

The Royal Photographic Society

HOLOGRAPHY GROUP

Newsletter May 2000

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Editorial

In spite of its religious significance, Easter is an ancient feast, the date of which is governed by the phase of the moon according to a complicated formula which allows its date to vary over five weeks. This year it has been on the latest possible date, and won't be as late as this for more than another century. I suppose the Christmas stock will be appearing on the supermarket shelves any day now, and no doubt there will be a few laser pointers on display. Some of these will be good enough to be usable for making small holograms. The situation is currently being investigated, and we will let you know when we have some reliable results.

Many of the RPS Groups run teaching workshops in their own specialist areas, and there seems to be no reason why the Holography Group shouldn't do so too. We are hoping to organise a full-day workshop in Bath in the autumn, and, depending on the interest shown, to hold further workshops in the various Regions at a later date. We still have to work out the details, but one thing is certain: everyone who attends will have the opportunity to make a hologram. We are also hoping to be able to supply film and processing solutions for your own experimentation, and possibly a suitable diode laser, which these days costs only a few pounds.

The Group held a joint meeting with the Scientific and Technical Group recently, and heard details of a revolutionary method of producing orthoscopic (right way round and right way up) real images by purely optical means, as well as a comprehensive run-down on the present stereophotography scene. Both talks are reported in this issue.

Holoscopic imaging: a new way to produce 3-D images

Neil Davies leads the 3-D Vision team which forms part of the Medical Imaging Research Group at De Montfort University, Leicester. The Group's work took off initially from an idea by Gabriel Lippmann, no less. In 1908 Lippmann proposed a method for producing full-parallax stereoscopic images using microlens arrays; since their inception some ten years ago the work has progressed a long way. At a combined meeting of the Holography and Scientific & Technical Groups on 14 March, Neil presented us with the results of the research so far.

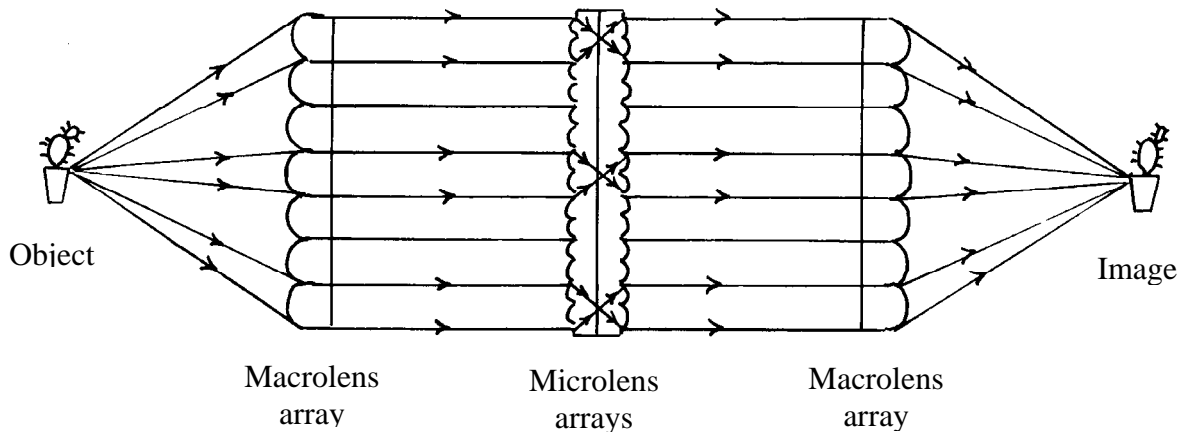
The term 'holoscopic imaging' was coined to distinguish the principle from both stereophotography and holography. Neil listed the visual clues involved in depth perception and showed that most of these were missing from conventional stereo imagery. The team's aim was to produce a real orthoscopic image in full colour without the practical difficulties associated with holography, nor the limitations of traditional lenticular stereophotography. The latter achieves a stereo image by presenting changing sets of stereo pairs as the viewpoint moves around horizontally; but there is no vertical parallax, and the scale effect causes images to appear as if cut out of cardboard. In addition, correct perspective can only be observed from a single fixed distance.

In order to achieve full vertical and horizontal parallax it is necessary to use an array consisting of a large number of microlenses rather than cylindrical lenses. Each microlens forms its own image from its own point of view, with its own unique perspective. When processed to a positive transparency, the film is viewed behind the original array of microlenses and the image is then returned by each lens to the original position of the object. The more lenses that are involved, the better will be the definition, up to the point where diffraction takes control. This limits the ultimate image resolution. In addition, and more seriously, when the image is viewed in the normal way from the object side, it is pseudoscopic (inside out).

In the 1940s Ives came up with the idea of reconstructing the image using a back-to-back optical system which would re-invert the perspective and produce an orthoscopic image. The original image was recorded on film, and the transparency illuminated through a further array of microlenses on to an 'encoding' screen, a field lens consisting of a further microlens array.

This system still presents two problems, however. One is that the image is remote, that is, it is behind the screen. The other is that whereas to give fine detail the microlenses have to be small, this limits the depth of the image.

To cut a long story short, as they say - some eight years of research - the team solved the first problem by doing away with the intermediate film and using a back-to-back microlens configuration to reverse the emergent angle of the rays. They solved the second problem by using a high-density microlens array for the image plane and a large-scale microlens (macrolens!) array for the field screens, one each side (see Diagram).



In practice such a camera has to have a large diameter (220 mm) in order to capture sufficient parallax, and the array of macrolenses has to be aligned very accurately indeed (individual variations less than 11 seconds of arc).

The result is a full optical image in 3-D in space, not a stereogram. You can position a film anywhere in the image space and take an optical 'slice'. The further aim was to be able to capture the image in real time directly by electronic means. As it happened, the image was found to be very robust to sampling techniques, even by pixel screens no better than newspaper standard, and would even stand up to faxing.

Neil showed the audience a number of samples of records made on 8 x 10 in film, and demonstrated the remarkable depth obtainable. Plainly, such a tricky assembly of optics isn't likely to become a regular amateur gadget in the foreseeable future, and equally plainly it can't be made any smaller or the parallax will disappear; but the device promises to have plenty of applications in the engineering and medical fields.

Lenticular stereograms on the cheap

David Burder of 3-D Images followed Neil with an informal discussion on practical methods of making lenticular and other stereograms. He began by describing a simple modification to an ordinary 35 mm camera enabling it to make stereograms. All that was necessary was a piece of concave-reeded Perspex interposed between the subject and the camera. After normal processing the transparency is viewed mounted under a normal lenticular screen. David offered to give further information to anyone who contacts him on 020 8 264 0022.

David discussed early methods of making stereograms using arrays of pinholes, and a heroic method by Roger de Montebello involving the making of a plaster cast of an array of ballbearings as a matrix for casting a multilens array, round which the emulsion was wrapped! Mechanical interlacing of images had always been difficult, but this could now be accomplished very simply by means of a computer program, and lenticular material could be fed directly into an Epson printer. It was now also possible to go directly from videotape to lenticular print for a moving image, though practitioners would need to beware of possible patent and copyright infringements.

Purpose-designed lenticular screen material had been almost impossible to obtain privately; but David had solved the problem by approaching an audiodisc pressing company, as a result of which he now had a huge quantity of disc-shaped lenticular screens. He discussed the vast commercial expansion of all types of stereogram, from Page Three girls to swimwear catalogues, CD record covers and even the shimmering surfaces of the huge figure in the Millennium Dome. Finally, he told of the return of the vectograph, a stereo pair using mutually orthogonal polarisation: for want of a metallic screen he projected a vectograph image on to Kevin's shiny leather jacket!

To say that a good time was had by all is something of an understatement, and it is to be hoped that we shall have many more meetings like it. Any volunteers to tell us about *their* neck of the woods will be welcomed with open arms.

Department of Partly-Baked Ideas

This time the Department's ideas are not so much baked as microwaved. In Michael Faraday's time you told things as they were, clearly: if an experiment blew up in your face you said so. Not so nowadays: a smokescreen of circumlocution is employed to hide what really happened. The simplest things are made to seem complicated, and perfectly ordinary phenomena are given outlandish names (which are never explained). Every profession, every technology, seems in time to acquire its own arcane language. In many cases (medicine, engineering) this is largely unavoidable. In others - I am thinking particularly of educational theory and social psychology - it is deplorable. Those of us who try to put things across clearly are often frustrated, too. Having recently refereed several well- and clearly-written papers intended for publication in a scientific journal, only to see them turned into quasi-scientific gobbledygook by an editor to conform to some presumed house style, I feel strongly about this. As a teacher and writer, it seems to me that any information should be put across in the simplest language consistent with precision. In 1987 I had the task of compiling a glossary of terms used in holography for Leonardo, and when I combed the technical and scientific literature I was dismayed at the number of gratuitous coinings, not just inappropriate, but often downright silly. And not just in print. I sat in on one lesson in which I heard an instructor referring repeatedly to his optical set-up as a 'camera' - and this to an audience composed mainly of photographers, who no doubt already had a fairly good idea of what a camera was. Some, as I discovered afterwards, were still wondering at the end of the lesson where the camera was.

With this in mind I submitted a paper to the 1988 Lake Forest Symposium entitled 'Holospeak: The Linguistics of Holography'. Rather than simply reading the paper at the meeting (a pointless exercise, as the audience was to receive a copy of it anyway), I read out a little doggerel poem I had written on the plane - probably the only time anyone has spoken to a scientific paper in verse. I subsequently sent an amended copy to *holosphere*, but as it was in its usual chaotic editing situation the MS got mislaid. So here it is. You may notice that the metre is the same as that of a well-known rugby club ditty (which incidentally also deals with lexicography, of a different kind).

Holospeak

The writing of a paper on the language of holography
Would seem to be a fairly simple task.
Concerned with a technology less ancient than photography,
A lexicon seems not too much to ask.

But when one gives the necessary close consideration,
It's not as simple as it ought to be:
The papers of the pioneers obscured communication
With jargon, to confuse the referee.

A data store employed a carrier beam in single-sideband
Using wavefronts generating interference;
They interrogated records using incoherent wideband,
With noise and crosstalk making an appearance.

Along came 'modern' optics, with its complex computations,
By courtesy of Fresnel and Fraunhofer,
With arguments, exponents, evanescent-wave equations,
Correlation, convolution - and, moreover -

Once the mathematics pundits got their teeth into the matter
The language grew yet further esoteric;
And academics spouted quasi-scientific chatter,
Leaving us poor folks bemused and near-hysterical.

So ordinary folk who simply wanted to make images
Decided to communicate in prose.
They bypassed the professors and their daft linguistic scimmages
With simple terms, just as the need arose.

They set up masters, flipped them and made intermediates, too;
Made pseudocolours, first pre-swelled in TEA;
Rehal'genated, solvent-bleached, and doctored Neofin-Blue,
And talked of fog and reciprocitee.

The moral is that arcane jargon blocks the understanding
Of that which makes holography unique.
Let's keep the language plain and unpretentious, by demanding
A lively lexicon - not Holospeak!

Graham Saxby

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