ABSTRACT

PHYSICAL MODELING OF THE ABERRATION OPTICAL SYSTEM OF THE EYE

Scope of work – 105 pages;

Number of illustrations – 44;

Number of tables – 35;

Number of sources according to the list of references – 25;

Topicality. An objective assessment of visual acuity in order to identify modern methods of professional fitness of a person can be carried out not only by traditional methods using tables with special optotypes, but also by methods of ophthalmic aberrometry of the eye. Aberrometry makes it possible to objectively diagnose aberration deficiencies in the optical system of the eye and to determine effective ways to correct them. One of the urgent tasks of modern medical instrumentation is the development of physical models of the aberrational optical system of the eye, which allows you to test aberrometers. Both the production of aberrometers and the use of aberrometers in clinical practice requires their periodic calibration and verification of the accuracy of their measurements of the amplitudes of the aberration modes of wavefront aberration. The physical model of the eye has previously known aberration parameters. After comparing the results of aberrometry with the aberrations of the model, conclusions are drawn about the accuracy of the aberrometer.

There are several known models of the aberration system of the eye. Model of the schematic eye of Gulstranda, which reproduces only the gaussian properties of the averaged eye. The model of the reduced (simplified) eye, which clearly shows the paracial properties of the eye, it is spherical and chromatic aberration, but such a model is not sufficiently anatomical precision. Models with lenses with parabolic distribution of refractive index, modeling the shell structure of the lens, displacement of the centers of the lens and pupils relative to each other and other non-axisymmetric features of the eye. The disadvantage of these models is the presence of a large number of fitted parameters.

The above models only partially meet the necessary requirements. Therefore, the task of creating the perfect physical models of aberration optical systems of the eye, which makes it possible to use them as reliable and sufficiently precise model measures of the most common aberrations of the eye, remains to be actual.

Object of research: an adjustable deformation of the spherical wavefront after passing through the optical environment of the surface of the eye.

Subject of research: methods and means for generating wavefront aberration with given aberration modes.

The purpose and objective of the study. The purpose of the dissertation is to improve the model of the aberration system of the eye, using of which in practice contributed to improving the quality and reliability of estimates of the accuracy of human eye aberrometry.

To achieve this goal in the thesis posed and solved these problems:

1. To review the known methods and means of creating physical models of the optical system of the eye, their comparative analysis.
2. Analyze statistical data on the aberration state of the optical system of the eye, obtained by ophthalmologic clinics.
3. Develop a physical model of the optical system of the eye, capable of generating wavefront aberrations adequate to aberrations of the human eye.

Publications. According to the dissertation, two articles have been published: one in the scientific conference "A look at the future of instrumentation" in may 2018 on the topic: "Physical model of the optical rystem of the eye"; the second in the scientific conference "Special instrument engineering: state and prospects" in December 2018 on the topic: "Physical modeling of the aberrational optical system of the human eye".

Keywords: aberrometry, wavefront aberration, model of the eye, the amplitude of the aberration modes of Zernike coefficients.