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Way of assignment of admissions of optical details of precision optical units

5. ENGINEERING DESIGN

The problem of assignment of admissions is one of stubborn problems at designing and release of the design documentation for the subsequent manufacturing objectives and other precision optical units. The designer should determine and prove admissions on deviations from settlement thickness of lenses, parameters of refraction of optical materials, accuracy of manufacturing of radiuses of curvature of surfaces.

Examples of such systems are objectives for microscopes. Infringements of settlement sizes are characterized by deviations from initial aberrational correction and deviations paraxial sizes from nominal. Known criterion does not suppose root-mean-square distortion of the wave front exceeding 0.25 λ [1]. However, a developer does not attach significance to such important parameter of quality of system as strict performance of geometrical dimensional characteristics of microobjectives (forward and back paraxial distance and others). At the same time, sizes paraxial distances cause an opportunity of maintenance of numerical apertures and values of depth of sharpness of a microobjective. Entrance and target apertures of a microobjective depend on accuracy of performance paraxial characteristics of an objective and directly are connected to its resolution and light power. They, in turn, are determined by a tangent of a corner of falling of beams and light heights on surfaces.

During assembly of an objective lacks of manufacturing of optical details are eliminated by change of a correctional air interval [2]. Character and size of these lacks just also determine possible admissions on manufacturing those changes of an air interval were effective. However the worker manipulates two air intervals, one of which – paraxial a piece of a microobjective which limits of change is connected to its depth of the sharpness dependent on the numerical aperture. Changing the correctional air interval appointed by the designer, and making refocusing on object, working achieves the

minimal spherical aberration, and, after check of passage of the working aperture. It is quite logical to carry out such "assembly" virtually.

At the first stage algorithm of these actions becomes sequence of actions when from details with a priori set admissions virtual assembly of a microobjective is made by alternate configuration of parameters of lenses by a principle «everyone with everyone». The quantity of possible variations is equaled to number of combinations and determined under known mathematical formulas.

At the second stage the algorithm should allow to carry out assignment of admissions for design data of lenses and a choice of a correctional air interval – in an automatic mode. The admissions appointed thus guarantee success during virtual and real assembly of an objective.

At last stage definition of concrete numerical values of a correctional air interval and paraxial a piece of the microobjective made with a priori known deviations from settlement design data of lenses can be useful.

The new approach to assembly of precision optical units will be, that satisfying a condition of maintenance of numerical apertures and values of depth of sharpness of a microobjective, is provided as well the comprehensible aberrational correction comparable to an initial settlement variant.

References:

[1] Ivanova T.A., Kirillovsky V.K. Designing and the control of optics of microscopes. - L.: Mechanical engineering, 1984.
[2] Sluysarev G.G. Methods of calculation of optical systems. Second edition, L., Mechanical engineering, 1969.

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