PC PRACTICE IN THEORY

Chris N French



Pseudo results while testing kinetic procedures.

An earlier article described how the power, speed, graphics and low price (£300 plus) of the modern "PC-Compatible" give it the potential to play a far greater role in a practice than the traditional ones of mere word-processor, accounts system or database. The philosophy presented was one oriented away from dedicated instrument hardware towards software. It was argued that the future of the PC in optometric and vision software is epitomized by software such as the **UMIST Eye System.**

Such software can change a cheap, modern machine into a sophisticated vision testing device. Designed for use in clinical practice, vision research and education such software clearly provides a particularly appropriate instrument for VDU screening where patients should particularly appreciate the medium of testing but the functionality goes well beyond such scope.

Acuity Testing

Acuity testing on CRT monitors has a long history and was perhaps first described by E. R. F. W. Grossman back in 1969. We began our work in the mid 80's and this provides the heart of the present system. The computational techniques are an everyday component of modern computer use in numerous contexts. Where the computer scores over the conventional Snellen chart or the more recent chart projector is in its far greater potential for accuracy^{11/2134} and flexibility.

The consistency or reliability (and thus the accuracy) of an acuity test is a function of the number of questions asked - the more symbols the better. On the other hand, time can be of the essence and brief tests have their advantages. The number of symbols at any size may be varied in the **UES** from one to 28 at each size (on each line if there is screen space). Within these constraints individual symbols may be repeated up to ten times. Symbols may be presented in the conventional manner in single lines, double lines or where there is screen space in multiple lines. Alternatively, they may be presented one at a time. In this last, interactive, mode the subjects responses will enable the computer itself to calculate the acuity in terms of Snellen fraction, minimum angle of resolution, cycles per degree and point size. Thus, the user is free to reach their own particular compromises between speed and accuracy.

Variety is catered for by a large range of possible symbols. The user can select from sets incorporating both "3x5" and "5x5" symbols (Bailey-Lovie style DEFHNPRUVZ; Sloan-style CDHKNORSVZ; sets for young children - HOTV, HOTVX, HOTVXLA, HOTVXALCU, HOTVXA = = +, lower-case aceimnoprstu and pictograms; special symbols such as Ffooks style ADO, illiterate E's, Llandolt-style C's, square-wave gratings and vernier acuity). 'Crowding bars" are available to simulate adjacent symbols when single symbol presentations are chosen. In both active and passive modes, symbol randomness can be "true" or "pseudo" (or random with negative recency imposed to prevent immediate symbol



"repeats") so that a patient's chart-familiarity can be eliminated if need be.

The aim throughout is to combine traditional methodology with novel innovative procedures made possible by modern technology. Menu driven, the system can be used casually as a quick acuity tester or with care as a precision vision testing tool with the computer-equivalent of passive conventional wall charts available alongside interactive, single symbol acuity testing. Both can be tailored to the user's needs - for example, two symbols per line or size for the busy ophthalmologist in need of a quick cheat-proof test.

With a 12" 1024x768 monitor and 8514/A graphics card, symbol sizes can be varied between 117 and 3 metre sizes ("6/117" to "6/3"). Several scales are available including conventional and logMAR. The screen position can be varied from 8 to under 3 metres for distance acuity, and down to 33cm for near with a suitable monitor. The system can be used with and without a mirror.

Screen polarity can be reversed (white on black) and, independent

of this, contrast varied. There is an additional interactive mode which permits the computer to establish identification contrast thresholds (down to 2V-2 %) for symbols of any pre-chosen size.

VGA's 64 shades of grey enables the clinician to present their symbols singly or as charts in up to 63 levels of contrast with acuity measured in the conventional manner.

Other Optometric procedures As with modern chart projection instruments a wide range of other displays can be presented including those designed to assist with astigmatism, phorias and field defects & distortions - an astigmatic fan, cross-cylinder circles, duochrome, OXO-style display, 'infinite' random UK vehicle number plate (with and without yellow background), Amsler-style grids and Worth style figure.

To keep children happy there are some screen-saving displays and a Sm-eye-ly face. Sme-eye-ly changes colour continuously, winks and smiles, and adjusts down to 6/6 when acting as a focus for children's attention.

18-bit Colour

The 64 colour range of each CRT colour gun enables the standard VGA monitor to produce a quarter of a million colours. The 18-bit colour vision task that results is experimental⁵. The colours might not be expected to provide as accurate a test as one using precision surface colours but how often do practitioners use a screening test without the proper illumination? The CRT carries with it the potential in its own built-in illumination and provides a demanding exercise for someone with anomalous colour vision.

Field Screening

Computer-controlled field screening too has a long history. Once again the main thrust in the past has been with dedicated machinery, but here the philosophy remains that of using a conventional computer and software to accomplish the ends⁶.

The **UMIST Eye System** provides for three field-screening modes - single static, multiple static and kinetic with full parametric control of stimulus timing, intensity and configuration with from 4 to 200 stimuli.

For all three, stimuli may be of a constant size and luminance, or these parameters may be varied systematically over up to 10 user-chosen levels. The fixation point may be in any of nine screen positions, the eve to screen distance varied to get the required screen angle (a large monitor offers advantages) and a rectangular region anywhere on screen selected by the user. Alternatively, the user can select one of several stimulus configurations similar to conventional field screeners or even design their own configuration.

Field screening procedures may be automatic, patient-controlled or involve the active intervention of the optometrist or their assistant. With suitable hardware, stimulus sizes can be varied from 10 minutes to 5 degrees in diameter and be simple disks or smiling faces. Stimulus luminance can be varied from a faint glow upwards over a 6-bit range (64 levels) as can that of the background. Control features make it easy to manipulate contrast directly.

It is important to note that some choices of parameters may put too heavy a demand on less powerful PCs - prompting the need for the latest 486.

Calibration

The effectiveness of such software is fundamentally dependent on the quality of the hardware and its calibration. To this end procedures are provided for monitor calibration. Numerous calibration files can be produced by the user and used as appropriate to the task in hand. None of these tests will work if the monitor in use is a poor one or one which has not been properly calibrated, and some tests are more dependent on this process than others. The user will need to beg, steal, borrow or buy a good quality light meter for precise photometric calibration. The facility exists to store a number of such monochrome calibration files (the production of which can be done by the software itself) as it may be appropriate to have more than one for each monitor and task.

Database

The results of all interactive, single-symbol acuity testings and colour vision and field screenings are stored automatically on hard disk (unless this is over-ridden by the user). They can subsequently be retrieved for examination and later printing on certain graphical printers.

Practice Experience

Although the original acuity and field procedures were used experimentally in UMIST from 1985 onwards, they have only been used in practice in the last couple of years - made possible by the increased power of the cheap

PC.

Other Software

Although the UES attempts to cover a wide area within optometry it cannot be totally comprehensive., in much the same way that no word-processor, desktop-publishing system, spreadsheet or relational database can meet everyone's needs in these regions. Other people have written software which complements what it achieves. Also, of course, new software is continuously being written and may be added to one's computer.

Orthoptic exercises and stereograms are examples of software which suit the modern VGA PC and are popular in the USA.

In future the 'multi-media' PC is likely to expand and augment this approach to vision with CD storage. On the face of it resolutions higher than 1024x768 would appear to offer few advantages - the real breakthrough was with 640x480 VGA - but 24 bit colour with its choice of 16 million colours could well offer new opportunities. One should also look forward to cheaper and faster machines with improved video screen technology.

References

 French CN, UMIST Eye System Manual.
Anastasi A, Psychological

Testing, New York: MacMillan, 1961.

3. French CN, MacNamara R, Oldbury N and Wood ICJ, Using standard PC monitors to measure acuity and screen the visual fields, Annual Meeting of the *Applied Vision Association*, 4th April 1990.

 MacNamara R, French CN, Wood ICJ, Using an IBM PC microcomputer to measure letter acuity, 7th International Orthoptic Congress, Nuremberg, June 1991.
French CN, Munsell Colours on PCs, Applied Vision Software for Personal Computers, Applied Vision Association, 27th November 1991. 6. French CN and Wood ICJ, Behavioral control of visual field screening using a microcomputer, *Optometry and Vision Science*, 1989, 66, 871-876 (pp6).

Availability

The UMIST Eye System for modern PCs is available from UMIST. Full details may be obtained by writing to "UMIST Eye System, Optometry & Vision Sciences, UMIST, PO Box 88, Manchester, M60 1QD." It is not available for use in the USA.