11th World Congress on Computational Mechanics (WCCM XI)
5th European Conference on Computational Mechanics (ECCM V)
6th European Conference on Computational Fluid Dynamics (ECFD VI)
July 20 - 25, 2014, Barcelona, Spain

EXPERIMENTAL IDENTIFICATION OF INERTIAL PARAMETERS OF HUMAN BODY SEGMENTS. APPLICATION TO THE HEAD

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Key Words: Dynamic *Parameter Identification, Inverse Dynamics, Biomechanics*

The determination of the inertial characteristics of the body segments is crucial in the development of biomechanical models. The uncertainties and errors in the masses, location of the centers of mass and moments of inertia can have large effects on the dynamic models (Hatze, 2002). Hence is clear, the relevance of those procedures that may be able to estimate these parameters in a reliable and personalized manner. Traditionally, inertial parameters are estimated by extrapolating data from studies conducted on cadavers. More recently other medical images based systems or mathematical models have been proposed. However, the efforts to measure these parameters from dynamic models are very small and focus on the field of stabilometry.

This paper presents a method for in-vivo experimental determination of the dynamic parameters included in the human body dynamic models. The theoretical model is based on the procedures applied to the experimental identification of dynamic parameters in robotic. The equations of motion of the biomechanical system can be rewritten in a linear form with regard to the dynamic parameters to be identified (moments of inertia of first and second order). Through techniques of selection of relevant parameters it will be possible to deal with the numerically ill-conditioning identification problem presented in the identification process. The experimental set-up is based on measuring the movement of the set of body segments to be analyzed, while the rest of the body remains immobilized. The experimental set-up includes an instrumented chair for immobilizing the movement of the body except the kinematic chain to be analyzed (lower limb, upper limb, head). This movement is measured directly by video photogrammetry, while forces/torques in the proximal joint are obtained through load cells. In this paper, the system has been applied to the determination of the inertial characteristics of the head-neck assembly. The results show the possibility of in vivo measurement of these parameters, allowing customization of full body biomechanical models.

REFERENCES

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