MICRODENSITOMETRY AND MICROCOMPUTER VIDEO IMAGE ANALYSIS

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The measurement of cell nuclear DNA content is of great value for assessment of malignant cell division patterns and its potential as an aid to diagnosis is well recognized. Flow cytometry is widely used for such analysis and with the advantages of speed and statistical precision has been suggested as a practical technique for routine diagnosis. However, the required cell suspension involves considerable pre-processing and may not always be available. Although alternative methods of microdensitometry and microfluorimetry with a microscope photometer can be used on stained slide preparations, the slow rate of measurement limits analysis to small numbers of nuclei and minor degrees of aneuploidy may not be detected. For these reasons, image analysers have been suggested for microdensitometry and developed as an aid for diagnostic cytology. Large numbers of nuclei can be analysed in a reasonable time on a conventional preparation with operator selection of relevant cell types. However, despite the potential value, image analysis densitometry has not gained wide acceptance for diagnosis. The high cost of the equipment and the fact that such machines often require support staff for effective operation are inhibiting factors for routine laboratories. For practical use in diagnosis the instrument should be inexpensive and easy to install and yet produce accurate and repeatable measurements in a reasonable time with minimal operator skill.

In the absence of such a low cost commercial instrument, the present study was undertaken to investigate the potential for use of a current microcomputer as the basis for an image analysis densitometer.

A system comprised of a microcomputer, video digitizer and solid state camera has been developed. Image analysis and densitometry are achieved with convenient control over image display and enhancement, background correction, white level and glare correction, binary image ammendment, editing, measurement and data analysis. The linear photometric properties of the solid state imaging device enable simple calibration and result in repeatable density measurements of high accuracy. The results highlight the importance of calibration of camera response and correction for microscope densitometric errors.

The study has shown that practical image analysis densitometry is possible using an unmodified and readily available microcomputer. The low cost and simple operation of such a system are important considerations for routine laboratories where budget or staff limitations preclude installation of an image analysis facility. The system gives rapid and repeatable performance for measurement of integrated density measurements of cell nuclei and analysis of DNA content distribution. This function is of immediate value for diagnostic applications where flow cytometry is not possible, the time required for microscope photometry is too great or an automated image analyser and support staff are not available.