The International Society for Optical Engineering

Some of the photos and figures here are available in color in the electronic version of the newsletter. To download, please go to **http://spie.org/membership/pdfs/holography/holography16-2.pdf**

HOLOGRAPHY

Tribute to Tung H. Jeong (T.J.)

Dr. Tung H. Jeong—holographer, researcher, educator—who recently retired after more than three decades in holography. (Recent photo.)

Here we profile Tung H. Jeong (better known as T.J.): Professor Emeritus and Director of the Center for Photonics Studies at Lake Forest College, IL. We want to honor his many contributions to SPIE and the role he has played in disseminating holography and building cooperative ventures within the holography community. In January at the SPIE *Practical Holography: Materials and Applications* conference, T.J. announced his retirement as chair. All of us throughout the holographic community are familiar with, and have been greatly influenced by, his work over the years. His pioneering spirit in holography as researcher, innovator, consultant and—most significantly—educator, has spanned nearly four decades, and is of worldwide scope.

As a child, T.J. emigrated to the US from Kwangtung, China, 1948. Upon graduating from high school, he received a full scholarship to Yale University where he graduated with a B.S. in physics and mathematics in 1957. He completed his Ph.D. in nuclear physics at the University of Minnesota in 1962. Shortly after this he joined the faculty of Lake Forest College, where he built an impressive set of structures that have helped to teach both his students, and the world, about holography.

An educator at heart, T.J. focused his early attention on science teachers. He explained, "in 1968, the Gaertner Corporation gave me a grant to design the first portable holography system—the *Gaertner-Jeong Holography System*—using magnetic bases. In the mid-80s, when Emmett Leith invited me to lecture to his class at the University of Michigan, I was very pleasantly surprised when he wheeled out my first model of this system he'd used for teaching his own students."

In the early 1970s he undertook two tours of duty as a holography educator for the Chautauqua Pro-

Continues on page 7.

EDITORIAL

So long, and thanks for all the holograms

This editorial represents the end of a chapter both of my life and, it seems to me, of the history of holography.

In the last two years we have seen the death of Steve Benton, who was a great scientist and engineer, a great mentor for many in the field and, (in my opinion) a great man. Also on the cover of this, the last issue of the *Holography* newsletter, you will have seen our tribute to Tung Jeong, who has recently retired. A dedicated and charismatic leader of the holographic community, he hosted the Lake Forest series of interdisciplinary conferences that, for a decade or two, helped to define the field.

Finally, you will also read of the end of the Shearwater Foundation, set up by Posy Jackson Smith in 1987 (coincidentally, the same year I started *Holographics International* magazine) to further the cause of holographic art. She, it seems, has long since turned her attention from holography to religion: perhaps not such a huge step for those of us whose religion has, at times, been holography.

Like Posy, I too have been slowly drifting away. Though I have tried to keep in touch with people in the community, the contacts have increasingly been about friendship rather than news. And now, after 18 years, I find myself editing a publication entirely dedicated to holography for the last time.

I still carry a holographic key-ring that, I think, I was given at my first-ever Lake Forest conference. It has multi-colored cogs—pastels—on a black background, with a gold crescent moon shining through because a circular section of the backing paint came loose shortly after I got it. The glass is cracked in several places too, but I still get a smile and a "wow" from the children (and most adults) to whom I show it.

And my mind has been forever altered by my appreciation of holography. My Ph.D., though ostensibly on artificial intelligence and theories of computation, was inspired by the complex physical process that is holography. I still look through my hair and see diffraction patterns in the streetlight, still gravitate towards any technology that uses some form of interference, still hope one day to have enough money (and space) to own a piece of holographic art.

Before you think that, like generations that have gone before me, I am predicting doom and gloom for the field that gave me my original inspiration and launched my career, let me convince you otherwise. I do see new beginnings. In this issue, you can read Pearl John's article about the new opportunities for learning holography in the UK. Also in this issue are details of another conference in the series started at Lake Forest: this time to take place in North Wales. Finally, you may remember the recent launch of The Holographer[1] by Kaveh Bazargan, a researcher who did innovative work in holography in the 1980s, moved out of the field, and has recently come back into the fold.

For me this is a full circle. Kaveh was the first honest-to-goodness holographer I ever met, and one of the people who offered me the most help and advice when I started *Holographics International.* When he contacted me a couple of years ago for advice about setting up his new service, I should have realized that the wheel had turned. Unfortunately, it has only just hit me.

We seem to have come full circle in other ways too. In science fiction, for instance, we have moved from Princess Leia to the slaughter of the innocents (you can read about that and all the bits in between in David Pizzanelli's article). Also, I got an e-mail from Michael Page about a new exhibition (*Matter + Energy = Art*) at the Ontario Science Centre. This is where I saw my first hologram at age nine and is especially pleasing because, when I went there a year ago to show my husband my original inspiration, I was told that both the holography exhibition and laser show had long gone.

Of course, my relationship with holography hasn't ended. I wrote a piece on the use of holographic optical elements and holographic data storage (in a piece on fingerprint recognition) just a few weeks ago. I still want to hear from you about the great work you're doing and, where I can, will get the word out through SPIE's new news service (see page below for more information) or through my own freelance journalism. But, having been on the stage with you all in the late eighties and early 1990s, I recognize that I have steadily been moving towards the wings and out into the audience.

So, in case life pulls me outside the theater altogether, I wanted to take a moment to say thanks. Holography has made me the scientist, the journalist, and—ultimately—the person I am today. I'm grateful, I had a blast, and I hope you'll keep in touch. And I can't wait to see what you folks do next.

Sunny Bains
Imperial College London
Editor, *Holography*
http://www.sunnybains.com

References

1. http://www.holographer.org/

Going forward: holography education in the UK

There appear to be a growing number of opportunities to learn holography in the UK. Here, I report on some new education initiatives. These include informal courses such one-off public workshops at art galleries and museums and Spatial Imaging's course (taught by holographic artist Patrick Boyd) targeted at those seeking an in-depth understanding of display holography. More formal institution-based courses have also appeared over the last year or so, including our own Foundation Photonics module at the University of Southampton—aimed at first-year physics and engineering students—and a more arts-based course at De Montfort University in Leicester.

Figure 1. Student Lori Napoleon of Chicago, IL, at the London School of Holography.

Regularly-held courses

Starting with the last of these, Martin Richardson—a Senior Research fellow within the department of Imaging and Communication Design at the De Montfort University—is running a course entitled *New concepts in Digital Imagery.* Now in its second year, it is offered to those studying for a Batchelor of Arts in multimedia. In their first year, students produce '3D' photographs, which are transposed into an 'interlace' programme for final use as lenticular prints. Special emphasis is placed on the animation effects that can be achieved with lenticulars rather than just the 3D effects. Students then make single-beam reflection holograms and are set test papers to demonstrate their understanding of the principles involved. Second Year students, who are allowed to pursue their own creative projects, are encouraged to use pulsed holography.[1]

AT the University of Southampton, we are offering a more science-and-engineering-based course on holography and laser applications to students with non-traditional qualifications who want to study engineering and physics. The week-long *Foundation Photonics* module is designed to introduce the field to those who have not previously studied physics at school. The course includes making single-beam holograms and research into applications of holography. We hope the course will increase student enthusiasm for physics as well as motivation generally. In addition, students are encouraged to promote their learning—and therefore holography—locally, nationally, and internationally through a variety of publications and media.

For those who do not wish to get another degree, a comprehensive holography course has recently been developed by Spatial Imaging and the holographer Patrick Boyd at the newly formed London School of Holography in Richmond. The courses, aimed at beginners, last for five days. Students learn the basic theories of holography and how to make a variety of types of hologram including the production of a single-beam reflection hologram, a shadowgram, a pseudo-color reflection hologram, and master and rainbow transfer holograms. Participants are also able to make holograms of people using a pulsed laser, learning both mastering and reflection transfer techniques (see Figure 1). Courses are now running monthly with four or five students per class, and advanced and specialist courses will also be made available at a later date.[2]

Informal workshop: Case study

The Peterborough Museum and Art Gallery in the UK recently offered three days of family 'craft sessions' in holography to support Martin Richardson's exhibition of digital prints, 3D artworks, holograms, lenticulars, and film, entitled *Time, Space and Movement.* The workshops—which I ran—were intended to demystify the unfamiliar imaging techniques used in the exhibition and help engage the general public with the artwork. Advertised as an educational family activity, 110 people of all ages took part in the workshops.

The holography sessions lasted approximately 20 minutes, held up to 20 participants and all the family groups who attended left with a hologram (see Figure 2). The workshop relied on the

Continues on page 4.

Figure 2. Family attending the workshop at the Peterborough Museum and Art Gallery.

Going forward: holography education in the UK

Continued from page 3.

Kingsview Holocamera, developed by Mike Anderson for use in educational settings, which proved extremely successful.[3] The rig consisted of a metal structure supporting a battery-powered laser diode and a couple of pieces of glass sandwiched together in a magnetic film holder with rubber feet to eliminate vibrations. Maximum film size used was 4×5in (see Figure 3). The workshop participants used a cardboard shutter to expose the holograms: if the children were too young to carefully remove and replace the shutter from in front of the beam they were asked to do the exposure count for their parents or older siblings. Despite children literally running up and down beside the table during the holographic exposure, all the holograms came out.

Old Agfa film was used in the workshop as it required a short exposure time (approximately 10s) using a diode laser of approx 4mW. We also used the JD4 developer from Integraf:[4] this allowed a short development time (10s), a wash (10s), and bleach for a minute or so, all with relatively harmless chemistry. Settling time was up to five minutes depending on the age group of the participants: some didn't have the patience to wait in the dark for more than two minutes!

There were very loose educational aims for the workshops: as the exhibition used three different 3D technologies. the participants were asked about the meaning of the term. A majority were able to explain that it meant three-dimensional, but they were generally unable or unwilling to describe what 'three-dimensional' meant. It was a reminder not to overestimate the general public's understanding of the technology that holographers take for granted. One participant, however, was able to discuss constructive and destructive interference as they had recently covered the theory in their Physics A-level course (an advanced high-school course studied by student in England between the ages of 16 and 18). It also proved important to spend a lot of time educating participants on how to illuminate and view their holograms with a torch (flashlight).

Hopefully, this type of workshop is part of a trend: in February I was invited to lecture at the Bates College Art Museum in Maine, in support artist Harriet Casdin-Silver's holography exhibition *The Body Holographic*. I was also able to run public holography workshops in conjunction with this exhibition.[5]

To the future

Going forward, holographers must continue to promote learning opportunities to ensure the medium's future. Holography can be used to inspire future scientists, motivating young people to study optics and photonics and therefore helping solve shortages of skilled workers. And it can also be used to inspire artists, encouraging new ways of seeing and new methods of visualization. Educating and engaging the general public is also essential, as it indirectly ensures a positive climate for businesses involved in holography and support for scientific and creative research.

Pearl John
Light Express Coordinator (Photonics Schools outreach)
School of Physics and Astronomy
University of Southampton
E-mail: mail@pearljohn.co.uk
http://www.pearljohn.co.uk

Reference

1. Contact Martin Richardson: mrichardson@dmu.ac.uk.
2. Contact: school@holograms.co.uk
3. Contact Mike Anderson: mikeholoanderson@aol.com
4. http://www.integraf.com
5. http://www.bates.edu/x62703.xml

Figure 3. Peterborough workshop participants with Holocamera.

OpTIC to host display holography symposium

The *International Symposium on Display Holography* will take place at OpTIC Technium in St Asaph, Wales, UK, from 10-14 July 2006. This is the seventh in a series of conferences that originated in Lake Forest, Illinois, USA, in 1982. The symposium will focus on holographic imaging for applications in art, advertising, science, marketing, display and any other application where the three-dimensional image is essential. Artists, imaging scientists, and business people from around the world will attend.

The Conference Chairman is Hans Bjelkhagen, who is with the Centre for Modern Optics at OpTIC. Co-chairman is the founder of the Lake Forest series: Tung Jeong. Nicholas Phillips, who has been involved in the development of large-format high-quality display holography in Europe and the UK, is also a co-chairman of the conference. Martin Richardson of De Montfort University, Leicester—who received his Ph.D. in holography from the Royal College of Art—is the Art Chairman.

Both Emmett Leith from the USA and Yuri Denisyuk from Russia will give invited papers, as well as acting as honorary chairmen. They recorded the first laser generated holograms in the USA and former USSR in the early 1960s.

The symposium is being dedicated to the memory of Stephen Benton of MIT.

Among the topics to be covered at the symposium are computer-generated and electronic display holography. Recent development of large-format color holograms will be reported. In addition, the meeting will cover the history and the future of holography. Other topics include art concepts, holographic recording materials, document security applications, the business of holography, and holographic imaging for advertising, product, trade-show, and point-of-purchase displays.

Associated with the symposium there will be two exhibitions of art holography, one being a selection from Jonathan Ross' collection, on display at a local castle.[1] This exhibition, which will be open during the week of the symposium, will also be open to the public and will run until mid-September.

Concurrent with the symposium there will be a one-day workshop for local school-children hosted by Martin Richardson. This, we hope, will engage some of the children's interest and perhaps influence their eventual course of careers.

Figure 1. First View of OpTIC Technium.


Figure 2. View of Solar Wall at OpTIC Technium.

The first call for papers has been issued, abstracts requested by November 2005. Further information will be issued shortly thereafter. If you wish to be on our emailing list, please contact us at the address below.

E-mail: conference@optictechnium.com
http://www.optictechnium.com

References

1. http://www.bodelwyddan-castle.co.uk

The Shearwater Foundation Archive

Now that the Shearwater Foundation has become part of holography history, its web site has been redesigned to provide an archive of its achievements. Full details of all grants given since 1987 are available there. It is hoped that this resource will be useful for researchers, historians, artists and scholars who have an interest in the development of creative holography and the support given to it by the Shearwater Foundation over two decades.

The Shearwater Foundation, of Florida, USA, gave out its first grants to artists in December 1987. Those pioneers each received an award of $10,000.00, for attaining the highest level of artistic achievement and, as the Foundation announced in its first ever press release, providing a, "standard of excellence for the entire field."

The Holography Program of the Shearwater Foundation was established and directed by Posy Jackson for it's first ten years of operation. The Foundation appointed a new advisory group each year, to research the field and make recommendations to the Board for possible funding. From this list of names, a number of artists were then chosen to receive the prestigious Shearwater Foundation Holography Award. The Award was unique in that it provided a cash grant to the artist without requiring any accounting for the accomplishments resulting from the support.

In 1991, as creative holography developed, the Foundation responded to the needs of the field by offering grants to groups and organizations, as well as its awards to individual artists. These grants could be applied for (unlike the holography awards, which were only given to those artists who had received the highest recommendations from the Foundation's yearly advisory group). These institutional and project grants were used to support a wide variety of projects that actively promoted creative holography worldwide.

In 1998, Dr. Andrew Pepper took over the administration of the Holography Program from Posy Jackson. Pepper continued to direct both the Holography Award and the expanding grants projects for the following seven years. One of the important additions Pepper made in the Program was the Holography Purchase Project. This provided public museums and collections with financial assistance to purchase creative holography for their collections. Several works were acquired for collections in the USA and UK through this project.

In November 2004, the Foundation ceased operations after the death of its last trustee. This marked the end of a 17-year program that had provided 128 grants and awards to artists and projects as diverse as symposia, publications, documentary videos, educational events, curated exhibitions and artist-in-residence programs.

The Shearwater Foundation Archive can be found at:

http://www.ShearwaterFoundation.org

Tribute to Tung H. Jeong

Continued from cover.

gram, where he trained nearly 600 physics professors from universities and colleges across the US to integrate holography into university curricula. "One of my long term goals," says T.J., "was to make holography a basic topic in science education, in textbooks, and in labs. I believe the Chautauqua program helped toward that end."

T.J. has been invited to lecture and teach seminars at over 500 universities, professional societies, and industrial sites in across Europe, China, Russia, and more. He has been a member of and in and served in many honorary and professional societies. He was a co-chairperson for SPIE international conferences in the Ukraine, Hungary, Bulgaria, Canada and Austria. In 1986 and 1987 he co-founded and chaired the initial SPIE *Practical Holography* conference at the meeting then known as OE/LASE.

In 1971 he instituted the annual summer *International Holography Workshops* at Lake Forest College. These were later accompanied by the triennial *International Symposia and Exhibitions on Display Holography,* held at Lake Forest in 1982, 1985, 1988, 1991, 1994. After moving to Europe in 1997, and then a break, this series is set to continue next year (see p. 5).The Lake Forest events were attended by scientists, educators, artists, business people, and amateurs from across the world. Noted artist holographer, Margaret Benyon commented, "T.J. has a very special and important place in the history of holography. Without his chairmanship of SPIE *Practical Holography,* and in particular his ISDH symposia at Lake Forest, it is hard to imagine how display holography could have blossomed in the way that it did."

For many people, his instructional motion picture, *Introduction to Holography* (funded by the Encyclopedia Britannica Educational Corp. in 1971), was their first contact with the field. Along with educators, interested parties could contact INTEGRAF: a company he formed in 1973 to disseminate instructions and holographic materials internationally.

Together with Dr. Hans Bjelkhagen, T.J. was instrumental in the realization of true-color holography. He is also credited with the cylindrical hologram and was the first to use fiber optics to reduce the cost and complexity of hologram production. He also helped to develop 3D moving holograms. His research has funded by grants from the National Science Foundation, Research Corporation, and ITW, to name a few. In the business world, T.J. serves as a worldwide consultant to corporations in various industries to develop holographic solutions to problems.

Professor Jeong has been honored repeatedly, both in the United States and abroad, in recognition of his achievements, his service to education, and his contributions to international relations. He has won the Robert Millikan Medal, the Saxby Medal of the Royalty Photographic Society of Great Britain, and the International Holographic Manufacturers' Association Life Time Achievement Award. He has been given two Honorary Professorships of Physics (from Beijing Normal University and Kunming University). And he has also been honored by the American Association of Physics Teachers and the National Science Teachers' Association.

T.J. says, "This may surprise most people: I am currently involved in helping more people than ever in getting started in holography. This year alone, forty five countries have bought my Holokits through Integraf, with me as its 'tech support'. On a daily basis, I answer e-mails from around the world, many from children as young as eight. So, I started by training college students and professors, then artists and other professionals, and finally end up teaching mostly young children. My biggest satisfaction is in this last group. It was a reason for me to retire from my other formal duties... I am glad to have switched from nuclear physics to holography. My main interest was to educate young people. Nuclear physics is too abstract, but holography is perfect for my goals."

Since Dr. Jeong announced his retirement, Hans I. Bjelkhagen and Roger A. Lessard were elected to co-run the *Practical Holography: Materials and Applications* conference in 2006. They say, "As a first task, we would like to thank him for his wonderful work that he did so enthusiastically for more than 20 years."

Thank you T.J., for your genuine warmth for students and colleagues alike: we wish you all the best in your future endeavors.

Rebecca Deem
E-mail: rebeccadeem@yahoo.com

Rebecca Deem is an artist, holographer, teacher and writer currently in Columbia, Missouri.

References

1. http://www.holokits.com

Hollywood's holograms

The full text of this article can be found, with many illustrations, on the web. Please go to: http://holography.co.uk/RPS/hollywood/hollywood.html

I disgraced myself watching the latest Star Wars film. The tension was at its height as Obi-Wan Kenobi told how he knew the terrible truth—that Anakin had slaughtered the 'younglings' and was turning to the Dark Side—when the audience was so silent that you might have heard a popcorn drop, alone in the crowd, I laughed out loud. Obi explained that he knew Anakin had done these this awful deed because he had seen it himself: on the *security hologram.*

It seemed to me at that moment that the circle was complete. In the real world, holography had been reduced to small silver objects serving as security markings, whilst in the mythology of science fiction holography the evolution of the hologram had reached the same destination.

Over the past twenty years, holography has been evolving in fiction in parallel to the farless spectacular evolution of real holograms in everyday life. The manner in which holograms are portrayed in films discloses the real expectations of the general public with regard to the medium, and actual holograms fall far short of what people want or expect from holography. Fictional holograms are depicted in an idealized form wherein they more clearly express human needs and desires.

The striking agreement and consistency within the different portrayals of fictional holograms in different films and programs on TV, and the large number that have been represented, has resulted in a notion a *mythical* hologram. This has, in recent years, become subtly infused into the popular concept of what constitutes a real hologram, so that the word 'Hologram' has a cultural significance *over and beyond* the literal dictionary definition.

The early adopters

One of the earliest uses of a hologram in Science-fiction was in the film *The Man Who Fell to Earth,* made in 1976 director Nicholas Roeg, starring David Bowie as an alien from outer space.

Throughout the film we get brief glimpses of the alien's family left behind on their desert world. In one shot we see his wife holding up a multiplex hologram. The action is cut in with a shot of Bowie on Earth, taking family snaps with a camera. The correlation is clear: the hologram is the family photo of the future. This is a rare use of holography in film, because although the context is purest science fiction, the hologram is *genuine* and the depiction of holography is *authentic*.

Logan's Run, also released in 1976, was directed by Michael Anderson and starred Michael York as the hunter turned fugitive. In the climatic scene where Logan 5 is being interrogated by a computer that is attempting to probe his mind, the internal conflict is represented by a multiplex hologram of Michael York's face, mouthing the words, "There is no Sanctuary".

Here representation of the hologram has progressed: although real multiplex holograms are used, they are given *the power of speech.*

Real hologram exhibits have in the past been put into installations with an accompanying tape-loop that gives voice to the mute image, so it might be argued that this portrayal of the medium still remains in a sense true to life, despite the science-fiction context. One fundamental aspect of the mythical hologram that is established in this scene is *the link between holograms and machines.* The hologram is situated in a pillar, yet it is portrayed as being somehow projected there by the computer.

Evolving unreality

The film most responsible for the genesis of the 'Mythical Hologram', however, appeared the following year: George Lucas' *Star Wars* (1977). Although not named as a 'hologram' in the first Star Wars film, the scene in which the image of Princess Leia is projected from the robot droid R2-D2 pleading, "Help me Obi-Wan Kenobi, you're my only hope!" has lodged into the popular consciousness and is irrevocably linked with holograms: not as they *are*, but as they ideally *should* be.

Not only did the image of Princess Leia *move* and *talk*, but also she was in *full-color*. Here, as in *Logan's Run*, the image is projected from a machine. From that time on, Hollywood's fictional holograms were all to be 'computer-generated'.

The fact that real holograms are images diffracted from a physical surface, which is composed of film, glass-plate or embossed plastic, is entirely eradicated. Fictional holograms service our *psychological* needs, and are not required to meet the dictates of authenticity. The tangible fact of the hologram plate somehow detracts from the ethereal nature of the effigy.

Unlike the three-dimensional image that we see in a mirror trapped behind glass, the *idealized* hologram image is able to move and float in space. No longer trapped in the plane of a physical surface, it is a free phantom, somehow emanating from a machine. To be entirely different from a photograph, an image on a TV screen, or another form of representation or sign, the mythical hologram is liberated from the substrate. This is the first step away from being a *representation* of a thing... to *becoming* the thing itself.

In the wake of the *Star Wars* films there were several instances of holograms as projections used to communicate, a kind of 3D video link, such as the one in the film *Critters*, where the image is referred to as, "a holographic transmission. In *Superman II*, we see another example of the projected three-dimensional image, as Lex Luthor makes his escape from prison. The image is fully life-like, reacting to the prison guard as he looks into the cell, and apparently playing a game of chess.

Only when the guard walks forward into the cell does he realize that something is amiss, as Lex Luthor suddenly vanishes. The guard has blocked the beam of the projected image and we see it playing on the back of his shirt. Here again, the image is projected by a machine. Looking vaguely like a gun, but also like Hollywood's notion of a laser, this provides a clue as to why the mythical hologram is always thought of as being launched from a device of some kind. Conceivably it stems from a simple confusion between laser light-shows, where graphic images are sometimes projected, and the fact that lasers are "used to make holograms": resulting in the misconception that hologram images are in fact *laser-projections* of some kind.

The 'Hologram' reaches maturity

An early scene in the film *Total Recall* shows holograms in a domestic environment, used as a kind of futuristic keep-fit tape, a hologram of a tennis coach gives instructions as to how to improve one's game. The scene serves as an introduction to a later scene, where Arnold Schwarzenegger, trapped by military-type badguys who are trying to shoot him, uses a 'Hologram' as a decoy to draw the soldiers' fire. They see it, they fire at it, and Arnie goes down splattered with blood...only to get up again laughing. Amid the laughter, the image shimmers and vanishes, leaving the soldiers perplexed and hesitating until their leader yells out the warning: "Look out! He's got a *hologram*!".

This shares all the aspects of the now well-defined Hollywood hologram: a full-color, animated, projection from a machine; in this instance a small device worn like a wristwatch. It goes further, however, in extending the attributes of the mythical hologram. This is not simply an identical *image* of Arnie, it is able to *interact* with the *physical* action: the bullets do not simply go through the hologram ricocheting off the walls, they penetrate it as though it were flesh. When the hologram is shot, it *bleeds* even though the real Arnie remains unscathed. Here we are approaching the absolutely iconic perfect likeness that Umberto Eco imagined holography to be years earlier in his book *Travels in Hyper-Reality*.[1]

From artifact to environment

The mythical hologram is at its most sophisticated, most exact as a reproduction of reality, in the televison series *Star Trek, the Next Generation*. Entering through the door of the holodeck is to enter into a fantasy world made real.

Here, nursery-rhyme characters like Little Jack Horner can be encountered eating his plum pie. Figures from literature can be summoned, and made to enact games for the pleasure of the person who has beckoned them forth. Once again, the holograms are 'computer-generated': when the computer program is cancelled, the image fades, and only a grid looking like a computer graphic remains.

In the Holo-deck all things are possible: it is a world of pure *wish-fulfillment*. It is like a dream dimension where the dreamer gets whatever he or she desires. It is not simply a 'virtual reality', because everything in this world is *tangible*, fully actual in every respect. In this context the term 'real-image' takes on a new literalism. Friends and work colleagues can be commanded to appear in any guise and perform any function.

These holograms not only materialize in full color and move about, reacting to the environment, like the hologram in *Total Recall*, these are much *more*: these are holograms one can *take out on a date*. One can eat with them, dance with them, hold rational conversations with them, and make love to them. They are the end of Umberto Eco's quest for the *Hyper-Real*: they are identical clones of human beings who are willing to indulge in your every desire, every whim.

This externalizing of one's internal fantasy world, making it an exact duplication of the authentic world, but under the domination of the individual's will, enacts the extreme Cartesian crisis: the conflict between the internal world of thought, and the external, real-life world. Here daydreams are imbued with all the attributes of objective reality. The fantasy is now *external*: imagination and desire has full expression as objective actuality.

The more fulfilling and objectively real the fantasy, the greater the desire is to take the 'false' in place of the 'real' and never to abandon the dream made flesh.

Alive and kicking

The conflict between the 'true' real and the 'fictitious' real is brought to a climax in an episode called *Elementary, Dear Data* where the fictional character of Moriarty is summoned up and accidentally becomes *self*-aware.

Like any other sentient creature Moriarty wants to survive and he persuasively argues that he has as much right to existence as any other conscious being. This is one of the rare occasions that the *moral rights of holograms* are examined in the *Next Generation* series. The theme runs on in the later Voyager series, where the ship's doctor is a hologram and his struggle to attain respect and equal rights as a sentient being is a central sub-plot to the series.

The English television show *Red Dwarf* takes the issue further, going the full distance to absurdity. Here the machine-generated hologram is an unpleasant individual called Rimmer, who lives on a red spaceship with three other unlikely characters. In one episode, Rimmer goes aboard a hologram spaceship to meet up with an entire crew of holograms. Rimmer meets several female holograms, falls in love with one of them, and they end up in bed together.

Rimmer is really only a logical extension of the holograms on the holodeck: it can eat, drink, and hold conversations... what else might holograms do when there are no human beings around indulging in wish-fulfillment, but to begin to interact with one another and start to have wishes and desires of their own?

Back to reality

The evolution of the notion of the mythical hologram over the past couple of decades, and more importantly, the *continuity of ideas* expressed in each of the many instances of fictional holograms, is seen in everything from the holographic Jazz Player in *Vanilla Sky* to the holographic librarian in *The Time Machine*. This has led to a popular understanding of the word 'Hologram' that is far *wider* than the dictionary definition that pertains to actual holograms. I understand that *real* holography will never deliver on these expectations. However, as with everyone else who enjoys science fiction, I would like to think that one day perhaps in the distant future, the fantasy Holograms of Hollywood might be a reality.

David Pizzanelli
Holographer
E-mail: david@Pizzanelli.co.uk
www.Pizzanelli.co.uk

Reference

1. U. Eco, **Travels in Hyper Reality,** Harcourt Publishers Ltd., London, 1990.

Touchless holographic human-machine interfaces

Continued from page 12.

bersome hardware or, in the case of people with poor vision, bypassing the need to put on glasses in order to comfortably operate the equipment.

Because holographic HMIs have no moving parts and can be completely sealed, they are impervious to dirt, moisture, oil, shock and temperature fluctuations. This feature makes them ideal for factory-floor and high-traffic environments, and both outdoor and military use.

R. Douglas McPheters
President
HoloTouch, Inc.
Darien, CT
E-mail: rdmcpheters@holotouch.com
http://www.holotouch.com

Exciting changes coming for SPIE publications

Beginning in January 2006, two new publications will take the place of oemagazine as well as our Technical Group newsletters. SPIE Newsroom, a dynamic news website integrated with spie.org, will cover the latest technical developments in optics and photonics. SPIE Professional, a quarterly print magazine published exclusively for Society members, will emphasize career trends and industry insights associated with the optics and photonics profession, as well as important Society news and information. This is the final issue of the Holography Technical Group newsletter.

The website will provide a steady stream of technical and industry news articles organized around technical communities that match SPIE members' areas of expertise and interest, including electronic imaging, biomedical optics, industrial sensing, defense and security, nanotechnology, and others. Readers can subscribe to monthly e-alerts to be directed to the latest technical articles in their field. SPIE Professional will offer members a new perspective on their industry and their diverse roles in it.

Both of these new efforts will launch in January 2006 - keep an eye on spie.org for the latest updates.

Holography

This newsletter is published semi-annually by SPIE—The International Society for Optical Engineering, for its International Technical Group on Holography.

Editors and Technical Group Chairs Hans Bjelkhagen, Raymond Kostuk
Technical Editor Sunny Bains
Editorial Assistant Stuart Barr
Managing Editor Linda DeLano

Articles in this newsletter do not necessarily constitute endorsement or the opinions of the editors or SPIE. Advertising and copy are subject to acceptance by the editors.

SPIE is an international technical society dedicated to advancing engineering, scientific, and commercial applications of optical, photonic, imaging, electronic, and optoelectronic technologies. Its members are engineers, scientists, and users interested in the development and reduction to practice of these technologies. SPIE provides the means for communicating new developments and applications information to the engineering, scientific, and user communities through its publications, symposia, education programs, and online electronic information services.

SPIE—The International Society for Optical Engineering, P.O. Box 10, Bellingham, WA 98227-0010 USA. Tel: +1 360 676 3290. Fax: +1 360 647 1445.

European Office: SPIEEurope • spieeurope@spieeurope.org • Tel: +44 29 20 89 4747. Fax: +44 29 20 89 4750 • Web: www.spie.org

In Russia/FSU: 12, Mokhovaja str., 119019, Moscow, Russia. Tel/Fax: +7 095 202 1079. E-mail: edmund.spierus@relcom.ru

Touchless holographic human-machine interfaces

Holographic human-machine interfaces (HMIs) allow people to operate electronic equipment by simply passing a finger through holographic images of what would otherwise be its keys or buttons, floating in the air at a convenient location. They have five basic components: the hologram; a light source to read-out the holographic images; a wave source emitter-detector that determines when the operator has interacted with one or more of the floating holographic images; firmware that transmits information between the interface and equipment; and a power source (see Figure 1).

There are many types of conventional HMI: keyboards, keypads, touch pads, and touch screens; less-complex interfaces such as switches; and more-recently-introduced interfaces such as smoke and droplet screens, projected infrared keyboards, and voice-recognition systems. However, holographic HMIs offer a number of practical and economic advantages over their conventional tactile counterparts.

For instance, holographic interfaces allow operators to enter commands and data with the same accuracy and precision as conventional tactile human-machine interfaces. However, unlike conventional electronic and electro-mechanical interface devices requiring the operator to touch or push, no physical interaction is needed. This means they pose none of the health and hygiene risks associated with traditional touch screens and keypads as well as more common switches and mechanical HMIs. Despite the best intentions of facility maintenance personnel and well-written cleanliness procedures, it is simply not realistic to expect that tactile interfaces will be germ free or even clean, especially in high-traffic applications such as ATMs, kiosks, and security keypads.

Also since the components of holographic HMIs can be entirely contained in sealed units, they have no exposed parts to fail under operator use or abuse. This higher level of reliability minimizes downtime for repairs and reduces medium and long-term cost of HMIs, particularly in high-traffic applications where damage from customer use is a fact of life.

Holographic HMIs can be designed with 2D or 3D floating images, in full color, and visible across wide angles of the horizontal axis. Their images can also be projected some distance from the electronics: up to 1m using current holographic recording techniques. The colorful images produced, which leap out at passers-by, can be used to attract customers as well as for their practical purpose.

One of the many variables of the hologram recording is the selection of angle of view. In the case of HMIs used for the entry of personal or financial information, a narrow angle of view across the horizontal axis can be used to effectively conceal the information from everyone in the surrounding area except the operator. This feature limits the ability of criminals to capture information by watching customers at ATMs etc. in public areas.

For applications in areas such as medecine, factory-floor environments, and consumer electronics, holographic HMIs can be designed so that the floating interface images appear some distance from the underlying machine. For example, in industrial settings, one operator is often responsible for operating more than one piece of equipment. Operator fatigue and distraction can be reduced by having floating holographic HMI images projected to a central location so the operator need not move to interact with all machines. Alternatively, images of holographic interfaces can be projected within easy reach of people playing video games or watching DVDs, thus eliminating the need to fumble with cum-

Continued on page 9.

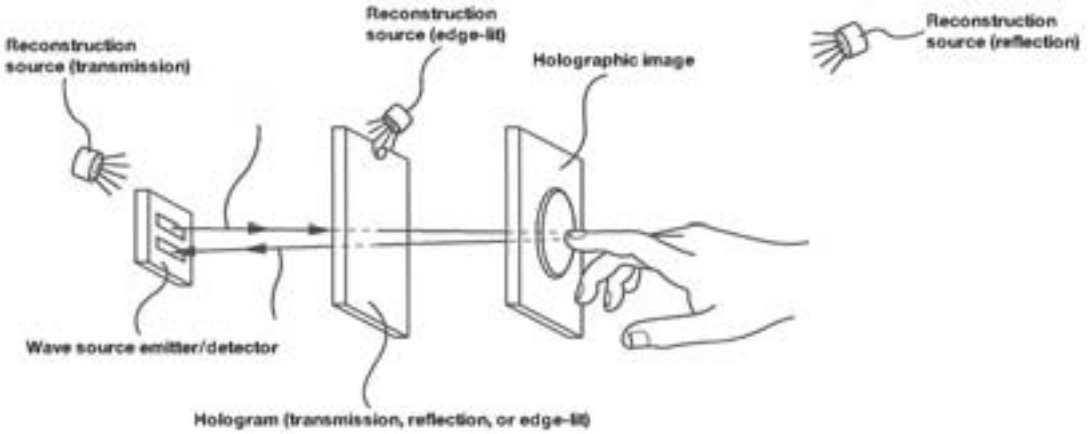

Figure 1. Simplified drawing of the components of a holographic human-machine interface (HMI).

SPIE Society of Photo-Optical Instrumentation Engineers
P.O. Box 10 • Bellingham, WA 98227-0010 USA

Change Service Requested

DATED MATERIAL

Non-Profit Org.
U.S. Postage Paid
Society of
Photo-Optical
Instrumentation
Engineers