Optica Applicata, Vol. XV, No. 1, 1985

Book reviews

Optics in Biomedical Sciences

Proceedings of the International Conference, Graz, Austria, September 7–11, 1981

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Springer Series in Optical Sciences, Vol. 31

Springer-Verlag, Berlin, Heidelberg, New York 1982
[pp. i–x + 274, with 212 Figs.]

This book contains the proceedings of an international conference held in Graz (Austria) in September, 1981. The conference was organized as a satellite meeting of the 12th Congress of the International Commission for Optics. The conference was focussed on the applications of general optical techniques in biomedical research and clinical diagnostics.

The book includes both the invited lectures and the contributed papers. It comprises the following topical parts: *Unconventional imaging in microscopy* (4 invited papers and 1 contributed paper), *Image processing* (12 contributed papers), *Interferometry and holography* (12 contributed papers), *Speckle-techniques and spectroscopy* (1 invited paper and 7 contributed papers), *Optometry* (1 invited paper and 11 contributed papers), and *Moiré methods* (1 invited paper and 5 contributed papers).

The invited papers were given by the following authors: P. W. HAWKES – on methods and recent developments of electron microscopy in medicine and biology, S. BOSECK – on applications of electron microscopy in medicine and biology, V. V. SAVRANSKY and G. A. SITNIKOV* – on laser projection microscope, its principle and applications in biology, C. F. QUATE and E. A. ASH – on ultrasonic microscopy in medicine and biology, O. J. LØKBERG – on speckle techniques for applications in biology and medicine, H. C. HOWLAND – on optical techniques for detecting and improving deficient vision, and by G. WINDISCHBAUER – on applications of Moirè techniques in medicine and biology. Except for the paper by V. V. SAVRANSKY and G. A. SITNIKOV, the invited papers mentioned above are of review character. Their texts are too short, if compared with the oral presentation at the conference. They provide, however, valuable reference material for all those engaged in medical optics and related interdisciplinary research fields. Unfortunately, the proceedings are incomplete, as the book does not include greatly valuable invited lectures, namely, those given by J. S. Ploem on image processing in biomedical sciences, S. Lowenthal on unconventional imaging in X-ray microscopy, H. Ohzu on biomedical applications of holography, and by T. Hirschfeld on the status of flow cytometry. I think, this may be due to the invited speaker's fault! Navertheless, the book represents a large contribution to the interdisciplinary dialogue necessary among researchers in optics and bio-medicine.

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* P.N. Lebedev is not the third co-author of the paper but the memorial name of the Physical Institute of the Academy of Sciences of the USSR in Moscow (The P.N. Lebedev Physical Institute etc.). A similar mistake is on p. 131, where a comma between the words "Fryderyk Chopin" and "Academy of Music" suggests that the most famous Polish composer and pianist of XIX-century is a co-author of the paper by R. Pawluczyk et al.

Part I presents a valuable survey of the development in the field of acoustic microscopy realized through scanning, as it is done in the *Scanning Electron Microscopy*. An acoustic image, displayed on TV monitor results from the reflection properties of an acoustic beam at the interface between a liquid and a solid. This system was primarily developed by C. F. QUATE and his co-workers, and today it presents a practical value in biomedical research. Excellent acoustic reflection images of a chick embryo fibroblast, some cellular details, and other biological materials are demonstrated. An interesting development of the application of photo-acoustic effects to microscopy has been observed recently. In this technique, known as optoacoustic (photoacoustic) and photothermal imaging, a modulated laser beam incident on the specimen excites thermally acoustic waves which can be detected by a variety of means. This hybrid optical-acoustic system permits a spectroscopically selective imaging. It is just reaching the stage of development, at which useful images of metallurgical and biomedical specimens are obtained. A contribution to this subject is given by G. BUSSE.

Another fascinating approach to technical and research problems of biological microscopy is developed by a group of scientists in the Lebedev Physical Institute (Moscow); this is a laser projection microscope. In general, for projection microscopy the passive displays of the image, e. g., diffuse screens, are used. In many cases, however, these systems are unsuitable in biology since they require strong illumination and highly intensive light fluxes may degradate or even destroy the object under examination, especially when living cells or tissues are investigated. One of the ways to overcome these drawbacks is the use of a laser amplification system. Its idea was given by Rabinovitch and Chimenti in 1970 and is extensively developed by Russian researchers who demonstrated at the conference a number of excellent images of biological specimens, observed by using this sophisticated system. Some of these images are presented in the reviewed book.

Part II includes rather theoretical contributions concerning the biomedical image classification, digital image analysis, optical Fourier transforms, processing of radiographs, use of gamma rays and tomography to detect pulmonary oedema, and similar problems.

Part III, the largest part of the book, deals with holographic and interferometric investigations of different parts of the human and animal bodies (dentures, tooth, tympanic membrane, eyeballs, pelvis, ...). In this part the most interesting paper is that by R. PAWLUCZYK and co-workers (from Warsaw, Poland) on the use of holographic interferometry to record vibrations of the face and neck when singing (a more exhaustive paper on this subject is given by R. Pawluczyk et al. in Applied Optics, Vol. 21 (1982), 759–765).

In Part IV mention should be made of O. J. LØKBERG'S and P. NEISWANDER'S paper on bio-medical use of electronic speckle pattern interferometry. This system has been used to study and measure the movements of biological objects like the human body. Experiments on vibration analysis of the basilar membrane and of the human hearing mechanism are presented. Some other papers in this part deal also with similar investigations of human tympanic membranes. I appreciate also the paper by P. H. KAYE and co-workers in which the laser diffractometry is used to categorize microparticles and biological cells. The paper by L. SZALAY on biomedical applications of molecular luminescence is, however, of review character and deals with some fundamental phenomena which cannot be qualified as a material for contributed paper.

Some useful instruments and optometric methods are covered by Part V. For instance, mention should be made of computer-aided objective optometer (D. BRUNEAU et al.), microprocessor-controlled laser scanning device for fundus imaging (U. KLINGBEIL et al.), laser optometer for examination of low-luminescence myopia (E. INGELSTAM and K. JANSON), device for measuring the shape of soft corneal lenses (W. H. STEEL and C. H. FREUND), technique for typographical and tear film thickness measurements of the cornea of the human eye (R. BUSCHNER et al.), speckle pattern stimulator for visual evoked potentials. I think that this part is the most practical part of the reviewed book.

Moiré technique is now readily accepted as an optical technique used to examine surface contours of different parts of human body. Part VI proves that this method is very useful

for research of the topography in scoliosis deformities, results of cosmetic surgery (e. g., symmetry of the nose), and other medical problems. In this part there is also a paper on rasterstereography used for automatic measurement of body surfaces. Rasterstereography is a photogrammetric method for three-dimensional measurement of body surfaces. However, in contrast to conventional stereophotography, but similarly to Moiré topography, a three-dimensional information is contained in a single image in projected and distorted raster lines.

The book is intended not only for research workers in optics but also for engineers, physicians, biologists, and others for whom optical methods may be useful in biomedical science and practice.

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