FUNDAMENTAL DYNAMIC CHARACTERISTICS OF HUMAN SKULL
Part II – Measurement and FE Modelling of Stress Wave Propagation after Impact Loading

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Original experimental results for the stress wave propagation in the human skull obtained by the laserinterferometry and double pulse holointerferometry measurements after impact loading are presented for dry and non-dry skull. The influence of the soft brain tissues was approximately modelled by especially prepared gelatine. The 3D finite element (FE) model of the human skull developed from the computer tomograph scanning was used for transient analysis after the impact loading. The FE model incorporates also a model of the interaction of the skull bones with the soft brain tissue. For the numerical simulation of the dynamic response of the skull in the time domain the solution based on the Green resolvent is used in the lower frequency region for a condensed FE model and the implicit Newmark method for integration in a general case using ANSYS code. The results of the calculations are qualitatively compared with the measurements. The FE model enables an approximate modelling of the sound transmission in the human skull to the hearing organs by the bone conduction in the hearing frequency range.

Key words: *transient dynamic analysis, laserinterferometry, double pulse holointerferometry, biomechanics of human head and hearing, bone conduction of sound, finite element model of the skull*

1. Introduction

Studies on dynamic response of human head after a transient impact loading are usually focused on various head injury mechanisms. Head impact experiments and the brain injuries were simulated mainly by FE modelling [1, 2]. However, the purpose of our studies is to create the human skull FE model useable for numerical simulation of the sound transmission in the human head by bone conduction to the hearing organ, especially to the cochlea. Such FE model can help to optimise hearing aids and prostheses for improvement of sound transmission to the cochlea of handicapped human being. A proper analysis of real transmission mechanisms and ways of sound waves propagation in the human skull by the bone conduction to the cochlea is missing.

For a reliable modelling of the dynamic behaviour of the skull the FE model has to approximate the fundamental dynamic properties of the system. This study directly follows the previous Part I [3], where the authors dealt with the frequency modal and vibration characteristics of the human skull. The Part II presented here summarises in a similar manner the original experimental and theoretical results obtained for the stress wave pro-

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