STUDY OF VIBRATION ON DEFECTS IN CORDLESS IMPACT HAND DRILL USING STATISTICAL ANALYSIS METHOD

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Faculty of Mechanical and Manufacturing Engineering Technology

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DECLARATION

I declare that this Choose an item. entitled " **STUDY OF VIBRATION ON DEFECTS IN CORDLESS IMPACT HAND DRILL USING STATISTICAL ANALYSIS METHOD** " is the result of my own research except as cited in the references. The Choose an item. has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : 

Name : *NUR SOLIHAH BINTI ADENAN*

Date : 9 January 2023

APPROVAL

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the Bachelor of Mechanical Engineering Technology (Maintenance Technology) with Honours.

Signature : Irman

Supervisor Name : *TS.DR. MOHD IRMAN BIN RAMLI*

Date : 9 January 2023

DEDICATION

To my beloved parents, family members and friends.

ABSTRACT

Vibration analysis used in condition monitoring allows for the detection and identification of defective rotating machine parts. As a result, reliability is increased while maintenance costs are decreased and safety is improved. Numerous prior studies on condition monitoring using vibration analysis of bearing, gear, and shaft are revealed by the literature review. One of the most popular techniques for condition monitoring is vibration signal analysis (VSA), which allows for the early detection of both the type and severity of defects, hence lowering the risk of failure. The analysis of the cordless impact wrench's vibration signal will be done in this study.

The cordless impact handrill itself vibrates at a natural frequency, but because of its defects, the excessive vibration it causes will make using it uncomfortable and affect the quality of the work. A study on it can therefore help to comprehend the vibration signal's nature. The data acquisition (DAQ) device and accelerometer transducer will be used in this study to record the vibration signal. The needed vibration signal will then be extracted from the time domain spectrum using MATLAB and Microsoft Excel once the data has been filtered and processed. Therefore, based on the normal and abnormal situation, statistical data, such as root mean square (RMS), presented in the form of a graph, can be compared. If there are any defects in the cordless impact drill, the vibration spectrum of the frequency domain from normal and abnormal conditions can be evaluated to investigate and compare the pattern of the spectrum.

ABSTRAK

Analisis getaran yang digunakan dalam pemantauan keadaan membolehkan pengesanan dan pengenalpastian bahagian mesin berputar yang rosak. Akibatnya, kebolehpercayaan meningkat manakala kos penyelenggaraan berkurangan dan keselamatan dipertingkatkan. Banyak kajian terdahulu mengenai pemantauan keadaan menggunakan analisis getaran galas, gear, dan aci didedahkan oleh kajian literatur. Salah satu teknik yang paling popular untuk pemantauan keadaan ialah analisis isyarat getaran (VSA), yang membolehkan pengesanan awal kedua-dua jenis dan keterukan kecacatan, seterusnya mengurangkan risiko kegagalan. Analisis isyarat getaran sepana hentaman tanpa wayar akan dilakukan dalam kajian ini. Handrill hentaman tanpa wayar itu sendiri bergetar pada frekuensi semula jadi, tetapi disebabkan kecacatannya, getaran berlebihan yang ditimbulkannya akan menyebabkan penggunaannya tidak selesa dan menjejaskan kualiti kerja. Oleh itu, kajian mengenainya boleh membantu untuk memahami sifat isyarat getaran. Peranti pemerolehan data (DAQ) dan transduser pecutan akan digunakan dalam kajian ini untuk merekodkan isyarat getaran. Isyarat getaran yang diperlukan kemudiannya akan diekstrak daripada spektrum domain masa menggunakan MATLAB dan Microsoft Excel setelah data ditapis dan diproses. Oleh itu, berdasarkan keadaan normal dan tidak normal, data statistik, seperti punca min kuasa dua (RMS), yang dibentangkan dalam bentuk graf, boleh dibandingkan. Jika terdapat sebarang kecacatan pada gerudi hentaman tanpa wayar, spektrum getaran domain frekuensi daripada keadaan biasa dan tidak normal boleh dinilai untuk menyiasat dan membandingkan corak spektrum.

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First and foremost, praise be to Almighty Allah for all his blessings for giving me a strength and patience throughout the duration of completing this report with the title “Study of vibration on defects in cordless impact hand drill using statistical analysis method”.

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LIST OF SYMBOLS AND ABBREVIATIONS

D,d	-	Diameter
mm	-	milimeter
RMS	-	Root mean square
MatLab	-	MATrix Laboratory
Rpm	-	Revolution per minutes
FFT	-	Fast Fourier Transform
DFT	-	Distinct Fourier Transform
DAQ	-	Data Acquisition system
Std	-	Standard Deviation
VSA	-	Vibration statistical analysis
g	-	Gravitational acceleration

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CHAPTER 1

INTRODUCTION

1.1 Background

Vibration is the oscillation or continuous motion of an object around an equilibrium point. Mass (store of kinetic energy), stiffness (store of potential energy), damping (dissipate energy), and force are the four fundamental physical components of vibration (provide energy). There are several types of vibration in engineering that is free vibration, force vibration, damped or undamped vibration, and random vibration. Vibration has a lot of benefits and drawbacks, prompting engineers all over the world to work hard to maximize its benefits while minimizing its drawbacks. Invariably, everything vibrates in the world, certain vibrations are acceptable and useful, while others are insignificant, and still others are tolerable, unpleasant, and unsafe.

Condition Based Maintenance (CBM) has been widely employed by performing some practice, while predictive maintenance is the most reliable CBM. It has the potential to reduce the level of uncertainty in maintenance tasks. CBM could access the element of vibration and simple to employ in a variety of situations, particularly in large machine or heavy-duty industries. Because the vibration spectrum can be obtained when the machine is rotating or moving in a stable state, vibration-based analysis methodologies can be widely used for CBM. Vibration analysis is one of several CBM methodologies used to display and monitor specific machines, components, equipment, and systems in a facility.

In engineering, vibration is unavoidable. Vibration in automobile engines, aircraft engines, machinery, and fan motors happen frequently and will continue to do so even after proper maintenance. Vibration is an oscillating movement or a forced sense of balance in daily used. Vibration Signal Analysis (VSA) can be used to analyze the vibration in machines. Vibration for hand drill can be observed by using vibration spectrum, and then the data that we have obtained will be processed using MATtrix LABoratory (MATLAB).

The influence of vibration on cordless drilling tools is critical to understand since it has a severe effect on performance and can result in equipment failure. Vibrations can have serious consequences if left unchecked, accelerating wear, reducing bearing life, and causing costly equipment damage. It causes noise and safety issues, which can lead to deterioration in plant conditions. However, vibration at high levels can produce cracks, loose bolts, loud noise even failure in structures (Wright, 2010). Vibration can cause a variety of health problems in humans which including weariness, headaches, and gastrointestinal troubles.

As we know, the vibration from an operating cordless impact hand drill will affected our arm-hand. Hand-arm vibration is when utilizing power tools, running machinery, or even holding or directing items as they are processed, vibration is conveyed into the user's hands and arms. Hand Arm Vibration Syndrome (HAVS) is a group of illnesses that includes Vibration White Finger and Carpal Tunnel Syndrome, as well as severe permanent damage to the bones of the hand and arm, can be caused by frequent or chronic exposure to this type of vibration (Dr Oliver Starr,2018). As a result of nerve and blood vessel injury, HAVS patients frequently report aching, tingling, or numb fingers and hands. Muscle weakness, decreased grip strength, and decreased dexterity are among frequent symptoms that can make daily chores more difficult.

In another way, the effects of various failures on the system's vibration response are investigated using the proposed signal processing methods. This study investigates the frequency spectrums of various faults. There will be suggestions for reduce machine vibrations. Various statistical approaches are employed to categories the system's problems. The final results are reached using statistical approaches and the fault's distinct frequencies.

1.2 Problem Statement

Every machine has its down time, either due to an improper operation or any machinery failure. The failure occurred inside the machine components, is hard to detect. Now days, cordless impact hand drills are growing more sophisticated and complex. In a modern cordless impact hand drill, the motor had become the most important component. When a motor isn't performing at its best, it might have an impact on the quality of the task. Aside from that, the motor failure will make the user's grasp on the hand drill uncomfortable. However, it may be difficult to notice a problem with the motor. The vibration signal analysis method is utilized to analyze the fault. To acquire the most presentable and precise data regarding the analysis defect on the cordless hand drill motor, a few statistical methods and equipment will be used in this investigation.

1.3 Research Objective

The main objective of this research is:

a) To measure the vibration on cordless impact hand drill using different parameter and different condition of Cordless Impact Handrill.

b) To analyze the data collected using MATLAB and Vibration Spectrum Analysis.

1.4 Scope of Research

The cordless impact hand drill is the focus of this project. The task consisted of three phases which is experimental activities, signal data analysis, and outcome validation. The vibration data will be collected using accelerometer. The data is converted into numerical values that can be manipulated by computer, which is data acquisition (DAQ). The graph will then create by the MATLAB. FFT and Vibration Signal Analysis (VSA) will be used to represent the data.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The oscillatory motion of a mechanical system is referred to as vibration. All bodies with mass and flexibility produce vibration (Thomson, 1996). As a result, most machines and engineering structures vibrate, and the amount depends on the mass, force exerted, spring stiffness, and damping system in the body. These are the four major components that resulted in vibration. The motion of a rigid body stores kinetic energy in the system, whereas force acts as an external excitation of vibration, increasing the frequency of vibration. Next, stiffness is the deflection of a flexible component that stores potential energy, whereas damping is the dissipation of energy owing to friction or resistance.

Impact hand drill is a machine that used for making round holes or driving fastener in wood and metal work that we used recently. Impact hand drill or sometimes known as hammer drills, are a type of drill that combines a hammer motion with the revolving motion of a normal drill. When the power of the motor cannot spin the bolt, the impact drill will begin to use bursts of energy to "hammer" the bolt in the desired direction. The function of impact hand drill is widely used to secure into wood, metal and also concrete. This chapter will discuss more detail on what we used such as Signal Analysis, Spectrum Analysis and MATLAB.

2.2 Vibration

In any machines or objects, when there are any movement, it will call as vibration. Oscillation or repetitive motion of an object around an equilibrium position is referred to as vibration. In vibration (provide energy), there are four fundamental physical component such as mass (store of kinetic energy), stiffness (store of potential energy), damping (dissipate energy), and force. There are several types of vibration in engineering that is free vibration, force vibration, damped or undamped vibration, and random vibration. Vibration has a lot of benefits and drawbacks, prompting engineers all over the world to work hard to maximize its benefits while minimizing its drawbacks. Invariably, everything vibrates in the world, certain vibrations are acceptable and useful, while others are insignificant, and still others are tolerable, unpleasant, and unsafe.

Vibration is a physical phenomenon that happens in all moving machines and spinning devices, regardless of their condition of health. A rotating shaft, meshing gear teeth, rolling bearing components, a revolving electric field, fluid movements, combustion events, structural resonance, and angular rotations can all create vibration. Vibration is a good tool for detecting the operating state and status of spinning machinery and structures due to its pervasiveness.

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In engineering, the vibration can't be avoided in any machines or objects. When there's is vibration in cordless impact hand drill, automobile engines, aircraft engines, machinery and fan motor, it will continually to do so even after a proper maintenance. In everyday application, vibration is an oscillating movement or a forced sense of equilibrium. Vibration signal analysis (VSA) is a method that can be used to analyzed the vibration in any machines or tools. Vibration spectrum can be used to observed the vibration in impact hand drill and then MATLAB have been used to process the data that have obtained.

2.2.1 Fundamental Of Vibration

The oscillatory motions of objects and structures, whether continuous or transient, are referred to as vibration. In some cases, they serve a purpose and are essential to the design of a machine, such as a pneumatic drill or a reciprocating engine. However, in most cases, they are incidental or inadvertent and may disrupt the normal operation of a structure or instrument.

In drilling operations, there are two types of vibration that have been observed which is External Vibration and Internal Vibration. For external vibration, during an operation of drilling, the drill's spindle may vibrate due to machine vibration induced by a malfunction. These vibrations are represented as external parameter-caused vibrations. However, external vibrations are caused by a variety of reasons, including shaft misalignment of the spindle, motor, nut-bolts, and transmitting devices such as pulleys or gear drives, as well as fasteners such as nut-bolts, clamps, and so on.

Internal vibrations in the drilling process are generated by the drilling process itself in the case involving internal vibrations. Internal vibrations are predictable due to the

system's internal properties. Moreover, there are many factors that contribute to occurs in internal vibration. The factor that may occur is because of the speed of the spindle, workpiece force acting in the opposite direction of the drill motion, feeding rate is high and lastly causing of the drill has a high overhang (Amit S. Wani, 2013).

During the drilling operation, two stages of vibration that has been produced. The first one is when the drill is turning and getting closer to the workpiece and another one is when the drill is spinning and drilling a hole through the workpiece.

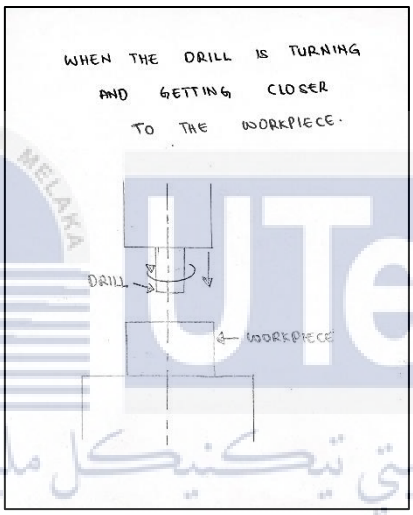

Figure 2.1 When the drill is turning and getting closer to the workpiece.