Keynote Presentation

EVALUATION OF WHOLE-BODY VIBRATION COMFORT

Setsuo Maeda, National Institute of Industrial Health, Kawasaki, Japan
Neil J Mansfield, Loughborough University, Loughborough, U.K

Introduction

The purpose of using experimental subjective and/or perception methods is: (a) to understand human subjective impressions of the physical characteristics of vibration; (b) to determine the relationship between the subjective perception of some aspect of the vibration and an evaluation index of the physical vibration characteristics; and (c) the establishment of target values for design of vibration environments in terms of human sensation of vibration characteristics. In order to understand the relationship between a physical measure of the mechanical vibration and the subjectively perceived aspect of the vibration environment, experimental methods shown in Table 1 have been used[1].

Table 1. Psychophysical methods.

Constant measurement methods	Constant stimulus method Method of adjustment Method of limits Adaptive psychological method
Subjective scaling methods	Interval scale Paired comparison method Category judgment method Proportional scale Magnitude estimation

The constant measurement methods of Table 1 are mainly used for measurement of the threshold of human sense. The subjective scaling methods are mainly used for obtaining subjective (or proportional) scaling between the perceived quantity and physical quantity.

In this review, the fundamental approach of experimental methods for obtaining the target values used in the design of vibration environments, and the different findings between the subjectively perceived methods for evaluating human response to vibration characteristics and the physical quantity of the vibration environment are summarized.

Fundamentals of Subjective Scaling

The relationship between the experimental psychological methods for providing target values in the design of the vibration environments and the physical quantities is illustrated in Fig. 1. Vehicle mechanical vibration can be characterized using many metrics, and these can be considered the 'input' to the human. In order to predict subjective responses to the vibration, it is necessary to link the characteristics of the source of vibration and human reactions, the 'output'.

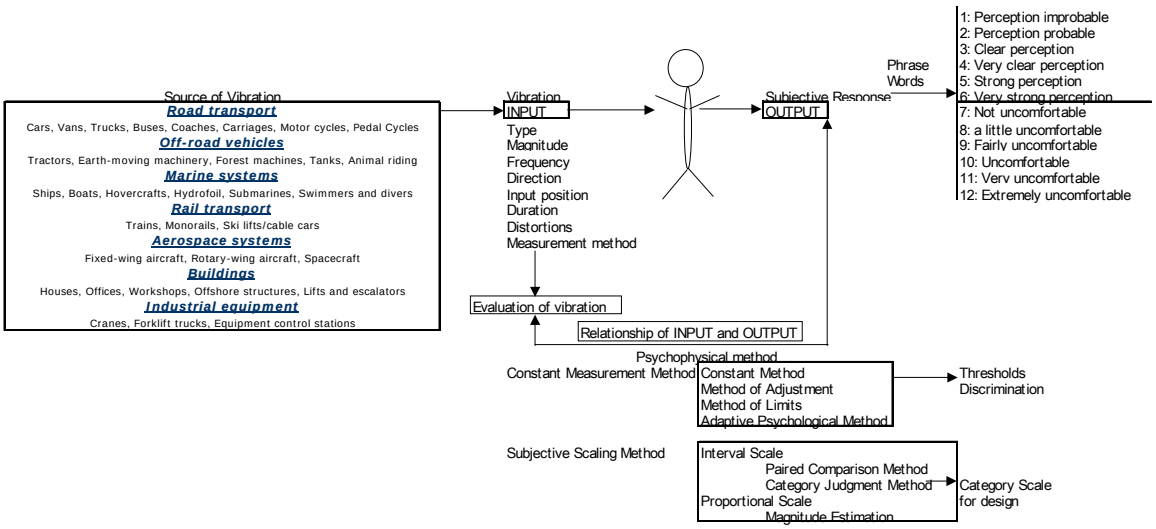

Fig.1 Relationship between vibration and subjective responses.

The constant measurement methods are usually used when the aim of the research is to understand human sensation in response to changes in the nature of the vibration (e.g. changes in frequency). The constant method uses an array of predetermined stimuli at discrete magnitudes above and below the expected threshold; the method of adjustment allows the experimental subject to control the magnitude such that they can set it to their threshold; the method of limits alternates the magnitude between detection and non-detection thresholds; adaptive methods use stimuli with magnitudes which step up and down, crossing the threshold, in response to subjective responses. In all of these cases the threshold could be absolute perception or some form of difference threshold.

Subjective scaling, such as using interval scales or proportional scales, has usually been used when the aim of the research is to understand human sensation in response to changes in the perceived magnitude of vibration. Paired comparisons requires subjects to choose one of two stimuli (e.g. greater intensity); category judgment requires subjects to select from a range of text descriptors (e.g. describing levels of discomfort); magnitude estimation requires subjects to give a numerical score to each stimulus. Some methods are used that try to combine qualities from more than one technique (e.g. Borg CR-100).

Each experimental method works in a different way and has its own advantages and disadvantages. Therefore, researchers must carefully choose the most appropriate experimental method. It is also essential to include enough information for readers to understand and assess the methods used when presenting and publishing results.

It will be necessary to conduct new experiments for the design of vehicles in the future, possibly requiring new psychophysical approaches. For example, new methods might be required to investigate the relationship between the human biodynamic response and subjective responses to multi-axis whole-body vibration.

Reference

1. Guilford J.P. (1954) Psychometric methods. McGraw-Hill, New York.