COMPUTING METHOD OF MULTIDIMENSIONAL TRANSIENT FUNCTIONS FOR IDENTIFICATION OF OCULO-MOTOR SYSTEM

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Instrumental algorithmic and software tools for constructing a nonparametric dynamic model of human oculo-motor system (OMS) based on its inertial and nonlinear properties are developed in the paper on the basis of the experimental studies data of «input-output» in the form of Volterra model.

Taking into account the specificity of the investigated object, test multistage signals were used for identification. If a test signal $x(t)$ represents an identity function (Heaviside function) – $\theta(t)$, it will result in identification of the transient function of the first order and the diagonal section of n-th order [1]. To determine the sections subdiagonal transition functions of n-th order ($n \geq 2$), OMS is tested using the n step test signal with given amplitude and different intervals between signals. With appropriate processing responses, n-dimensional transient functions of subdiagonal section are received

$$h_n(t-\tau_1,...,t-\tau_n) = \int_0^\infty \dots \int_0^\infty w_n(t-\tau_1-\lambda_1,...,t-\tau_n-\lambda_n)d\lambda_1 \dots d\lambda_n, \quad (1)$$

where $w_n(\tau_1,...,\tau_n)$ – Volterra kernel of n-th order.

Based on the experimental data obtained using the developed computational algorithms and data processing software, a nonparametric dynamic model of the human-eye apparatus in the form of a transient function and transient functions of the 2nd and 3rd orders is constructed. Verification of the constructed model showed the adequacy of its investigated object – practical coincidence (within the acceptable error) of the object and model feedback for the same test effect.

The information technology for obtaining experimental data for identification of OMS based on tracking the pupil's rotational angle with the help of video registration is developed. The method of carrying out an experiment on pupil eye tracking on the basis of Eye-tracking technology has been developed. Software for automation of experimental research for the identification of OMS has been created.

References

1. *Vitaliy Pavlenko, Dmytro Salata, Mykola Dombrovskyi and Yuri Maksymenko*. Estimation of the Multidimensional Transient Functions Oculo-Motor System of Human // Mathematical Methods and Computational Techniques in Science and Engineering: AIP Conf. Proc. MMCTSE 2017, Cambridge, UK, 24-26 February 2017. Vol. 1872. Melville, New York, 2017. 020014-1–020014-8; doi: 10.1063/1.4996671. Published by AIP Publishing. 978-0-7354-1552-2. - P.110-117.