

Visualization in Biomedical Microscopies: 3-D Imaging and Computer Applications. Andres Kriete, ed. VCH Publishers, Weinheim, Germany, 1992, 404 pp. DM 258.00

The essence of visualization lies in capturing an image and getting the maximum information out of it.

In 1988, an international conference on 3-D image processing in microscopy was hosted by the Institute of Anatomy and Cytobiology at the University of Gießen in Germany. This conference had opened a forum for scientists to discuss all the advances in microscopical 3-D imaging, reconstruction and analysis. With a special emphasis on confocal microscopy, many similar conferences were later held at Amsterdam (1989), London (1990), Atlantic City (1991) and so on. In an attempt to conglomerate all the material presented at five different conferences, Andre Kriete has brought together a select group among the many leaders in 3-D microscopic imaging, guided by the hope of giving a comprehensive and balanced picture of the field.

Kriete admits that the knowledge of computer science is the key to scientific visualization, but if applied to biomedical microscopy in multi-dimensions, it is essential to combine a range of different disciplines and diverse instrumentation. For instance, expertise in biological specimen preparation, technology of microscopy, physics of imaging, and the principles of both computer science and the branch of medicine or biology are essential.

This book is an introductory guide as well as one of the first of its kind on bio-medical visualization in microscopy, a new method of computer-aided 3-D imaging. This multi-authored book, covers many aspects of computer graphics, image analysis and specimen preparation. Specific examples include 3-D imaging of serial mechanical sections in light and electron microscopy as well as non-invasive sections in microtomography and confocal microscopy.

Among the modern techniques for visualization of microscopic images, Confocal Laser Scanning Microscopy (CLSM) appears as one of the most exciting and

valuable new developments. CLSM reduces the depth of focus with spatial filter arrangements, thus allowing optical sectioning (microtomography) which is ideal for studying the 3-D morphology of nerve cells (as described in detail in Chapter 5). If compared to a conventional microscope, the confocal microscope offers an enormous improvement in the axial resolution, which can be described in terms of wave optics which has relevance to cell biology (entailed in Chapter 6).

Two different kinds of confocal instruments are available: the tandem scanning microscope (TSM) and the laser scanning microscope (LSM). The TSM uses normal light chopped by a rotating Nipkow-disk, and allows real-time and real-colour imaging. The more commonly applied LSM, which uses a laser source for scanning a specimen, has the advantage that one can optimize magnification by modifying scan angles. In addition, various imaging modes such as fluorescence, interference and polarization contrast are possible. The total effect of the confocal principle is reached by lenses with high numerical apertures.

At present variations of the confocal technique are being developed such as scanning in real-time or simplified arrangements, such as the fibre scanning optical microscope. A totally different approach to reduce out of focus blurr, is based on a physical phenomenon called double-photon excitation. In this case, fluorescence is generated by simultaneous absorption of two photons of long wavelength at the site of a single molecule. The necessary energy emitted by pulse lasers is only present at the focal plane, thus a 'confocal' effect is originated without any additional manipulations.

There are yet about 3-4 alternatives to optical microscopy available to us today, viz. the acoustic microscope, NMR imaging, X-ray microscopy and scanning tunneling microscopy (STM). Each of these have limitations of a unique kind and hence have restricted use in biomedicine.

The primary drawback of the acoustic microscope is that it requires sophisticated algorithms to facilitate image interpretation from the depth depending on the material. NMR-imaging represents a

remarkable development in microscopical science and an extremely valuable tool in biomedicine. However, a major disadvantage of this technique is that it entails very high cost. X-ray microscopy characterized by high penetration power, is also a potential tool for the 3-D investigation of opaque biological specimens. STM has mainly been employed for the study of material science and is not usually applied to biomedicine.

Applications of these different techniques are well presented in separate chapters. These are:

- (i) Confocal Laser Scanning Microscopy (CLSM) or optical sectioning used as a tool for studying the morphology of nerve cells.
- (ii) Confocal Fluorescence Microscopy (CFM) and its application to cell biology.
- (iii) Microscopical visualization of the brain *in vivo*.
- (iv) Confocal Ocular Microscopy (COM) used in ophthalmology.
- (v) 3-D image cytometry.

In one of the chapters which is authored by Kriete an exciting new technique has been presented, viz 4-D visualization: the time-resolved imaging of *in vivo* microstructures.

Recommendations of hardware and software needed for a particular kind of microscopy have been mentioned at the end of almost every chapter.

This book presents an excellent 'image' of 3-D imaging. However, very high costs are involved in advanced microscopy and instrumentation and so not easily affordable by institutions of developing countries. Secondly, as pointed out by Alan Entwistle of the Ludwig Institute for Cancer Research, London, it would be essential to train or teach technicians as well as senior staff if the complete potential of these versatile techniques have to be exploited.

Nevertheless, this book will serve microscopists, physicists, computer experts, biologists and medical experts as an introductory text as well as a reference source.

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