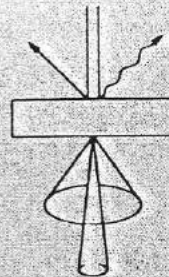


# SEMT

Society of Electron Microscope  
Technology



## THE USE OF COMPUTERS

## IN ELECTRON MICROSCOPY

Friday, 7 December 1990

at  
IMPERIAL CANCER RESEARCH FUND  
Lincoln's Inn Fields, London WC2

### PROGRAMME

**2.00 Image archiving in current EM technology**

Stephen Metcalfe (Sight Systems, Newbury, Berks.)

**2.35 Biomedical applications of 3-D reconstruction**

John Cookson (Hill Centre, London Hospital Medical College.)

**3.10 Tea**

**3.30 Semi-automatic and automatic image analysis.**

Brian Hayes (Berkhamstead, Herts.)

**4.05 Morphochemical Analysis**

Andrew Morris (Leica, Cambridge)

**4.40 Chairman's Summing up and general discussion**

**5.00 Twentyfirst Birthday Celebration.**

Past members and friends of SEMT will join us for a finger buffet with wine to commemorate the first 21 years of SEMT.

# THE USE OF COMPUTERS IN ELECTRON MICROSCOPY

Friday, 7 December 1990

## ABSTRACTS

### IMAGE ARCHIVING IN CURRENT EM TECHNOLOGY

**Stephen Metcalfe (Sight Systems, Newbury, Berks.)**

With modern technology, picture storage using computers offers many advantages. These advantages will be explored and compared with existing methods of image storage.

Photography has long been established for recording images from both electron and optical microscopes and in recent years new technology such as video printers have made inroads into this arena. Although not new technology, optical disc image storage is making a parallel path. Whilst it is unlikely that this new technology completely replaces photography many advantages are available to the forward thinking laboratory.

Drawing an analogy between video printers and photography, the video printer still will not offer the same quality and definition as wet photography but the advantages, namely speed, low cost and convenience has encouraged many laboratories to take on video printers to support photography and increase overall efficiency. Likewise optical disc storage suffers from similar limitations in quality terms but can also provide many advantages namely low cost storage, database convenience (no more searching through boxes of pictures) and a stepping stone on the march of Information Technology since our pictures are stored using internationally recognised digital standards.

Physically, an image archiving system consists of a computer, some sort of image capture or display device, a mass storage area for the picture data, either erasable or permanent and most important, easy to use and understand software (OASIS). Optical disc systems can be configured for less than £4000 depending on the configuration. In summary, the advantages and convenience of a mass picture storage system can be both affordable and useful.

### BIOMEDICAL APPLICATIONS OF 3-D RECONSTRUCTION

**John Cookson (Hill Centre, London Hospital Medical College)**

Serial sectioning is used to help biologists and biomedical scientists understand the structure of individual organs, tissues and cells, the structure of the components hidden within them and the relationships and connections between these structures.

Two methods have been applied to 3-D reconstruction of serial section data normally depending on the source of the sections. The acquisition of slice data from scanning systems is usually in the form of arrays of numbers each of which represents the value of a measured parameter over a finite volume of the slice. This volume is called a volume element or voxel.

The advent of newer microscopical and imaging techniques including computerised tomography (CT scanning), Positron Emission Tomography (PET), magnetic resonance imaging (MRI) and confocal laser scanning microscopy (CLSM) has led to an explosion in the numbers of such data sets.

Other data are based on digitised boundary data from adjacent sections which must be joined by surfaces. The most common method to produce a model of the surface is by triangulating the surface between the contours. Displaying surfaces made up of triangular patches can be done with classical computer graphics techniques.

The display and manipulation of voxel data requires the storage of very large quantities of information. Systems for this are very expensive. As these are coming down in price more applications will be possible. The advent of new computer technology, notably highly parallel systems and chips such as the Intel i860, offer the prospect of very fast reconstructions and the software to make this a routine technique. Systems for display of triangulated surfaces can be based on smaller computers such as the IBM-PC.

Applications of surface and volume rendering techniques to X-ray microtomography, electron microscopy, light microscopy, CT scanning systems and gross anatomy are described. The limitations and strengths of the different reconstruction and display systems are discussed.

## **SEMI-AUTOMATIC AND AUTOMATIC IMAGE ANALYSIS.**

**Brian Hayes (Berkhamstead, Herts.)**

A review will be given of the different types of image analysis system, from simple systems where micrographs are traced using a digitiser tablet to automatic systems for video analysis. The advantages and disadvantages of the different systems for electron microscopy will be discussed, and examples of applications will be given.

## **MORPHO-CHEMICAL ANALYSIS**

**Andrew Morris (Leica, Cambridge)**

The morpho-chemical analysis system has recently been launched by Leica Cambridge Ltd. This system consists of a Stereoscan 360 electron microscope together with an energy-dispersive micro-analysis system which have been combined with a Quantimet 570 Image Analyser. The result is an instrument which is ideally suited to combine image and elemental information.

The rationale behind the morpho-chemical analysis system was to combine a SEM with an image analyser containing a custom-built architecture. The Quantimet 570 contains all the features found on previous Quantimets, such as an extensive range of field and feature measurements and binary image processing. In addition the Q570 offers large grey image storage facilities and a wide variety of image transforms. Many of the morphological transforms developed in France at the Ecoles des Mines have been implemented in the Q570. These processes are designed to enhance certain features within images whilst suppressing others and they therefore are very useful in the analysis process.

This paper provides an overview of the system from both the image analysis and electron microscopist's standpoints. It continues to describe the way in which it is operated providing maximum ease of use and sample throughput.

### Image Archiving in current EM Technology - S. Metcalfe

Why do we need to archive? The image may not be repeatable: to make it available for subsequent image processing: for peace of mind.

Why on film? Originally it was the only system available. Now video printers can be used, and are cheaper; stereo pairs can be stored. Image processing is relatively new.

"Oasis" can take input from LM, EM, video recorders etc. The output can be to printer, monitor, etc. Mass storage on optical disks is possible, at a cost of about 6p per picture (once you have got the hardware!). At first it was only on Write Once, Read Many disks; erasable optical disks can now be used. The system is compatible with Link. A computer database can be used for filing.

Modern EMs have the possibility of direct linkage; old ones need to have a slow scan added, to a video converter, at a cost of about £12,000.

### Bio-medical Applications of 3-D Reconstruction - J. Cookson

The first problem is to get good serial sections, aligned and un-distorted. Get computer reconstruction of outline showing layer effect of sections; do triangulation on these, then get the computer to smooth them. Then add colour, highlights: the apparent light source can be moved; stereo pairs can be produced.

He uses IBM computer with Super VGA graphics board. This was for a study using tetracycline lines to mark growth.

The technology is available, but needs to be developed further and marketed.

At present, he suggests taking ~~pg~~ photographs first, then processing them, rather than taking the image directly from the EM; it is difficult to trace round an outline at the same time as determining exactly where it is.

Semi-automatic & Automatic Image Analysis - B. Hayes

On digitiser tablets, trace outlines with the cross-wire of the mouse; he uses an Acorn Archimedes computer. This system is now considered old-fashioned by the manufacturers. The tablet accuracy is about 0.2 mm.

Datafiles of measurements can be displayed graphically.

Archimedes boards cost about £300; IBM much more.

Granulometry - opening a field to analysis by shrinking grains which are touching in a crowded field.

When choosing software, do specify the measurements which are to be made, if special ones will be required.

Morphochemical Analysis - A. Morris

Granulometry can also be used to remove small particles completely.

"Watershed function" of various grey levels can delineate zones of influence of depressions, nuclei etc.