

THE CONFLUENCE OF ART AND SCIENCE: HOLOGRAPHIC SYMMETRY, METHODOLOGIES AND CONCEPTS

MELINDA MENNING

Name: Melinda Menning.

Address: Centre For Lasers Applications, Division of Information and Communication Sciences, Macquarie University, N.S.W. 2109, Australia. *E-mail:* melinda@ics.mq.edu.au

Fields of interest: Holography, Visual Art, Optical Science, Photography. Natural forms, in particular Australian native flora and seashore life of SE. Australia.

Awards: National Student Art Prize.

Publications and/or Exhibitions:

Menning, M. and Piper, J. A. (2000) Holography as a medium for the confluence of art and science, Paper presented at the *Sixth International Symposium on Display Holography*, St Poelten, Austria, July 2000; to be published by SPIE - The International Society for Optical Engineering, Bellingham, Washington, in 2001. Have exhibited several holograms internationally since 1991.

Abstract: *In this paper holography is considered as a medium for the confluence of art and science, given that this axiom is well established amongst both artists and scientists working within the international holography community. The paper will focus explicitly on symmetry as an aspect of this confluence. The paper will set out to demonstrate to a broader audience how concepts of symmetry relate directly to holographic methodology and the process of image formation and subsequent reconstruction. These processes and principles give rise to the unique visual qualities of this medium and as such are an integral to artist's and scientist's considerations and conceptualisations when setting out to produce holographic images.*

1 HOLOGRAPHIC IMAGE FORMATION

The paper will demonstrate how and why the optical configurations required in making holograms necessitates the creation of a form of symmetry. On a surface level the fundamentals of this symmetry are based around always having to configure two or more

laser beam paths that are of equal distance. It is essential for light originally from the one laser source that has traversed the optical system to arrive at the holographic plate at the same time, or in phase, in order to form a holographic grating or interference pattern. This physical code is formed by the interaction of light and matter in such a way that it holds a massive amount of information, which is later, decoded and replayed as a visual image (visual information). The information is recorded in the form of microscopic fringe patterns, which are discrete areas of varying refractive index; this will be further explained using graphic illustrations.

The fringe orientation, formation, number, resolution and spacing are all dependent on the geometric layout of the holographic optical system. The paper will demonstrate using a simple form of symmetry devised by Nils Abramson how this occurs. The formation of fringe patterns is predicted by the use of this form of symmetrical conceptualisation. It moves through from the macroscopic scales of the functioning optical system to the microscopic pattern formation of the fringes that make up the hologram. This in turn determines the type of visual information you are recording and hence what kind of hologram is being made and subsequently viewed. Nils Abramson's models are well known to holographers for cleverly and simply explaining complex mathematical and optical concepts via the use of what he calls the holodiagram. This diagram will be shown and discussed as will its application to practical holography, this is considered as an example of applied symmetry.

Once the formation of the holographic image has been discussed the paper will then discuss some of the qualities of a hologram. Line drawings will be used to explain the nature of the symmetry of image re-construction. The spoken paper will demonstrate how at times it can be difficult to perceive and define the difference between what is considered or perceived to be symmetrical or a-symmetrical, upon viewing the differences between a pseudoscopic and orthoscopic image, this will be done by showing these images. The symmetry and asymmetry of the image and its conjugate will be discussed. As will the notion of a hologram as a lens, giving rise to a form image reversal, which can be seen in a more obvious and accessible way via the hologram. So interwoven is holography with concepts of symmetry that holograms have been called mirrors with a memory. Again geometric models will be used to describe and expand on these concepts, revealing how symmetry is integral to understanding characteristics peculiar to holography.

2 THE HOLOGRAPHIC CONSCIOUSNESS

The phenomena and principles of holography have been used as conceptual tools and metaphors to expound a variety of ideologies, perceptual frameworks, and metaphysical stances. Importantly notions of the holographic consciousness, described as the infinitely

divisible organisation of information within the brain that can be attributed to any one perceivable area of the brain, while also being attributed to the whole of the brain's functioning. These conceptual models hold a unique beauty in their attempts at describing the organisation of information that is no longer based on linear and hierarchical structures. With this naturally there comes a re-examination of notions of the symmetrical models for the functioning of the brain and consciousness. Given the volume of books and papers on this field largely written by theorists, (without discounting their methodologies), I would like simply to acknowledge the importance of this research.

3 PRACTICAL METHODOLOGY

In contrast on a surface level it may seem that I will present what appears to be a mechanistic view of holography and its relationship to symmetry. I would propose that this explanation arises from a genre of practical experience and understanding. Very few people compared to the number of readers of books about these theories have the opportunity to experience and understand the physical principles directly involved the process of making a hologram, hence a certain mystic has settled over holography. Diagrams, conceptual models based on symmetrical principles naturally aid to reveal these processes in a far more universally accessible way than complex mathematical equations. So much so that the use of symmetry is inherent to the actual processes used in production and has become an invaluable tool in the teaching of holographic methodology. Hence this paper presents its view through the window of practical methodology.

The processes involved in production require pre-visualisation techniques unlike any other medium for art making, achieving results can be very slow and in many ways are comparable to mezzotint. The practitioner is required to have a thorough understanding literally of the whole message they wish to convey visually, throughout the process in order to achieve an image that appears to have any degree of visual sophistication. Many practitioners view the process in itself as holistic; it can take many years and the assistance of cumulated knowledge to develop these skills. The global community of those practicing in this area remains small and is at times dislocated by distance and space. As a consequence holographers openly joke about constantly having to re-invent the wheel. It must be realised that we are only into the second generation of practitioners. Unlike computer technology, display holography has slipped through the tendrils of multi-national corporate giants (with the exception of mass-produced embossed holograms). There are distinct advantages that may yet prove to outweigh the many perceived disadvantages that are associated with the homogeneity of technique and appearance that prevails computer-based imagery. Practitioners of holography deal more with physical optics and are not constrained by processes that have been commodified

into discrete packages of information, which inevitably affect the final appearance of an image.

4 DISJUNCTION BETWEEN AESTHETICS AND IDEOLOGIES

The contextual layers for symmetry in holography and its relationship to the confluence of art and science cover a vast terrain of interwoven notions of theoretical, philosophical and metaphysical concern. It has been said, that given the volume of these ideologies the aesthetic appearance of holograms has failed to live up to expectations of many, especially in the art world. “Beautiful in theory but ugly in practise.” This is one of the most problematic areas of discussion in holography. It is not the purpose of this paper to defend this practise. Holographers would say it’s simply a matter of time, understanding and consistent application.

Conclusion: The paper will demonstrate how holographic processes like symmetry can both be seen as mediums to give volume and meaning to the flow of the coming together of art and science. Just as symmetry can be used to translate complex theory into visual concepts so holography involves scientific principles of optics, which are translated to visual information, contributing to our understanding of visual art. Science and art can indeed be viewed as separate disciplines within themselves, however given those differences there will always be cross over between the two areas, this intersection is in a constant state of change, hence the use of the word confluence.

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