3-D: exploring the 3rd dimension

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Something is happening to our communications media. More and more we are attempting to represent a "real" view of the world through film, sound, and television. New technological advances such as HDTV, IMAX, 3D computer graphics and increased spatial sound rendition all paint a clearer psychological impression of reality for the viewer or participant. These changes in technology have established the building blocks which will enable a move toward a greater three-dimensional quality for both sound and image. Therefore, 3D media technologies are the next logical step in our search for true "mediated reality."

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Work in 3D media is going on the world over. The technological challenge for Canada is to gain a competitive edge by understanding, applying, using, and rapidly diffusing this information to our communications industry. Concerned professionals will be converging on Montreal this spring to explore the implications of advances in 3D media technologies. Our communications and entertainment industries will evolve in directions that we are now only just beginning to understand.

THE ONE-MAN SHOW

Flashback. One of the authors of this article grew up in a small village in Scotland. As a child, he used to be very impressed by Johnny Manders, who ran the local cinema single-handed. Johnny would stand out in the street as a barker. *Roll up, roll up, only a few seats left!* When he lured in some customers, he would interrupt his spiel to be ticket collector and usher. After capturing a large enough audience, he would become the film projectionist. The movie would be interrupted halfway through while he sold popcorn and soft drinks. (It always seemed to stop during an exciting part but now the author realizes that there was only one projector, and it was necessary to change reels.) After the audience had bought enough to bribe Johnny to get back to being projectionist, the movie would continue.

Fast-forward. Thirty years later, the author attends a two-day graduation party for a friend. He is taking many photographs to build a souvenir album. He runs out of colour film, borrows some black-and-white film, and continues taking pictures with more abandon, since the film is cheaper. He runs out of black-and-white film, but continues with even more abandon using the empty camera. Since there is no record of the shots, he decides to abandon the camera completely and *take shots* simply by blinking, suddenly realizing there was little point in taking stills when he had a continuous movie going. Blinking no more, he sits back to enjoy the movie.

Rewind. In retrospect, running a one-man cinema is not so impressive. Every one of us is running a magnificent mobile movie studio of the mind, employing a wide-angle lens, stereophonic sound, technicolour, and cast of thousands (but only one hero/heroine), in which we are the scriptwriter, producer, director, cameraperson, sound engineer, stage manager and crew. This movie studio also doubles as a movie theatre, in which we can simultaneously watch the show. At the same time we are the movie critic who reviews the performance next morning! Our only limitation in this movie theatre of the mind, is a single seat. To show our home movies to other people we must learn to write, speak, play music, and make films.

The movie metaphor is apt because film is the

medium which perhaps, of all the media, best captures the full quality of our personal maps of experience. Indeed, the history of film could be considered as a series of steps towards a closer approximation of the mind movie. *Movies* added movement to the still image of the photograph, the *talkies* added sound, and colour was added to the black-and-white image. *Really we create nothing*, says Jean Baudrillard, author of the book *Simulations*, *We merely plagiarize nature.*

There are a number of ways to add to the accuracy of our movie of the mind. One technology is high-definition television (HDTV), which provides improved picture resolution. With HDTV the aspect ratio of the TV screen is closer to that of the eye than it is on conventional television. The IMAX film format comes even closer to our mind movie by removing the artificial frame around the image. The IMAX screen is so large that it fills most of our visual field. The OMNIMAX screen, bigger and curved at the edges, is even more effective. Though it does not remove the border completely, the IMAX / OMNIMAX format modifies it to the more natural oval shape of the eye as it takes a snapshot of the world.

The various media could be classified in terms of spatial dimensions. Thus, print and radio would be one-dimensional, photography and painting two-dimensional, sculpture and holography three-dimensional, dance and theatre four-dimensional, since they add the dimension of time. Film and television would be three-dimensional, the third dimension being that of time rather than depth. The next step in a progression toward a more accurate simulation of the mind movie for film would, therefore, involve filling in this "missing" depth dimension.

A 3-D WORLD

Progression is, of course, not necessarily progress. Many will resist this next step, just as they resisted the introduction of talkies and colour in the past. Many certainly resist the retroactive introduction of colour to films originally shot in black-and-white. Whatever the arguments mustered by critics of colorization (and there are many good ones), the idea that black-and-white is somehow more natural, is totally unfounded. There is nothing *natural* about black-and-white unless the viewer happens to be totally colourblind.

The same argument applies to the artificiality of the two-dimensional image. 2-D representations of our 3-D world are cultural artifacts, a fact which is demonstrated by anthropological studies where people with no previous experience of photographs and paintings have trouble interpreting them.

We live in a three-dimensional world and the eye is therefore designed to perceive objects in 3D. Adding this third dimension of depth to the current two-dimensional movie is the next logical step toward a more accurate representation of the world-as-we-perceive-it in our everyday experience. Indeed, the third dimension is often used as a metaphor for reality. In film scripts, an unreal character is frequently described as being *two-dimensional*. To be at home in our objective world, we need to perceive as well as conceive in three dimensions.

In film, a foray into the third dimension has of course, been taken before; there was a run of three-dimensional movies in the 1950s. That first wave of innovation receded, and a second one is currently building. The timing of these waves of interest is not purely a matter of chance. They seem to be a symptom of the *sailboat effect*. When the steamboat was introduced, there was a dramatic surge in the efficiency of sailboats in response to this challenge. The 1950s wave in 3-D film production was a response to the challenge of the introduction of television. This second wave is a response to the challenge of the recent spate of further innovations in video technology – videocassette recorders, videodiscs, high-definition television, pay-TV, cable-TV, and so on.

Despite the temptations of economy and comfort, sophisticated media consumers did not defect from film to television in the past. This was partly because they could not see what they wanted to see when they wanted to see it and partly due to the fact that the TV audience could not avoid seeing what they did not want to see (commercials) when they did not want to see them. With pay-TV and cable-TV increasing the programming offerings and with VCRs permitting the viewer to zap out or zip past commercials and to rent recently-released films, people may succumb to the temptation of this second wave of video innovations.

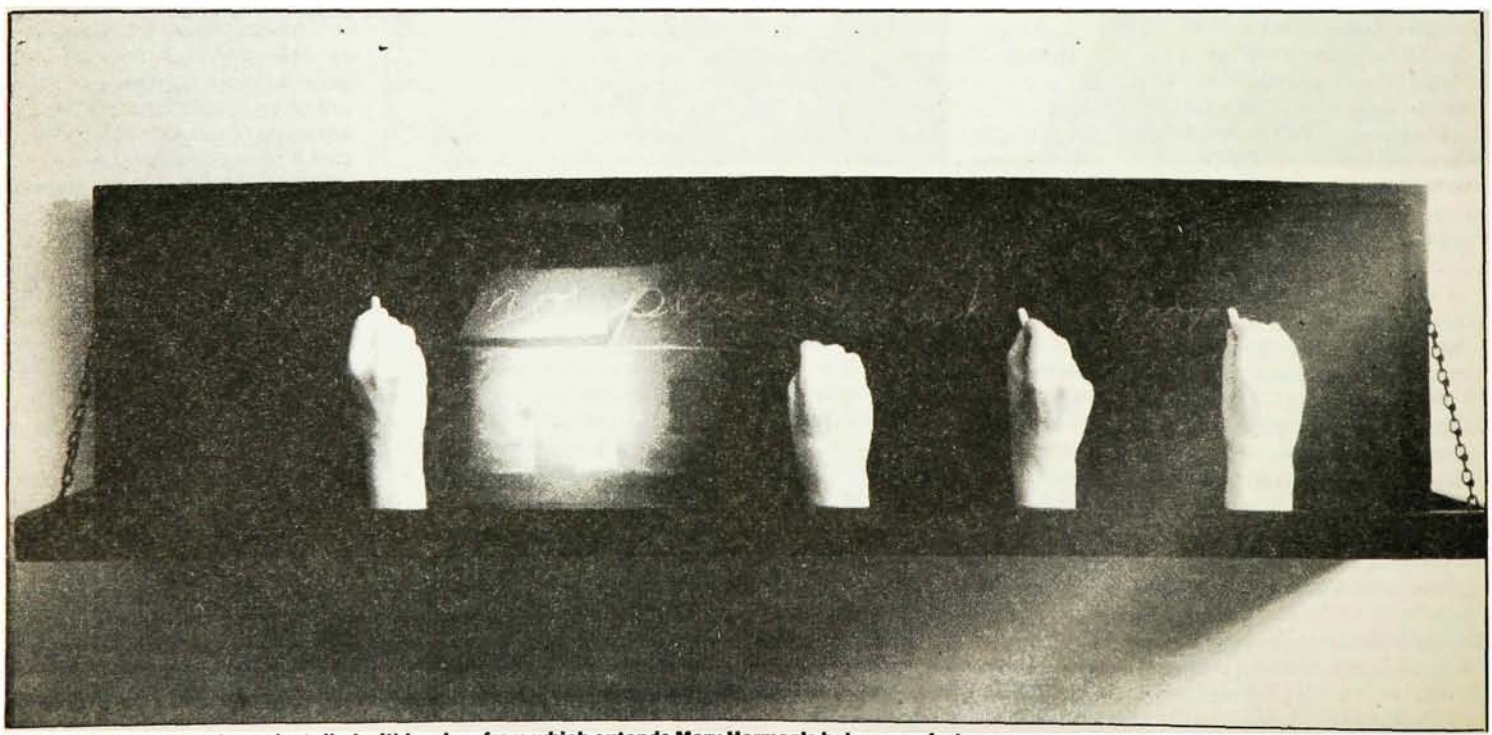
THE FUTURE IS HERE

The film industry recognizes the threat. In a recent issue of *High Technology* magazine, Jack Valenti, president of the Motion Picture Association of America, stated that in order to compete, theaters must *provide an epic viewing experience that cannot be duplicated on a VCR* – otherwise *they're going to be out of business.*

Despite these expressed concerns, the film industry has shown little interest in technological research and development. The last major change in the neighborhood cinema was the introduction of 70mm film in 1956. Even that undramatic change has had little penetration into mainline cinema. Thirty years later, 90 per cent of films are still shot and projected in 35 mm.

However, new film technologies such as FutureVision and Showscan are taking an evolutionary approach in trying to enhance the current technology and improve film using existing equipment. For example, FutureVision increases the rate of film projection from 24 to 30 frames per second so that flicker can be reduced and illumination increased, thereby creating a sharper, brighter, and more stable image.

The IMAX Corporation, with its IMAX and OMNIMAX formats, is taking a revolutionary approach. Since these formats require the introduction of an entirely new and expensive system of cameras and projectors, they tend to be found at world fairs (Expo 86), in theme parks (Disneyland and EPCOT Center), and in museums (Canadian Museum of Civilization). Introducing this format into the neighborhood cinema is prohibitively expensive due to the time and experience needed to produce the films, and the sophisticated environment needed to show them.



Plaster models of hands are installed within a box from which extends Mary Harman's hologram of a house.

MOTHER NATURE'S LESSONS

At the present time, we must ask ourselves if 3-D can graduate from simply being a special effect to being an intrinsic aspect of the film medium, much like colour, sound, etc. In attempting to improve the status of 3-D in film, we would do well to sit at the feet of Mother Nature and humbly learn her lessons. Such is the arrogance of our species that we constantly pride ourselves on our inventions at the expense of nature's creations. Psychologists have stated many times that the eye is a lousy camera. *The film is in backwards; there is a hole in it, and the camera is constantly shaking up and down.* Inevitably we find that those apparent design flaws have an important function. For example, the shaking up and down is physiological nystagmus without which the image fades. Our eyes take millions of snapshots a day during our lifespan, without ever having to reload the film.

When we developed stereo for the ears, we found that it was twice as good as mono. We assumed, therefore, that quadro would be, at least twice as good as stereo. It was not. Organic systems optimize whereas our mechanical systems aspire to maximize. The reason why stereo is optimal is because we have two ears. Two speakers simulating our two ears can thus pick up sound which feels real. As we turn from stereo for the ear to stereo for the eye, we can learn much from our previous experience by analogy. To produce 3D film, two cameras are used, shooting the same scene from slightly different perspectives, in order to simulate the function of our two eyes.

In benefitting from the analogy between stereo for the ears and for the eyes, we should be sensitive to the ways in which they differ. Colin Low, 3-D film producer for the National Film Board of Canada, suggests that our ears are specialized to detect threat from behind, whereas our eyes perceive threat from the front. Our nervous systems are designed to detect change, since it is change which is threatening. Change along the z-axis (that of depth) is particularly threatening since it represents something coming towards us. 3-D film in the '50s took advantage of this third dimension of depth in order to simply throw things out at the audience. Nature, on the other hand, would suggest that we use the third dimension to invite the audience into the film medium.

The large IMAX screen increases reality by filling our entire field of vision. 3-D IMAX creates intimacy by projecting close to life-size images into the audience. Those who were tempted to reach out for the Teddy Bears in the 3-D IMAX film *Transitions* can understand the impact of removing the frame of the screen and adding the third dimension to produce remarkable effects. If seeing is believing, then seeing in 3-D is *really* believing.

3-D COMEBACK

The film industry is not the only one exploring three-dimensional imaging systems. A spate of recent experiments suggest that 3-D will make its comeback in both the film and television media. In 1982, the United States Federal Communications Commission (FCC) relaxed their rules regarding the broadcast of material which required the audience to wear special glasses allowing classic 3-D films to be shown on television. At this time, those viewers without glasses, allowing classic 3-D films to be shown on television. At this time, those viewers without system was used to shoot the Superbowl half-time show in 3-D, permitting those with glasses to see the 3-D effects and those without to view the show normally. This was a major step forward. New technologies, using lenticular screens, aim to dispense with the need for glasses entirely.

Shooting *Transitions*, Colin Low's 3-D IMAX film for the NFB

An argument could be made that 3-D video and television systems will overtake developments in 3-D film production because they are more intimately tied to computer technology. The disadvantage of television over film has always been the small size of the screen. In contrast, the film image can be projected up to hundreds of times the size of its negative onto a very large screen. This problem of the small TV screen is compounded in the case of three-dimensional viewing by the window effect. The three-dimensional effect is not nearly as effective when the image is projected out and cut off by the border of the small screen.

The most startling medium to gain public attention in recent years has been *holography*, which is the only *intrinsically* three-dimensional imaging technology. Photography is intrinsically two-dimensional and film, by using the phi-phenomenon to ensure persistence of vision from frame to frame, tricks the eye into an illusion of movement. Three-dimensional imaging techniques again trick the eyes by simulating certain natural depth cues in the flat image. Holography, on the other hand, approximates the function of the brain behind the scenes. The brain is where the action is; after all, what do the eyes know? Karl Pribram, a leading researcher on human brain functioning, argues that the increased interest in holography is due to the fact this technology may be imitating the way our brain stores information in a three-dimensional form.

The disadvantage of holography at the present time, is that it requires laser technology in order to produce holograms. This is a problem of coherent light which must be artificially created, compared to incoherent light which is natural and used in photography. New developments suggest that holography may make a breakthrough in overcoming this problem in the foreseeable future.

An exciting fourth dimension of time can be introduced into a hologram through the movements of the viewer. As one walks by or changes viewing perspective, the holographic image changes accordingly, giving a different view of the scene. This fourth dimension of time, applied to holograms through computer technology, requires vast amounts of memory. Stephen Benton of M.I.T. is presently exploring a digital-to-hologram converter; a computer peripheral device which would receive, send, and interpret holographic information within a computer network environment. Eventually, fiber optics and optical storage devices may be able to transmit and store the vast amounts of information which will be required for new developments such as holographic TV.

A MEETING IN MONTREAL

Whatever their relative advantages and disadvantages, explorers of 3-D imaging systems in film, television, holography and sound, share certain universal principles and pervasive problems of perception. The authors of this article organized *3Dmt'89*, an international conference on three-dimensional media technology. World experts, working in the various fields of 3-D, met in Montreal in May to discuss and demonstrate their latest insights into the future of 3-D media applications. This convergence of media minds will help towards an understanding of the principles and a solving of the problems.

Each of us lives in a 3-D world and deals with 3-D objects and environments on a daily basis. Inasmuch, we are presently seeing many practical applications of 3-D imaging techniques other than in common media-related professions. We all have 3-D bodies (some more so than others), thus doctors who have to operate on them and fashion designers who have to clothe them can benefit from those techniques which permit 3-D representations of the body. Dentists have to fit 3-D teeth into 3-D mouths and plastic surgeons have to create 3-D noses to fit 3-D faces. Architects and planners must create and construct 3-D houses and cities. Engineers in the space, aeronautics and navigational industries are also placing great emphasis on 3D imaging systems in order to simulate a variety of environments. These virtual 3-D realities of sight and sound will be used in training procedures, entertainment applications, or for forays into the future exploration of this planet or others. All of the above reflect the diversity of practical applications of 3-D imaging systems. Whoever first imitates nature by creating an economically viable and psychologically sound system, will reap rewards in many fields within media and beyond. •