MECHANICAL RESPONSE OF DRIVER`S TORSO – AXIAL SYSTEM TO MONOTONOUS HYPOKINETIC LOADING AND POSSIBILITY OF ITS DETECTION

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INTRODUCTION

Monotonous hypokinetic loading, like sitting when driving a car, may lead to organism exhaustion, that negatively influences driver`s concentration and affects his abbility to adequately respond to external impulses [1]. Sitting stress causes material fatigue of the torso and changes in functional segments of the spine, also changes in circulation and additional chemical, physiological and biomechanical responses of the body [2].

One possible way to detect the mentioned phenomenons is evaluating body response to monotonous stress. As objective characteristic we use transfer function of the torso – neck – head segment.

METHODS

We expect that the changes in mechanical properties would reflect in the transfer function characteristics under vibration exposure. The fatigue effect is induced by the long-run operating activity (driving car in real city traffic). The transfer functions: seat – buttock – head is acquired before and after the driving both in the lab conditions with exact vibration stimulation and under real vibration stimulation by car ride.

It was constructed experimental "chair" simulating vibration stress during car driving (range 1-200 Hz) for lab measurement. It was used accelerometers fasted in the frame of the "chair" and on figurants head. The measurements were done before and after the 3 hours ride (Figure 1 - left).

"In situ" measurements were performed while driving over cobblestones at the constant speed of 30kph 15 min before and after the 3 hours car ride. The vertical amplitudes of acceleration were detected on head, seat – buttock interface and car frame (Figure 1 – right).

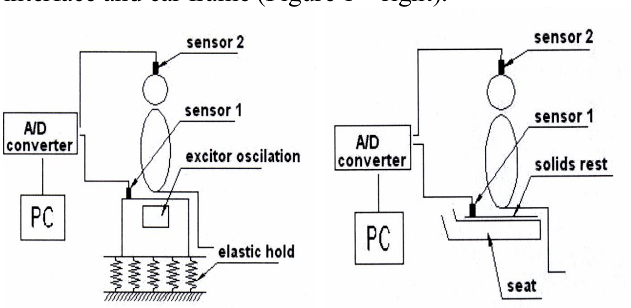

Figure 1: Left – schema of lab experiment setting, right – schema of car measurement setting

RESULTS AND DISCUSSION

This is a case study determining a method from two laboratory measurements and four in situ measurements of one subject.

The results show that the transfer characteristics depend on stimulation frequency, biggest effect had frequencies below 10 Hz.

Transfer function of analyzed segment is changed after the period of vibrational loading.

Change in transfer function is evident both in amplitudes and in phase shifts.

The change in transfer function dependant on fatigue was evident both by lab measurements and in the car ("in situ").

It was used FFT to determine frequency characteristics.

The results prove sensitivity of this method to fatigue phenomenon. On the other hand larger study is needed for the general conclusions.

It is required measurements in three axis and measurements of dependence on duration and magnitude of the stimulation, figurant`s posture and also comparison of driver – passenger outcomes etc.

It would be eficient to compare our results with other fatigue indicators (questionars, tracking task, interface pressure distribution, kinematic analysis, EEG).

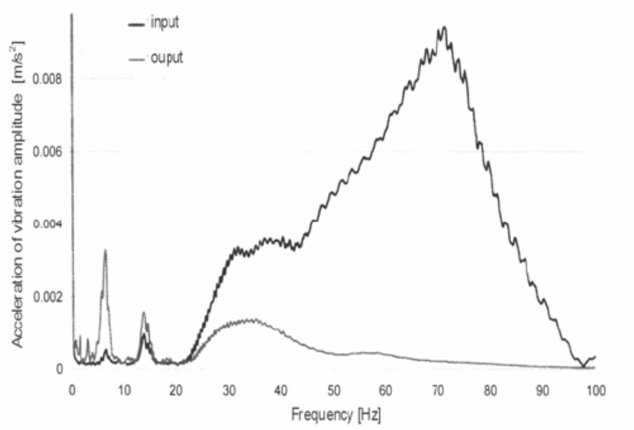

Figure 2: The graph shows that the answer to lab vibrational stimulation has two peaks, first around 5 Hz of stimulation frequency and second around 12 Hz.

CONCLUSIONS

This fatigue detection method will be used for bigger group of figurants. We will also focuse on endangered groups of probands (professional drivers, pregnant women, subject with degenerative changes on axial system, children etc.).

ACKNOWLEDGEMENTS

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