PROCEEDINGS

53. IWK

Internationales Wissenschaftliches Kolloquium
International Scientific Colloquium

Faculty of
Mechanical Engineering

PROSPECTS IN MECHANICAL ENGINEERING

8 - 12 September 2008

www.tu-ilmenau.de

TECHNISCHE UNIVERSITÄT
ILMENAU

Published by
Impressum

Publisher Herausgeber	Der Rektor der Technischen Universität Ilmenau Univ.-Prof. Dr. rer. nat. habil. Dr. h. c. Prof. h. c. Peter Scharff
Editor Redaktion	Referat Marketing und Studentische Angelegenheiten Andrea Schneider
	Fakultät für Maschinenbau Univ.-Prof. Dr.-Ing. habil. Peter Kurz, Univ.-Prof. Dr.-Ing. habil. Rainer Grünwald, Univ.-Prof. Dr.-Ing. habil. Prof. h. c. Dr. h. c. mult. Gerd Jäger, Dr.-Ing Beate Schlütter, Dipl.-Ing. Silke Stauche
Editorial Deadline Redaktionsschluss	17. August 2008
Publishing House Verlag	Verlag ISLE, Betriebsstätte des ISLE e.V. Werner-von-Siemens-Str. 16, 98693 Ilmenau

CD-ROM-Version:

Implementation Realisierung	Technische Universität Ilmenau Christian Weigel, Helge Drumm
Production Herstellung	CDA Datenträger Albrechts GmbH, 98529 Suhl/Albrechts

ISBN: 978-3-938843-40-6 (CD-ROM-Version)

Online-Version:

Implementation Realisierung	Universitätsbibliothek Ilmenau ilmedia Postfach 10 05 65 98684 Ilmenau

Home / Index:
http://www.db-thueringen.de/servlets/DocumentServlet?id=17534

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Modeling of optical calculation of frontal lenses in view of technological features of assembly of microobjectives

5. ENGINEERING DESIGN

At calculation of optical circuits of microobjectives the basic attention is given simplicity and high adaptability to manufacture of manufacturing of optical details.

Adaptability to manufacture is a set of properties of the design shown for optimization of expenses of work, means, materials, etc. The computer facilities allows to optimize expenses of work at creation of microobjectives, but manufacturing of these systems is a complex technological problem.

During creation of optical systems of objectives of microscopes inevitably there is a question on an opportunity of their realization in conditions of a batch production. Due to use of computer facilities influence of deviations of their constructive elements of lenses on optical characteristics of an objective can be established on stages of aberrational calculation [1].

As an object of research frontal (first) components of microobjectives have been chosen. As a result of research of optical calculations the following is established:

1. Paraxial distance for different objectives of the same increase can differ on 50-100% and are determined at the task for calculation.
2. Numerical apertures – also.
3. The set of various design data (radiuses of curvature, thickness on an axis and the mark of glasses) defines linear increase and aberrational correction.
4. Sizes of a spherical aberration and isoplanatics have spontaneous character that is defined by the optical circuit of an objective as a whole.

The real optical system represents a point of a subject with the certain aberrations, i.e. errors. Leaving of a point of a subject the homocentric beam of beams after refraction and reflections on a surface of optical system becomes non homogeneous, i.e. not all beams converge in the connected point of object.

In objectives of a microscope it is not possible to correct completely a spherical aberration for a point located on an optical axis of system on all working pupil. If it is possible to correct a spherical aberration at edge on a zone it accepts the significant sizes. Therefore and the image of points of a small element of a plane, perpendicular to an optical axis, will not be ideal. However, it is possible to calculate system so that images of points of a small element of a plane

about an optical axis had the same lacks, as well as the image of the point laying on an axis of system. The condition it refers to as a condition of isoplanatics.

At purpose of admissions for manufacturing of optical details the designer "fulfils" real process of assembly of a microobjective when lacks of manufacturing of optical details are eliminated by change of a correctional air interval. In this case the collector manipulates two air intervals, one of which forward free working piece of a microobjective which limits of change are coordinated to its depth of the sharpness dependent on the working aperture. Changing the correctional air interval appointed by the designer, and making refocusing on object, the collector achieves minimal (on his subjective concept) a spherical aberration, and after check of passage of the working aperture considers, that the objective is ready.

For development of optical circuits of microobjectives it is possible to use components with beforehand known dimensional and aberrational properties.

In Russia the method of an estimation of quality of the image of systems of visual microscopy on character and size of distortion is used at diffraction on an aperture (the diffractive image of a point). At supervision in a plane of the image of a picture of Erie the information contained in a bright nucleus, the first dark minimum and in the second light maximum, enables to estimate size and character of the distortions brought by optical system. Quality of objectives is checked under the image of a point in the center of a field of vision and at edge. This method is recommended in shop certification. However, carrying out of such check needs the special equipment. For example, calculation and use of a special objective for the control is required. Optical calculation and a design of such objective it was offered.

As a result of the lead researches of face-to-face components the following conclusions are made:

1. The basic components, special aberrational correction for an opportunity of control, including with use of elements ASM, face-to-face components of microobjectives are demanding.
2. At calculation of frontal components important that condition Abbe was observed so-called, i.e. isoplanatics value should be minimal.
3. The original objective specially designed for the control of frontal components of microobjectives, has the following characteristics: V =-10x S =-8 mm A=0.45.

References:

[1] M. Laikin. Lens Design. – 2nd ed., rev. and expanded. ISBN 0824796020.

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