TOOL-SPECIFIC EFFECTIVENESS OF VIBRATION-REDUCING GLOVES FOR ATTENUATING PALM-TRANSMITTED VIBRATION

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Introduction

Vibration-reducing (VR) gloves have been increasingly used to reduce hand-transmitted vibration but it remains unclear how much these gloves can reduce the exposure. To help answer this question, the objective of this study is to apply an approximate method to estimate the tool-specific effectiveness of the gloves for reducing the vibrations transmitted to the palm of the hand in three orthogonal directions (3-D).

Method

Four typical VR gloves shown in Fig. 1 were considered in this study, two of which can be classified as anti-vibration (AV) gloves according to the current test standard of AV gloves[1]. Three groups of vibration transmissibility spectra of these gloves were used to synthesize the representative 3-D spectra for the estimations of the glove effectiveness when used with specific tools. The first group of spectra was simultaneously measured in the three orthogonal directions (x_h, y_h, z_h) on a 3-D vibration test system in a recent study[2]. The second group of spectra was measured on a 1-D vibration test system along the forearm or z_h direction in another recent study[3]. The third group of data was measured in the current study in the x_h and y_h directions. As an example, the test set-up in the x_h direction is shown in Fig. 2. The average spectrum of each glove in each direction was used to represent the transmissibility spectrum of the glove. More than seventy vibration spectra of various tools or machines were used in the estimation, which were also measured in this study or collected from reported studies. The tool-specific effectiveness of each glove was estimated using the method similar to that reported before[4]. The performances of the gloves were assessed based on the percent reduction of the frequency-weighted acceleration required in the current standard for assessing the risk of the vibration exposure.

Fig. 1: Gloves used: A- gel; B – air bubble; C- air bladder; D- dipped neoprene.

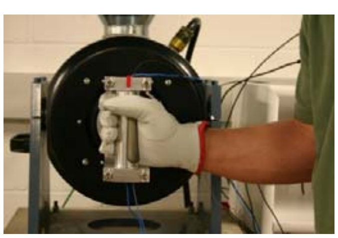

Fig. 2: Additional test in the x direction.

Results and Discussion

Although the excitations used in the measurement of the glove transmissibility on the 3-D vibration test system were substantially different from those used on the 1-D test system, the transmissibility spectra simultaneously measured on the 3-D system were similar to those separately measured on the 1-D system. The spectra measured with the 80 N grip were also similar to those measured with the combined 30 N grip and 50 N push. These observations suggest that it is acceptable to use the linear transmissibility method to approximately estimate the vibration reduction of the gloves.

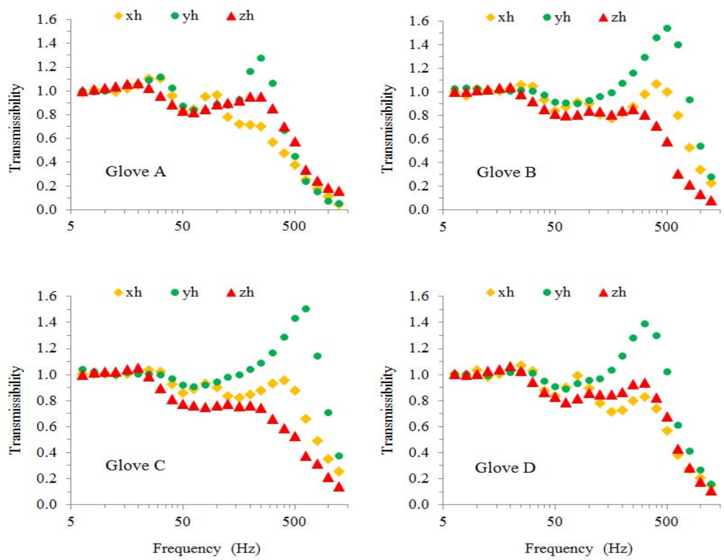

Fig. 3: The 3-D transmissibility spectra of the four

The synthesized spectra of the four gloves are shown in Fig. 3. The estimated tool-specific reductions indicate that the VR gloves could not significantly reduce (<5%) the vibrations generated from low-frequency (<25 Hz) tools or those vibrating primarily along the axis of the tool handle. On other tools, the VR gloves could reduce the palm-transmitted vibration generally in the range of 5% to 23%, primarily depending on the specific tool. While the AV gloves considered in this study were more effective along the forearm direction than other VR gloves, they were less effective in the other two directions. As a result, the non-AV gloves were more effective than the AV gloves at reducing the vector sum of the tri-axial vibrations in some cases. These observations suggest that the single-axis method defined in the glove test standard may not provide a fair judgment of the VR gloves and the AV gloves classified according to the standard may not be the best choice in some cases. The glove selection should consider the 3-D transmissibility values. Furthermore, the effectiveness of the gloves at the fingers is usually much less than that at the palm of the hand. While gloves can keep the hand warm, protect the hands from mechanical cuts and abrasions, and reduce contact stress, they may also increase the grip effort and reduce the finger dexterity. Therefore, the selection of the gloves should consider not only the tool-specific vibration reduction at the palm but also many other factors.

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Forward – Welcome Address

On behalf of my conference co-chairs, I am pleased to welcome you to Guelph, Ontario, Canada for the 5th American Conference on Human Vibration. The 5th ACHV is being co-hosted by the University of Guelph, Laurentian University, Western University and the University of Toronto. We are honored to be hosting this biennial conference on the University of Guelph campus. As the premier North American conference for human exposure to vibration, the conference provides a unique and convenient opportunity for researchers, engineers, medical professionals and industry representatives to exchange information on all aspects of vibration control and human responses to hand-transmitted vibration and whole-body vibration. The theme for this year's meeting is "Human Vibration - From Theory to Industrial and Clinical Applications".

Founded in 1827, Guelph was named after the British Monarch King George IV, who was from the House of Hanover. Selected as the headquarters of a British development firm called "The Canada Company", Guelph was designed by John Galt, who was a Scottish Novelist. The town was designed to resemble a European city center comprised of squares, wide main streets and narrow side streets. Guelph was home to Lieutenant Colonel John McCrae, the author of "In Flanders Fields". Its references to the red poppies that grew over the graves of fallen soldiers resulted in the remembrance poppy becoming one of the world's most recognized memorial symbols for fallen soldiers. Guelph was also the home of North America's first cable TV system. Fredrick T. Metcalf created MacLean Hunter Television (now part of Rogers Communications) and their first broadcast was of current monarch Queen Elizabeth II's Coronation in 1953. With a population of over 120,000, Guelph is part of a technology triangle which is comprised of the cities of Guelph, Kitchener, Cambridge and Waterloo. Guelph is consistently rated as one of Canada's best places to live because of its low crime rate, clean environment, high standard of living and low unemployment rate. Almost one quarter of Guelph employment is provided through the manufacturing sector with over 10% provided through Educational services. The City of Guelph has identified life science, agri-food and biotechnology, environmental management and technology companies as industries on which to focus future economic development activities.

Many thanks to Elyse Dubé from Conference Services at the University of Guelph for all of her hard work in helping to plan and sort through the conference logistics. We'd also like to thank Guelph Engineering students Gregor Scott and Dan Leto as well as School of Engineering technician Carly Fennell for their help in setting up the laboratory tours. We hope that your visit to the 5th ACHV and Guelph will be both educational and enjoyable.

Sincerely,

Michele Oliver, Jim Dickey, Tammy Eger and Aaron Thompson