16th INTERNATIONAL CONFERENCE
Dynamical Systems – Theory and Applications
December 6-9, 2021, On-line
dys-ta.com

Anti-Vibration knob for the Motorcycle, Customizable on the Basis of the Driver's Ergonomics

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Abstract: Tingling in the hands after hours of driving a motorcycle? Old memory! Anyone, young or adult who has ridden a motorcycle for several kilometers, will remember an unpleasant tingling sensation in the hand. The vibrations induced on humans while riding a motorcycle cause this tingling and other unpleasant sensations. Several more or less serious pathologies are caused by exposure to these vibrations, a very common example is Carpal Tunnel Syndrome. Recent studies on the control of structural vibrations, whose excellent results published in international journals of high impact, have stimulated interest in devolving these methods of analysis also for biomechanical structures, such as those of the bone skeleton of the hand. In particular, by analyzing the vibrations induced on humans while driving a motorcycle, it was decided to design and manufacture knobs with anti-vibration material made according to the anthropometric characteristics of the driver's hand. Experimental investigations assess the efficiency of the anti-vibration knob (Italian Patent Application No. 102021000004691 filed on 01.03.2021), reducing the magnitude of stresses in the most damaging frequency range for the driver.

Keywords: Anti-Vibration, Knob, Biomechanical Structures, International Standards ISO.

1. Introduction

The exposure of the human body to vibration is present in everyday situations and may be a source of discomfort and in some cases may cause health problems. Human exposure to vibrations may be classified into two main classes, in (i) Whole Body Vibrations (WBV) and (ii): Hand-Arm Vibration (HAV). Whole Body Vibrations (WBV) are defined as those vibrations that, as the name suggests, affect the whole body, particularly in a frequency range from 0.5 to 80 Hz. This type of vibration may be present in transportation systems, such as buses, cars, trains, etc. Hand-Arm vibration (HAV) are considered as those vibrations that are transmitted to the hand-arm system, in a frequency range from 6.3 to 1250 Hz. This type of vibrations may be present in hand power-tools like pneumatic hammers and saws or in handlebar of bikes, motorcycles. Specifically, WBV affect the human organism via lower extremities, the pelvis and the back; on the other hand in the case of HAV, disturbances in finger’s blood circulation and hand’s neurological function injuries may occur.

2. Results and Discussion

The assessment of human exposure to vibration can be performed in accordance with key International Standards ISO (International Organization for Standardization) that for WBV is the ISO 2631 and for HAV is ISO 5349. Moreover, the primary variable used to characterize a vibration measure is the root mean square (rms) acceleration. This rms acceleration should be weighted in frequency domain, through the use of a weight curve defined in the ISO 2631 and 5349 in such a way to take into account the importance that the vibration at different frequencies may affect human body parts.

Vibrations transmitted to the hand and arm or to the lower-back should be measured in three directions, (x,y,z) according to an orthogonal coordinate system. Since the measurement of vibration should be performed following a system of triaxial coordinates, it will be obtained a value of frequency weighted rms acceleration for each axis, x, y and z, represented by a_{hwx}, a_{hwy} and a_{hwz} in m/s^2. Following ISO requirements, combining these three values by a vector sum, it will lead to the total weighted vibration acceleration a_{hv} in m/s2: $a_{hv} = (a_{hwx}^2 + a_{hwy}^2 + a_{hwz}^2)^{1/2}$. Besides the magnitude of vibration, represented by the total weighted vibration a_{hv}, the assessment of vibration exposure takes into account the daily duration of exposure T, in hours, defined as the amount of time that the hand or lower-back is exposed to the vibrations in one day. Thus, it is defined the daily exposure to vibrations $A(8)$ in m/s2, as: $A(8) = a_{hv} (T / T_0)^{1/2}$ where T_0 is referred to eight hours of exposure. The daily exposure to vibration $A(8)$ is interpreted as a total vibration value weighted by the frequency, expressed as an equivalent value for eight hours of exposure.

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Fig. 1. Complete Instrumentation

The instrumentation chosen (Fig.1) for data acquisition included the use of the ny-myRio 1900 acquisition card and the triaxial MEMS accelerometers GY-61 ADXL335, suitably wired and protected through 3D printed shells. Through this experimental setup, it was possible to assess the efficiency of the prototype of the anti-vibration knob (Italian Patent Application No. 102021000004691 filed on 01.03.2021). Specifically, recording hand vibrations, induced by driving the motorcycle, in both cases: with the original knob (OK) and with the anti-vibration knob (AK), it was apparent the efficiency of the prototype in reducing vibrations as shown in Fig.2.

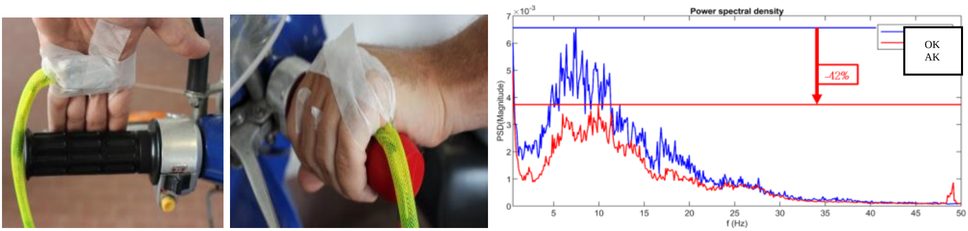

Fig. 2. Original Knob; Anti-Vibration Knob; Power Spectral Density

References

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