Laser interferometry method for measuring and analyzing micromovements of the eyeball

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Laser interferometry method for measuring micromovements of the eyeball has been investigated. A technique for processing an interference signal is proposed, which makes it possible to obtain graphs of speed and acceleration during eyeball movements, indicating the nature of eye movement in a closed state. The unknown motion parameters are found from the frequency of the interference signal of the laser self-mixing system as a result of the windowed Fourier transform. A semiconductor laser module RLD-650 based on quantum-well structures with a diffraction-limited single spatial mode and a wavelength of 650 nm was used as a radiation source. Semiconductor laser radiation, which was stabilized by a current source, was directed onto a foil fixed to the closed eyelid. Part of the laser radiation reflected from the foil was returned to the semiconductor laser cavity, and the change in the output power was measured by a built-in photodetector. Experimental measurements were carried out to determine the parameters of eye movement on volunteers at the age of 20 years. For the first volunteer, in a calm state, the velocities of the eyeball movement were in the range of up to 800 µm/s, and the accelerations were in the range of ±20 µm/s². For the second, in a calm state, the velocities of the movement of the eyeball were in the range of up to 1300 µm/s, and the accelerations were in the range of up to 40 µm/s². In volunteers, the speed and acceleration of eyeball movements at rest had the lowest values. These parameters increased with eye movement. When the eye moved to the left and to the right, the speed of the eyeball movement in the first volunteer was higher than when the eye moved up and down. On the contrary, when the eye moved to the left and to the right, the velocities of the eyeball movement in the second volunteer were less than when the eye moved up and down. Interference signals from the movement of the eyeball make it possible to analyze eye movements even when closed. It has been shown that the physiological state of the body can influence the nature of eye movement. This influence can be used to assess the psychoemotional state and diagnose various pathologies of the oculomotor apparatus of the human body.