PROCEEDINGS

55. IWK

Internationales Wissenschaftliches Kolloquium
International Scientific Colloquium

13 - 17 September 2010

Crossing Borders within the ABC

Automation,

Biomedical Engineering and

Computer Science

Faculty of
Computer Science and Automation

www.tu-ilmenau.de

TECHNISCHE UNIVERSITÄT
ILMENAU

Impressum
Published by

Publisher:	Rector of the Ilmenau University of Technology Univ.-Prof. Dr. rer. nat. habil. Dr. h. c. Prof. h. c. Peter Scharff
Editor:	Marketing Department (Phone: +49 3677 69-2520) Andrea Schneider (conferences@tu-ilmenau.de) Faculty of Computer Science and Automation (Phone: +49 3677 69-2860) Univ.-Prof. Dr.-Ing. habil. Jens Haueisen
Editorial Deadline:	20. August 2010
Implementation:	Ilmenau University of Technology Felix Böckelmann Philipp Schmidt

USB-Flash-Version.

Publishing House:	Verlag ISLE, Betriebsstätte des ISLE e.V. Werner-von-Siemens-Str. 16 98693 Ilmenau
Production:	CDA Datenträger Albrechts GmbH, 98529 Suhl/Albrechts
Order trough:	Marketing Department (+49 3677 69-2520) Andrea Schneider (conferences@tu-ilmenau.de)

ISBN: 978-3-938843-53-6 (USB-Flash Version)

Online-Version:

Publisher:	Universitätsbibliothek Ilmenau ilmedia Postfach 10 05 65 98684 Ilmenau

Home / Index:
http://www.db-thueringen.de/servlets/DocumentServlet?id=16739

EXPERIENCE WITH DIGITAL MICROSCOPES

Vinogradova O. A. *, Cand.Tech.Sci.; Pavliy A.D. **, Frolov A.D. **, Frolov. D.N. *, Cand.Tech.Sci.
* Firm "Focus", St.-Petersburg
** The National Research University of Information Technologies, Mechanics and Optics

ABSTRACT

We reviewed the theoretical and practical aspects of creating digital microscopes, in which the image of the object is projected onto the electronic.

1. INTRODUCTION

The block diagram of a digital microscope is solved as a composition of at least two modules: the projection optical-mechanical (objective), which serves to transfer object image to receiver and electronic (the receiver), which serves to process data. To display the information received is used monitor separately or as part of a personal computer. The basic role of optical-mechanical module, the lens is responsible for the correctness of a function of image formation for further work with other modules.

You can use multiple lenses, which reproduce the characteristics of lenses of conventional microscopes for observing the images through the eyepiece [1]. In this case, it is possible to significantly reduce the size of the projection optical-mechanical module, to reduce the weight and dimensions of the digital microscope. However, it is always advisable, as with most such lenses technical capabilities receiver are not used to the fullest. This applies, first of all, the resolution of the receiver, which must comply with the resolution of the lens. Therefore, we propose to use only one lens, which has forced specifications.

2. ACQUIRING IMAGES IN DIGITAL MICROSCOPY

One of the principles of the microscope is to ensure the similarity of an image of the object. The digital microscopes used two-stage system. The first stage, optical projection, forms the image of the object on the receiver. The challenge is to ensure compliance with the parameters of the lens parameters of the receiver. As the image detector used CCD, CMOS, etc. In the digital microscope transmitted to the receiver vector field of the object must conform to the normal, observed through the eyepiece. Therefore, you should choose a receiver of at least 1 inch. We assume that the measure of the resolving power of the receiver is the size of a single pixel of the "elementary" structure of the receiver (although practical experience shows that to obtain a digital microscope, a good image is required to complete 2-3 pixel detector). The image of the object structure the minimum size of the resolving power of the lens should be the size of one pixel unit.

The second stage, "E" consists of a receiver and monitor. As can be seen, the receiver is the link between the two steps. The choice of the monitor in digital microscope should not be accidental. With all the variety of different combinations of sizes of monitors and receivers the characteristics and consumer properties of digital microscopes can differ significantly. In modern monitors the length of the diagonal pixel is approximately 300 microns, and the length of the diagonal pixel in modern receivers is about 3 microns. If we assume that each pixel in the display corresponds to a pixel detector, the value of "e" to increase the visualization system will be about 100x. This information about the image of the object microscopy, "adopted" the receiver will be fully transferred to the monitor.

3. FEATURES AND LIMITATIONS OF DIGITAL MICROSCOPES

There are important conditions which determine the approaches to the development of digital microscopes. Some classical studies, possible when observing through the eyepiece, can not be implemented in a digital microscope. For example, the study phase, anisotropic, fluorescent and other objects. A characteristic feature of the image detector and monitors - their cellular structure limits the spectrum of research and inability to determine the full replacement of observation through the eyepiece. In a typical three-phase CCD with electrodes made of polycrystalline silicon is often used as a detector of optical radiation, the light entering the semiconductor, passes through several layers, the thickness of each of which is comparable to the wavelength. These layers have different optical characteristics, resulting in inevitable appearance of strains of the world, including, as a result of interference phenomena. These and other factors are the source and cause the emergence of the so-called "Noise". Spectral characteristics of observation through the eyepiece and used in digital microscopes receiver also does not coincide completely, determines the impossibility of complete correlation of research results. Despite these limitations, digital microscope can be used for most types of microscopic studies. When designing a digital microscope to take into account the specific requirements for the design of its main modules in the first place, the projection optical-mechanical module - the lens.

4. REQUIREMENTS FOR THE OPTICAL SYSTEM OF DIGITAL MICROSCOPE

A compulsory element of the optical system is a digital microscope lens, carries a projection image of the object at the receiver. Illumination and observation observation system through the eyepiece can also be part of a digital microscope, but not necessarily. Because the classical theory of image formation in the microscope is not fully be used when creating a digital microscope, the calculation of its optical scheme. This is the definition of the resolving power of the lens and the nature of his aberration correction. But, first and foremost, it concerns his position and lighting characteristics.

Receiver image, in contrast to the human eye is not able to "adjust" under the resulting image. Familiar features of observation - accommodation, convergence is not available. The receiver is very sensitive to differences of illumination and the presence of optical vignetting. The design solution, causing the possibility of calculating the optical system for digital microscope is not unique, that is the subject of many discussions between the developers. We suggest using a telecentric system [2] as a basis for constructing the optical system of digital microscope. And you must use the principle of telecentric theory not only for the projection system (lens), but also for lighting and surveillance systems through the eyepiece (if they exist in a digital microscope). Figure 1 compares images of the same objects, obtained using conventional and telecentric system. In a system with a telecentric rays moving the object along the axis does not affect the size of the image, and images of extended objects along the axis will not be italicized.

It should be noted that the optical system is considerably more complicated in comparison with that in normal light microscope, and, as a complication of the concerns of the projection optical system (mainly lenses), and lighting.

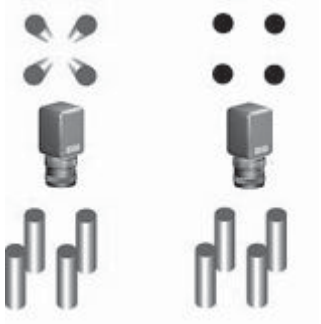

Fig. 1. Images of the same objects, obtained using conventional and telecentric system.

CONCLUSION

The characteristic microscopic process of obtaining congruent enlarged image of the object for subsequent study could be implemented in digital microscopes. Digital microscope system can not fully ensure the functionality of a traditional observation through the eyepiece, however, can be used for most purposes in practical microscopy. The best seems to use a digital microscope having an illumination system and the possibility of observing through the eyepiece.

REFERENCES

[1] G.E. Skvortsov, V.A. Panov, N.I. Polyakov, Fedin, L.A. Microscopes. - L., Engineering, 1969.

[2] Frolov, D., Zverev VA, Raguzin RM The optical system of the modern microscope / / Journal of Optical Technology 2002 Volume 69, № 9 pp 11-15