APPLICATION OF BIOMECHANICAL MODELS IN DESIGN AND SIMULATION OF ACTIVE AND PASSIVE VIBRATION DAMPING

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1. Introduction

Biomechanical models of human body are created for verification of vibration influence on individual parts of human body. By using those models, it is possible to estimate acceleration and frequency of vibrations, without necessity of experimental research. These experimental researches proved to be unreliable. Experiences of individual persons can be subjective and vary widely [4]. In biomechanical models, there are some elementary masses, connected by typical viscous-springy elements.

2. Physical models of the seat and of the human body

There are about 60 models, presented in scientific literature. Usually, there are discrete mechanical models, which consider lying, seating and standing position [3]. According to ISO and DIN standards there are other, simplified models. Those models present human body as sum of four masses in different configurations. In Fig. 1 models of human body, according to ISO and DIN are presented.

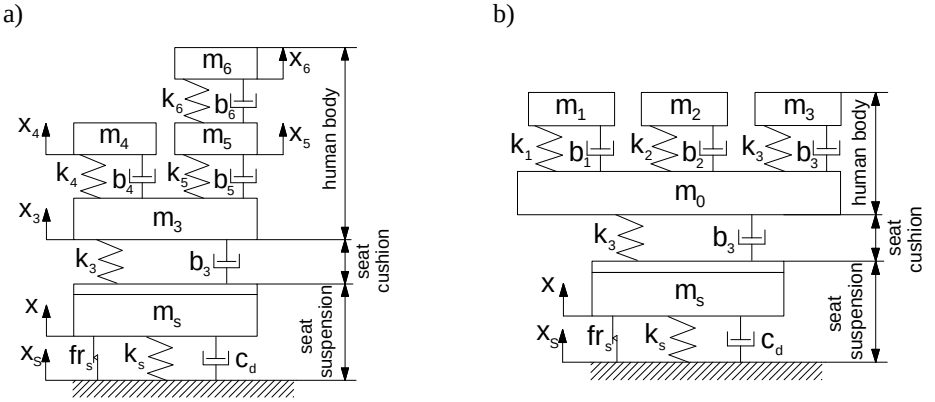

Figure 1. Physical models of the seat and the human body: bio-mechanical model ISO 5982 (a), bio-mechanical model DIN 45676 (b).

3. Simulation results

For evaluation of human body dynamical behaviour the white, band limited noise as excitation signal is used. The courses of power spectral densities of acceleration measured at he seat cushion (PSD) and transfer functions of suspension systems (T), are show in Fig.2. The presented simulation results are obtained for passive and active seat suspension system.

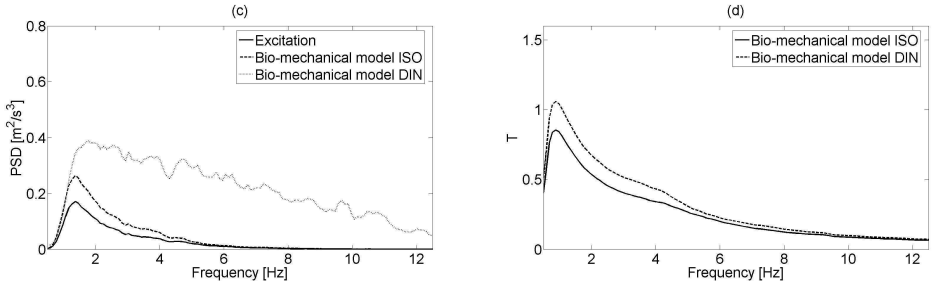

Figure 2. Simulated power spectral densities of acceleration (PSD) and transfer functions (T) of passive (a, b) and active seat suspension (c, d).

4. Conclusions

Values of power spectral density and transfer function, elaborated on the basis of simulation research, show that there are considerable differences between the system loaded by mass of modeled human body according to ISO 5982 and DIN 45676. Whereas, comparing dynamic properties of the seat, in use of two given biomechanical models, practically there is significant difference in the frequency range 0 – 5 Hz. Results of computer simulation show necessity of further investigations, for the purpose of uniform estimation of vibro-isolation properties. A model, which in the best way can reproduce dynamical behaviour of human body is needed.

5. References

[1] DIN 45676 (2003). *Mechanische Eingangsimpedanzen und Ubertragungsfunktionen des menschlichen Korpers*, Deutsches Institute für Normung.

[2] ISO 5982 (2001). *Vibration and shock – Mechanical driving point impedance of the human body*, International Organisation for Standardization.

[3] M., J. Griffin (2004). *Handbook of human vibration*, Elsevier Academic Press.

[4] M. Nader (2001). *Modelowanie i symulacja oddziaływania drgań pojazdów na organizm człowieka*, Oficyna Wydawnicza Politechniki Warszawskiej.