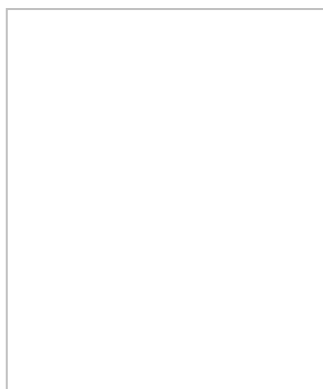


The Royal Photographic Society

HOLOGRAPHY GROUP

Newsletter December 2000



Hologram produced from dot matrix master by
Spatial Imaging Ltd

Editorial

Once again the festive season is upon us. Here in the Midlands it has been with us since the end of October, what with Diwali, Bonfire Night and at least three other festivals. There have been nearly six weeks of fireworks, and it will no doubt start again with New Year's Eve (the real Millennium?) and go on until Chinese New Year in February. How about someone making an animated stereogram of a firework display, in colour, of course?

Two events have marked the autumn scene: the visit to this country of Professor Tung H Jeong ('TJ' to his multitudinous friends) to receive an RPS award for his contribution to three-dimensional imaging, and his subsequent presentation to the Group and its guests; and the Group's first holography workshop at the Octagon, Bath. Both were very successful. They are reported on in this Newsletter.

The permanent exhibition of holograms in the Octagon has proved to be a great success with the public, and a new display has replaced the previous one. Most of the exhibits are from Jonathan Ross's collection, and the Society greatly appreciates his generosity in lending these valuable items. Bob and Molly Gibson masterminded the hanging (as usual). That true-colour holography is at last beginning to come into its own is evinced by Hans Bjelkhagen's small figure with its delicate colours, made using three laser beams.

It is beginning to look as if this technique is going to become easier, and should be a good deal cheaper, in the future. The quality of diode lasers has improved to the point where the cheapest laser pointer from a souvenir stall has a sufficiently well-disciplined beam to make small holograms using kitchen resources, as 'TJ' showed us. And the price of green and blue diode lasers is coming down at the same rate as their reliability is rising. Does this mean that we shall all be making natural-colour reflection holograms with a few pounds' worth of equipment before long? Well, equipment is one thing: ability is another. Ask any elderly photographer who has made colour prints from separation negatives! But at least it is becoming possible without your having to spend a fortune. For the aspiring professional, too, things are getting less expensive. Today's solid-state lasers can be blue and red as well as green, and are already down to a tenth of the price of the big argons and kryptons; they run off a 13-amp wall plug, and don't need water-cooling. And with coherence lengths of 100 m or more, well, as Marx almost said, Workers of the waves, untie: you have nothing to lose but your knotted string.

With these optimistic thoughts, we wish all our readers a very happy Christmas and an illuminating New Year.

Graham Saxby

The Holography Group Workshop

The Group held its first workshop in The Octagon on 11 November. What with the floods and the rail chaos, we weren't at all sure whether anyone would manage to turn up at all, let alone on time. But in the event eleven of the fourteen who had contacted us did turn up, and we were able to start on time after all. The organisers were Bob and Molly Gibson, Jeff Blyth and Graham Saxby. The day began with an illustrated lecture by Graham on the principles and applications of holography, followed by a discussion about the many types of hologram on display. The group then split into two, one half tutored by Bob and Molly, who demonstrated holographic set-ups on their transportable table, showed how they made their models, and set up the master holograms to show the way to produce the final multi-image, multi-colour holograms that had earned them their RPS distinctions. The other half descended to the darkroom, where Jeff Blyth showed the way to use two very simple frames (one made from a bar stool, no less!), and took each individual through making his or her own hologram, using no more than kitchen equipment and a pocket laser from a souvenir shop. By the end of the day, everyone was able to take away a hologram they had made themselves, and a stack of advice from Graham's printed output on how to apply holographic interferometry to the making of musical instruments, the detection of cracked rails and the preservation of old works of art, as well as the way to win your ARPS and FRPS in creative holography – and, not least, how to make holograms for fun on a shoestring.

Everyone seemed to feel the day had been a great success: we have already had enquiries as to the next workshop. Watch this space!

Professor Tung H Jeong receives an RPS award

This year the Awards ceremony, which hitherto seemed to have been modelled on a school speech day, was dragged into the twenty-first century by our President, Ray Clark. Instead of a round of what, to be honest, has often been pretty dreary eulogies, we were treated to a snappy set of introductions by the President himself, illustrated by projected examples of the recipient's work, all tastefully arranged with captions and descriptions. There was a good sprinkling of holographers present, as the Saxby Medal for progress in three-dimensional imaging was to be awarded to Tung Jeong, Emeritus Professor of Physics at Lake Forest College, Illinois, a pioneer of education in holographic techniques and the inventor of the cylindrical hologram, as well as the organiser of the enormously successful triennial holofest at Lake Forest (which this year, for a change, was held in Europe, at a venue near Vienna).

Holograms on the kitchen table: Tung Jeong shows how it can be done

The Group took advantage of Prof. Tung Jeong's visit to the UK by persuading him to address the Group and its guests at the London Camera Club on Saturday 4 November. Typically, he chose holographic education as his theme. He began by saying that in view of the nature of the audience he wasn't going to attempt to carry coals to Newcastle, but to show the way he taught holography to schoolchildren, and to throw around a few ideas on the future of holography. He said that he had originally begun a career in nuclear physics, but had changed to education and found himself an intellectual alien when he joined Lake Forest staff. But in 1966 he saw his first hologram, and decided that this was to be his specialism. In order to get a grant he had to do something interesting that wouldn't cost much – so he invented the 360° cylindrical hologram, and went on from there.

The difficulty with teaching children about holograms, he said, wasn't the children, who were always enthusiastic, but the parents, who were uneasy about letting the children use lasers. He had overcome this by buying the laser pointers without collimating optics. The beam spreads out into a wide ellipse, which cannot harm the eyes. It is polarised along the minor axis, and absolutely clean – and safe. To parents who felt holography was an intellectual backwater and not an 'earner' he would talk about IT and recording four megabits in a nanosecond, and its future in information storage and retrieval. There was no longer any need in practice for expensive optical equipment in simple hobby holography. To demonstrate this he proceeded to make a Denisyuk hologram there and then, with a diode laser clamped in a wooden clothes peg stuck into a film cassette can of sand and the object standing on the table propping up the holographic plate. His processing trays were ordinary dishes and the wash water was genuine Evian. The developer was a simple concoction of metol, ascorbic acid and sodium hydroxide, and the bleach plain copper sulphate/potassium

bromide. The result was quite passable in spite of the lack of a decent blackout (we *had* done our best!).

During his presentation, ‘TJ’ showed us a great many holograms and slides illustrating various types and applications of holograms. One of the holograms was etched in pure silica glass (no archival problem here). He explained how you could store over a thousand images in a thick emulsion and retrieve them one at a time; he described the role of holographic optical elements (HOEs) in optical switching circuits. Although there was little published in the field owing to industrial secrecy, research was well advanced. Most research grants nowadays were for HOE research. There was also an important place for holographic interferometry: apart from the more obvious applications in vibration analysis it was useful for real-time visualisation of otherwise invisible phenomena such as warm air currents and aerodynamic turbulence, using a holographic window as the primary hologram for generating live fringes.

He discussed the commercial aspects of holography at some length, citing promising avenues that had failed (e.g. MacDonald’s promotions) and others that had succeeded (head-up displays in aircraft and automobiles), and discussed the principles of holography through scattering media (flesh) using femtoseconds pulses in order to record only the directly transmitted light. It seemed that whereas the past century had been the age of electronics, the new one would be the age of photonics.

Coming down to earth, TJ opined that the main reason display holography hadn’t really caught on as a domestic thing was that the ordinary person had no real idea how to view a hologram – which was why the MacDonald enterprise had fallen through. More education was needed. With his simple system, he said, he had given demonstrations of hologram making on the beach after dusk, showing everyone that holography could be cheap, simple and safe. Even full colour holography could become easy now that red, green and blue diode lasers with single-mode fibre pigtailed were available. He emphasised the need to be able to display large transmission holograms within legal laser emission limits, and showed that by illuminating a hologram with hundreds of small diode lasers, with an HOE to direct the light, they could be displayed brightly without contravening safety regulations.

Altogether the meeting was an outstanding success, and the Group expressed its appreciation to Prof. Tung Jeong for a splendid talk and demonstration.

Department of Partly Baked Ideas

My article for the Fall 1990 issue of *holosphere* did get printed in its entirety and with only one typo. This was the heyday of the Museum of Holography. It had received numerous bequests and grants, and nobody could have foreseen that it would soon fall on evil times. The Museum was even beginning to pay contributors to *holosphere* (I was delighted, and very surprised, to receive a cheque for \$200 one day). I had recently been collaborating with Bill Durell on testing his design for a holographic set-up using single-mode optical fibres. The optical fibres used in decorative lights are multi-mode: they relay light by total internal reflection, and as there is an infinitude of optical path lengths possible, if you put a laser beam through such a fibre the coherence gets screwed up. But if you decrease the diameter of the fibre to a few micrometres the mode of transmission changes. There is destructive interference at the fibre walls, and the light travels along the fibre as it were as a single ray, emerging clean, coherent and diverging by about 10–20°. A pigtail is a short length of single-mode fibre coupled to a diode laser, and it corrects the beam optically without destroying either the coherence or the polarisation. A pigtailed diode laser is a better bet for making holograms than an unmodified one, as you don't get the same uncontrolled divergence; but they are, of course, more expensive.

The DPBI had been looking at the recently-evolved system that constructed synthetic holograms pixel by pixel, the embossed result looking much like a halftone colour reproduction, though much brighter. The trouble is that they are two-dimensional and change their colour as you change your viewpoint – fine for gift-wrappings but disastrous for portraits. To get the third dimension into a photograph you have to take a series of views of the subject and interlace them with a lenticular screen superimposed to make the viewing directional, so that each eye sees only one image at a time. The DPBI had been thinking about the possibility of direct 3-D printing. In its simplest B & W form, halftone printing is basically a binary process: the ink is either there or not. For recording continuous tones the process uses black dots of varying sizes, relying on the limited resolving power of the eye to blend them into shades of grey. This means that about half the area of the image is inked, the remainder consisting of blank paper. But what is black? It is simply the absence of light. If you reflect light away from the eye the result looks black. So instead of black dots, use reflective dots and put a slight slope on them so that they can be seen only from a specific direction. By using the space between the dots to print a further set of dots sloping in the other direction we can have an autostereoscopic picture (one that doesn't need a viewing aid). But we can do better than this. Printers' ink isn't true black, but dark grey. As the sloping dots do appear as a true black when your eye is out of line, they can be made smaller, leaving room for further images. The DPBI calculated that provided the contrast of the original didn't exceed about 15:1 (a density range of about 1.2) there would be room for around six images in colour, giving a quasi-continuous parallax.

Graham Saxby

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