Optical calculation of structures and unification of objectives for microscopes

Frolov, A.D. *, Frolov D.N. **, PhD. Technical. Science

* St. Petersburg State University of Information Technologies, Mechanics and Optics

* The Labor-Microscopes, St. Petersburg

Phone: +7 (921) 748-02-12, Fax: +7 (812) 590-82-83, E-mail: fronda@list.ru

Abstract: We propose to conduct multi-level unification of optical systems of lenses at the time of marker and aberration of the optical calculations and design of the optical design. It is shown that by using a basic optical scheme can obtain a whole range of lenses designed for use in various applications and implementation of various research techniques in the microscope. It is shown that the basis for unification of optical systems of lenses for microscopes is the use of optical calculation as a composition of elements with known marker, aberration properties.

1. Introduction

As is known, the optical calculation is the first after agreeing terms of reference and the main stage in the development of lenses for microscopes. Mainly because it determines not only technical but also the consumer properties of the developed lens. When the optical calculation was carried out incorrectly or with errors, it turns out this is only after all other stages of designing and manufacturing the lens, when it spent all of the planned time and material resources. Then all over again, again, the harmonization of technical specifications, a new optical computation and new full cycle of designing and manufacturing the lens. Therefore, the optical calculation though is the result of the virtual work of calculating engineer with a personal computer, and many of the criteria and terms such as "optical axis" - a rather abstract, the experience and qualifications is calculating engineer, his intuition and just "success" a very large extent depends on the appropriateness of the entire project. As a result of the calculation of the optical system are determined by the overall and aberration characteristics of the lens.

2. The unification of the technical characteristics microobjectives

In the development of domestic lenses for microscopes with standardized characteristics revealed a need for qualitative change in methods and approaches to the analysis, design and manufacturing of parts, assembly of lenses for microscopes. To achieve the goal of being an intensive search for the most rational designs, develops and implements in the production of new optical materials, improved methods and techniques of analysis and design, develop expertise.

3. Complete unification of the optical design.

The unification of the technical characteristics of lenses and optical lens design for microscopes is the unification of "high" level when the developed optical design predetermine the process of designing and manufacturing in principle. In this case, does not always mean the borrowing of specific elements with specific design parameters from one lens to another, although such borrowing is not a difficult engineering task. At the present level of development of computer technology, computing speed, formal problem can be solved quite easily. Another thing is that obtained with a "unification" of the optical design can not be considered as optimal.

4. The unification of the basic elements of optical design

Now becoming increasingly widespread principle of modular optical design microobjectives that as of cubes made up of selected basic optical components. These components must be universal in its aberration and overall performance. The most common basic elements are the single lens, as well as cemented doublets. Work basic elements should best use their corrective opportunities. Possible within a single optical design using all the basic elements to correct aberrations, it is known that the use of basic lenses only spherical surfaces, they are in some cases can be free of astigmatism, coma, spherical aberration. Clearly, building an optical system of such elements, which would have no aberrations of any kind, the whole system will also free from these same aberrations. However, practice has shown that the best of this principle can only be the construction of lenses of small increases. In the synthesis of optical lens design of medium and large increases, especially height aperture, the designer must decide the composition from which the basic elements it will use to achieve varying optical correction lenses as well as any aberrations in the basic elements should be corrected, and what to leave (or even increase) to compensate for the subsequent basic elements.

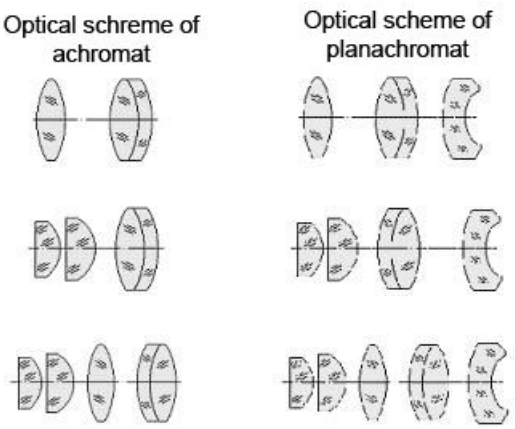
5. Unification of optical structures microobjectives

As base can be regarded as compositions of two or more optical elements. Note that the choice of any optical design determines the magnitude of the relative holes basic optical elements, ie, affects the light diameter of the lens. This means that when the lenses in the same numerical aperture, but by using different optical designs diameter of the lens may be different. The optical power of lenses can also be different. These factors, in turn, determine the initial requirements for the appointment of tolerances for the manufacture of parts, creating a "mechanical"

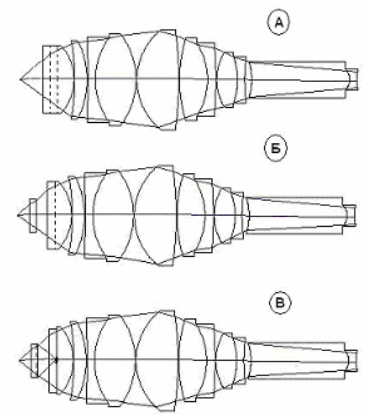
construction of the lens, the choice of methods for control of parts.

It should be noted that the characteristics of selected basic optical elements, as well as some of their combinations within a single optical lens design for a microscope amenable to formalization, as illustrated by the optical circuit microobjectives presented in Figure 1.

Of course, the simpler the design of optical lens, the easier it is to unify the components, but the unification is possible and in complex optical designs. Including and unification of the "entry level" by borrowing elements from the lens into the lens. In Figure 2, for example planahromatic lens with a large working distance, with a linear increase of 100x and a numerical aperture of 0.70, an example of one of the options for unification. The resulting optical calculation of optical design is made in such a way that the "main" variant, the lens works as a lens for the reflected light metallography (ie the study "without coverslip" drug). By changing the thickness of the front lens, without changing other design parameters of the lens, we get the lens for operation in the inverted biological microscope, which is designed to work "through the glass' thickness up to 2mm. Another variation of the frontal component allows get a lens for research on the method of interference contrast.



Pic. 1. Optical schreme of objectives



Pic. 2. Planachromatic microobjective

Conclusion

In domestic and foreign microscopy tendency for the general unification of lenses for microscopes. The natural desire of developers to the unification requires an integrated approach (in the broad sense) to the design, image quality and technical characteristics of the developed opto-mechanical products, in particular, lenses for microscopes.

References

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