Vibration sensor mechanical sensitivity improvement

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Abstract— **In this paper, we research the mechanical sensitivity of the vibration sensor; The mechanical sensitivity mathematical model is developed in function of the relative movement modulus in firstly and in function of the measurement error in secondly. The developed model allowed improving the mechanical sensitivity by enhancing the performance of vibration sensor (the best choice of damping rate and the frequency ratio). The right choice of the damping rate and the frequency range allowed keep the mechanical sensitivity constant. This model is validated by computer simulation and experimental tests.**

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Keywords— Sensitivity, vibration, Sensor, modeling, simulation, frequency ratio.

I. INTRODUCTION

In industry, there are a very large number of applications that use the mechanisms in which two bodies in contact move relative to each other. These mechanisms are often subject to wear phenomena (particle detachment) or to vibration phenomena corns in contact. The presence of vibrations in the body may be responsible for unpleasant noise (such as brake squeal) or be responsible for a reduction of the efficiency of the mechanical system (for example the phenomenon of grazing during braking can cause failure of mechanical parts).
To reduce the vibrations of mechanical systems, frequency studies have been conducted to develop systems to reduce this nuisance. This usually results in a geometry optimization or adding damping. Although this approach allows the problem to reduce vibration nuisance, it is based on the study of vibration existing but not concerned with the causes of these phenomena. This approach has two major disadvantages. Firstly it is specific to each mechanical system (geometry, material ...) and must be conducted on each new system with mechanical vibration problems. Second, although it allows reducing vibration, or changing their frequency, it rarely eliminates them [9].
It is therefore necessary to use another approach to further understanding of the phenomena of vibrations induced by friction. Why it is important to study either the vibrations themselves but their origins in order to, not reduce or modify the vibrations but prevent it from being generated. This new approach also allows the problem to generalize studies on different systems (different geometry, material ...) with the same vibration phenomena.
The origin of vibration in the body in contact is the contact itself, the understanding of how the contact and especially the phenomena responsible for the generation of vibrations and also the wear is an important issue both in economic (masters or reduced wear) than term environmental (noise reduction) [7-9].
Vibration analysis of rotating machines is commonly used for monitoring of mechanical components (bearings, gears ...).
These vibrations are detected using sensor called accelerometer or vibration sensor. Its function is to transform the level of vibration into a time electric signal. The rest of measuring equipments (amplifier, FFT analyzer) convert the time electric signal to a frequency electric signal from signal processing operations using software. These operations are signal generation, signal decomposition and signal spectrum calculation. The purpose of signal conversion from time to frequency domain is to identify the frequencies of vibration [1-3].
Sensor sensitivity is very important in the measurement of vibration. A sensitive vibration sensor is an accurate and reliable one.
Given the importance of sensitivity and its influence in the vibration domain, we are interested in studying and analyzing the vibration sensor sensitivity [4].
The sensitivity of the vibration sensor reflects the peculiarities of its electrical response: this is the case of piezoelectric accelerometers, which have no continuous response. The sensitivity study reveals some common key points to different types of vibration sensors [6].
Most machine vibration comes from oscillating or rotating parts. They can be mechanical, electromagnetic, hydraulic, etc... They are transmitted to the structure by means of bearings and foundations via fasteners. But a correct diagnosis based on the reliability of the information gathered and imposes foremost, better accuracy measure. The maintenicien must accurately define all the features required for each point considered. It is easily understood that the best measurement points in the maintenance of machines, are the bearings and it would be unreasonable to take action on the covers [5]. There are different types of vibration sensor, and all three parameters (displacement, velocity, acceleration) can be measured.

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