problems in both scientific labs and on the factory floor. In the specific areas of machine condition monitoring, fault diagnosis, and remaining service life prognosis, neural networks will play an increasingly important role, and its ability will be continually enhanced through other innovative and complementary technologies. Research is continuing in the author's group, with the ultimate goal to develop effective and efficient bearing condition monitoring and diagnostic techniques that can be applied to solving real-world problems.

Amit R Patel [13] in this paper Test rig for vibration monitoring of bearing have been designed. The design of test rig includes design of Shaft, Bearing selection, pedestal selection, motor selection, and base preparation. A 3-D model have been developed using Pro-engineer modeling software. The vibration signals generated by the healthy/faulty bearing can be captured by the accelerometer mounted on the test bearing. The analysis of the vibration signal is useful for the condition monitoring of rolling Element bearings.

Sutej Reddy Dr. S. P. Gupta, Dr. Vinod Kumar [14], in this paper a remote condition monitoring system has been developed using Lab VIEW. This developed system enables the transfer of the digital data simultaneously from the plant location to the several remotely placed control stations through internet or any other transmission networks like LAN, WAN e.tc. Particular attention has been paid to the wavelet analysis of the vibration signal for demonstrating the condition monitoring of the induction motor. The developed system has been tested for the bearing fault identification of the Laboratory test motor. A key feature of this work is the development of the sophisticated GUI at the server and the client locations thus facilitating the operators at both the ends with not only customized and user friendly but also efficient remote condition monitoring system.

CONCLUSION

From the above study we can conclude that lots of works have already been done in the area of vibration measurement. All experiment done using the same material of work piece to find the optimum machining parameter. Further study can be done on Lathe machine measuring vibration for different work piece material by putting NI instrument Accelerometer at tool post Which is connect to Portable data acquisition system(DAQ) Which is supported by Lab view software And can calculate optimum condition of lathe machine for working on different work piece material.

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