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The Dynamic Display of Art Holography

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Abstract: Holograms have been displayed in single-artist and group exhibitions, since the late 1960's. The content within a holographic image can be greatly compromised if the hologram is not displayed correctly. Holography exhibitions can either enhance or diminish the impact of the images depending on how the exhibit layout and lighting are designed. This paper looks at art holography from the exhibition installation perspective and offers methods for assuring dynamic displays.

Keywords: holograms; art holograms; hologram exhibitions; reconstructed holograms

1. Introduction

The history of holography, methods of hologram construction, and the trends in how the field has evolved is beyond the scope of this paper. This information is readily available. In Appendix A, I have listed some good resources for anyone wanting to better understand the medium.

During the time period from the late 1960s through the mid-1980s, there were technical and material challenges to producing holograms that were bright enough for the types of lamps that were available for illumination. Holograms required a white point source of light and at that time, there were few options. As a result, exhibition rooms were generally kept dark for the holograms to appear bright and clear. Over the years, the recording materials improved, formats enlarged, chemical processing improved and MR-16 halogen lights became available. These advances made it possible to move holography out of dark display spaces and into exhibition spaces with ambient light. The visual possibilities and myriad of special effects available to the art holographer that have resulted are also beyond the scope of this paper but are readily available in the literature (Crenshaw 2009).

The focus of the earliest exhibitions and into the 21st century has been to install holograms so that they appear bright, so that there is enough space in front of the holograms for viewing and that the predominately glass artworks are safe. Traditionally, installations were arranged based on the size of the hologram and which of the two main varieties they were, white light viewable Reflection or white light viewable, Transmission holograms.

It is the opinion of this author, as both an artist and curator, that after all these decades, we have not taken a critical look at how we design holography exhibitions. There are few guidelines, no standards, and minimal installation instructions requested for participation in a holography exhibit. This is in part due to a lack of understanding of the full dynamic range of holograms. In this paper, I address some of these fundamentals in this paper and offer suggestions for hopefully mitigating some of these issues.

2. Brief Biography

As critical and practical comments in this paper are based on my experience as a holographic artist and curator, this brief biography is provided to help contextualize those comments My exploration of the medium began in 1979 when I attended the Fine Art Research & Holographic Center in Chicago, Illinois. This excellent school provided both theory and hands-on experience for people who wanted to understand holography and create their own holographic images.

During the 1980s and into the early 1990s, as Director of The Holographic Studio in Vancouver, BC Canada, I was fortunate to work in this art holography optics studio and I was able to produce a large body of abstract pseudo-colour holograms. During this time, I also worked in collaboration with Sydney Dinsmore and we produced a series of figurative holograms. I have always created my own art holograms, rather than commissioning them to be produced for me. My artworks are still included in international holography exhibitions. In addition to creating holograms, I have curated, designed and installed holography solo and group exhibitions internationally.

3. Why Is Installation Criteria So Important?

Holograms are virtual sculptures made from light; they are not stereo or 3D photographs illuminated by a lamp. Holograms are rarely installed or understood in the same way traditional sculptures are.

It has been my experience that installations, in general, do not require detailed information from the artists about how to best exhibit a work. This may diminish the impact of the images, by not considering some important fundamental aspects of holograms. This lack of understanding holograms in this way means that people do not fully understand how to engage with the image in the viewers space, and this can compromise the intent and impact of the image.

4. The Illumination of the Hologram

Reconstructing the holographic image as it was intended is dependent, in part, on the characteristics of the illumination lamp, and the angle of incidence of the lamp to the surface of the hologram. The lamp does not merely illuminate the hologram, the light from the lamp transforms to become the image. This aspect of holography is a tool in the kit that artists that can take advantage of if they are aware of their options. Changing the characteristics of the reconstruction light will change the characteristics of the hologram.

4.1. Colour Temperature and the Point-Source, Reconstruction White Light

If colour is important in an image, then the colour temperature of the illumination source is of great importance. Colour temperature is indicated in the lighting industry as a value of Kelvin (K). Colour temperature will, of course, alter the colour of anything that is illuminated, but the hologram is unique because the reconstructed image is actually made from the light from the source, as indicated above.

In general, artists working in holography are still limited to using white, point-source light for holograms, although this is changing due to the availability of LEDs (Sarakinos and Lembessis 2018). The colour temperature K value and spectral output of white LEDs and incandescent halogen MR-16 white lights can be quite different, and this difference will show up when a hologram is reconstructed. MR-16 lamps, used almost exclusively in the field for decades, have a warm tone and a lower K value of around 2900 K. Some white LEDs can have a K value above 5000 which produces a very cool almost blue white light. Artists and Curators need to be aware of this when they are installing images in various venues. The Kelvin temperature value is available on lamp packages or in the lamps technical data sheet.

Holograms that I created based on the colour playback finalized, under MR-16 lams were exhibited with LEDs of different colour temperatures and the warm tones in the images were compromised. Figure 1 shows one of my very early abstract holograms as it appears, illuminated with the MR-16 warm tone lamp it was tested and finalized with. Figure 2 is a simulation of how it would look if illuminated with the incorrect cool temperature white LED.

There is so much left up to chance these days, as there are many new lamp configurations with different spectral output curves and K colour temperatures and other properties that are not well understood. The LED offerings in the marketplace continue to expand. It will be important to understand how these changes in the reconstruction lighting can possibly enhance or compromise the intent of the image. Supplying the required colour temperature and lamp properties to best

optimize holograms should be included with other installation instructions. It is my experience that this is not the case currently.

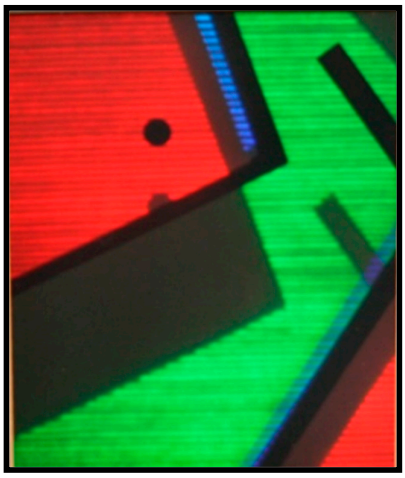


Figure 1. A 9″ × 7″ pseudo-colour hologram titled *Color Study with Light Blocks* created by the author in 1985. It shows the reconstruction with an MR-16 warm temperature (~2900 K) lamp.

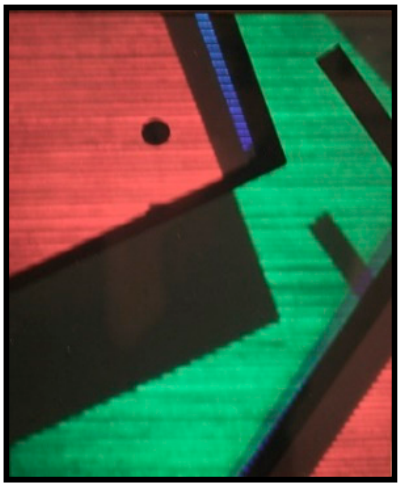


Figure 2. A simulation of how a different lamp can drastically alter the playback colours.

4.2. Monochromatic Illumination

Holograms recorded using a specific wavelength colour of laser light, like red[1], for instance, will reconstruct in that same colour, unless some colour control techniques are utilized during the recording process (Saxby and Zacharovas 2004). If the artist desires the hologram image to be monochrome, then the clearest and brightest images are reconstructed using the same laser wavelength light as used in the recording. Lasers are not installation-friendly, but colour lamps are, and LEDs can mimic the properties of laser light if they produce a narrow bandwidth of light.

An example of monochromatic lighting being used to enhance holograms, or that appear to have been utilized for this purpose, is in the installation of the Louise Bourgeois holograms in the *New Order* exhibition at the Museum of Modern Art (MOMA) in New York, which I had a chance to see in the spring of 2019. The Bourgeois holograms (Figure 3) were exceptionally clear, bright and with good depth resolution and they were illuminated with a red light which was further controlled by using a focusing projector system.

[1] Red laser light is light in the wavelength range of ~600–700 nM.

Figure 3. Louise Bourgeois, one of *Series of Eight Holograms*, 1998–2015 (photo taken by the author).

The Bourgeois holograms technically could have been illuminated with a white point source of light but an informed decision was made to use a monochrome source for depth and clarity necessary to reconstruct the many visual elements in the images and to suggest a reference[2] back to the red laser used to create the holograms. If these holograms are displayed in other venues without the same monochrome lamps, the quality and content of the images will be compromised.

5. The Angle of View

Holograms have a predetermined horizontal parallax which is the angle of view (AOV) of the image. Not all holograms have a vertical parallax, but most do have a horizontal parallax. The AOV will depend on how the hologram was made. Some variables that support the criteria are

- the ratio of the size of the master hologram to the copy hologram
- the number of masters and their placement in relationship to the copy hologram
- the properties of the recorded object if it is a direct recording and so on.

The AOV is a technical limitation that an artist can use effectively if aware of how to control it to best reveal the content of an image. Unfortunately, the angle of view (AOV) is not well understood and is generally not requested as an installation specification when holograms are exhibited. To date, I have never been asked to supply the AOV.

5.1. Determining the AOV

The AOV can be defined in a general way by placing a protractor at the face of the illuminated image and then moving through the reconstructed images viewing (playback) area, as shown in Figure 4. This simple technique can be done for any hologram and the AOV is indicated in degrees and can then be included in display instructions. The hologram shown below has a wide ~120° AOV, which is, in part, a result of the type of hologram it is, a direct recorded single beam hologram and how the content of the image was designed.

[2] https://www.cheimread.com/videos/louise-bourgeois-holograms.

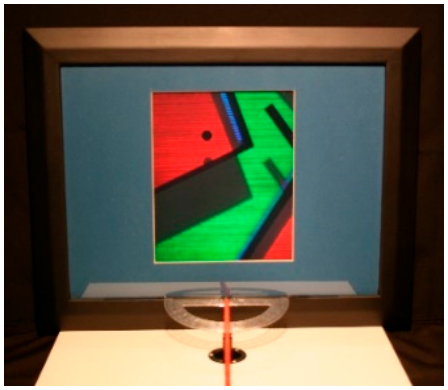
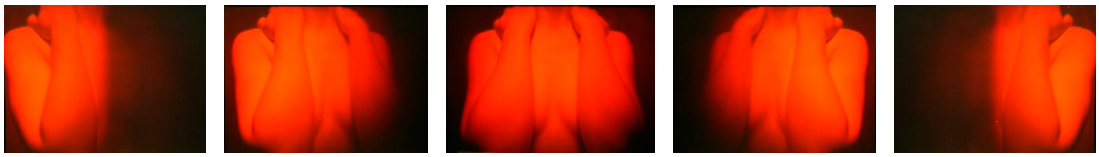


Figure 4. *Colour Study with Light Blocks* hologram and protractor with string.

A series of figurative holograms was created in collaboration with artist Sydney Dinsmore[3] in the 1980s. The limited AOV is obvious in the following hologram from the series *Is This What You Want?*[4], as shown below in Figure 5. This hologram was photographed at an equidistance from the center of the image out to each side. This hologram has an AOV of ~40° AOV. The narrow AOV was based on the technical limitation of the master and the copy or transfer hologram being the same size.

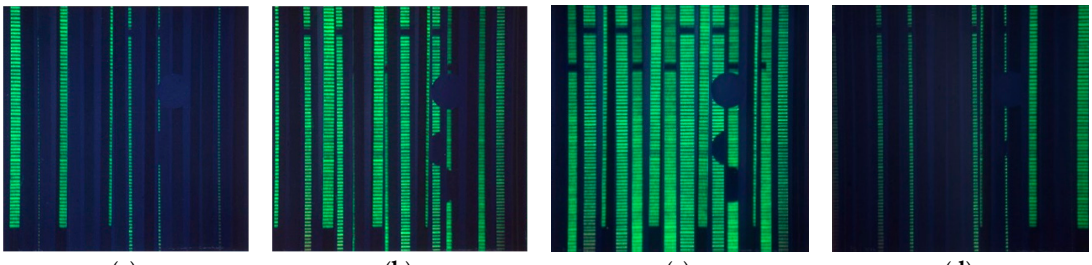


(**a**) (**b**) (**c**) (**d**) (**e**)

Figure 5. (**a**) 20° to left of center, (**b**) 10° to left of center, (**c**) center, (**d**) 10° to right of center, (**e**) 20° to right of center.

5.2. The AOV of "Levels with Light Blocks" and its Importance in the Exhibition Space

The hologram produced by the author is shown below. *Levels with Light Blocks* (1985) in Figure 6 shows how the AOV impacts and reveals image details when the viewer moves through the AOV. In this reflection hologram, the viewer's movement through the several deep levels of light opening and closing in the image throughout the AOV is critical to the image created. The display environment should not diminish this changing imagery by cutting off the AOV due to the limitations of or incorrect placement in the display space.



(**a**) (**b**) (**c**) (**d**)

Figure 6. (**a**) Far left view of hologram, (**b**) left of center view of hologram (**c**) center view of hologram (**d**) far right view of hologram.

[3] https://www.sydneydinsmore.com/.

[4] This 30 cm × 40 cm pseudo-color reflection hologram as created in collaboration with Sydney Dinsmore. From the series *Is this what you want?*, 1988, 12″ × 16″.

5.3. The AOV of "Is This What You Want?" and Its Importance in the Exhibition Space

The collaborative project with Sydney Dinsmore titled *Is This What You Want?* is shown in Figure 7. The figures with their protective gestures are designed to be viewed as a set, not as individual holograms in isolation from the larger group of art works. Sydney and I both have backgrounds in curating and designing exhibitions. Building on this experience, we designed an installation that enhanced the content of the series. This approach assisted the viewers to clearly see the images, achieved through experiencing the collective angle of view and provided subtle clues as to how to move within the entire series. Hanging the images separately on the wall without taking this into consideration would have diminished the essence of the series and what the work was about.

Figure 7. Pseudo colour reflection holograms, 30 cm × 40 cm, from the series *Is This What You Want?*

Figure 8 is an image of a suspended hologram in front of a 5′ × 3′ photographic banner. We photographed the laser images in the master holograms and had them printed on banners. Figure 9 indicates how we defined the viewer space using the photographic banners. The banners identified the contained space and the holograms were placed in such a way that the angle of view of each hologram overlapped with the angle of view of each adjacent hologram. This placement of opening and closing of the image view assists the viewers to move through the series as the content unfolds and then diminishes, unfolds and so on. Figure 10 shows one of the banners suspended at the entrance to one of our exhibitions.

Figure 8. Suspended hologram in front of a banner created by Crenshaw & Dinsmore.

Figure 9. The defined space.

Figure 10. Photographic banner by Crenshaw & Dinsmore at the entrance to one of our exhibitions.

5.4.A Note on Vertical Parallax

Certain types of holograms do not have vertical parallex. This is a technical constraint that is inherent in the creation of white light transmission, so-called Rainbow holograms. Most holograms do have vertical parallex which can be considered the upper and lower AOV of the image. There is little flexibility in exhibits with regards to the vertical AOV as images are set at standard viewing heights based on the type of venue they are displayed in. Most venues set the center of art holograms at 60″ (152 cm). For this reason, this aspect is not given the same consideration as the horizontal parallex AOV, which gives the depth clues required for true 3D imagery.

6. The Exhibition Layout

Some art works are designed to stand alone and are not part of a series that requires reference to other images in an exhibit. Even so, it would be beneficial to request information on an image AOV so that holograms can be placed in a sequence that enhances rather than confuses or distracts. Understanding such properties and mapping this out as an installation instruction would assure a more dynamic display in general, no dead zones where images are not visible, and would subtlety guide the viewers throughout the entire image field of the exhibited artworks.

An example is shown in Figure 11 of the partial installation placement of holograms in the *Déjà vu* group exhibit in Vancouver BC, 2010. This exhibition space was adequate but limited and had to be shared with another artist and two other displays. Designing the layout based on the AOV of the images created a dynamic display with limited visual dead zones.

Figure 11. These pseudo-color reflection holograms were created in collaboration with Sydney Dinsmore. *Rumours* 1992 multi-channel panel (14″ × 48″) is on the left and the figure from the series *Is This What You Want*, 1988, 12″ × 16″) is on the right.

The *Rumours* panel is made up of five multiple exposure (aka multi-channel) holograms. The panel reveals many images as the viewer moves back and forth throughout the AOV. This hologram requires enough space to allow viewers to move around in order to view the full impact of the imagery. In order to playback the image on the right, which had to be placed in a corner, the hologram was tilted out from the wall on one side which swung the AOV back into the viewer space by slightly changing the angle of the hologram to the illumination lamp. The shadows under the holograms reveal how the lighting is manipulated.

7. Proposed Installation Specifications for Holograms for Any Display Space

In review of the information presented and, on the criteria, affecting the hologram display, Table 1 shows a proposed installation guide that could accompany any art holograms. The first four items are currently requested, the next three are recommended. As an example, the sections were filled in as it would be for the vintage image shown in Figure 1. Figure 12 is a suggested installation diagram of the AOV that should be included as well.

Table 1. Hologram Installation Guidelines.

Title, Artist, Date of Artwork	Technical Classification	Format and Dimensions	Lamp Playback Incident Angle	Lamp Colour Temperature	Preferred Centre Viewing Height	Horizontal Angle of View (AOV)	Other Information
Colour Study with Light Blocks M. M. Crenshaw 1985	Pseudo-colour reflection hologram	Glass, framed, 9″ × 7″	45°	2500–3000 K MR-16 type incandescent halogen, or similar LED	60″	120°	Wall mounted

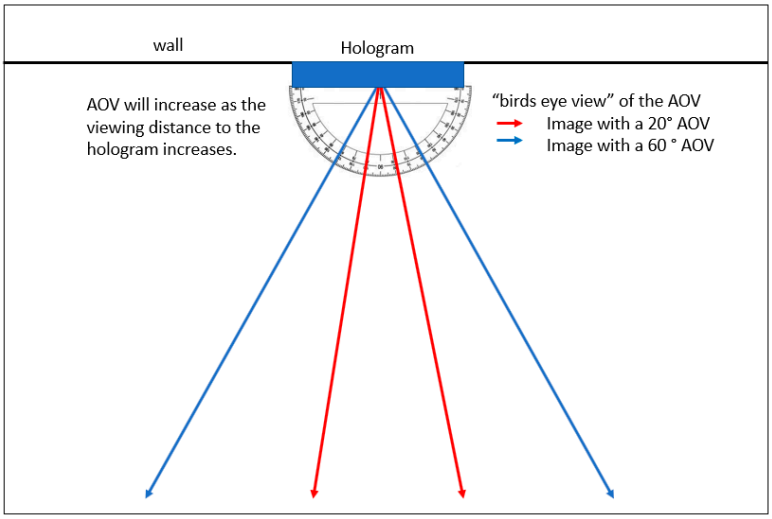


Figure 12. Birds eye view diagram of the angle of view of a hologram with a 20° AOV, and one with a 60° AOV.

8. Conclusions

The quality of Art holography installations has been limited, in part, by a lack of knowledge of the technical criteria to support effective viewing. We have at least moved on from dark rooms and poor reconstruction lighting to more favorable environments, but the full dynamic range of images is still not fully understood and/or acknowledged. There are some large collections out in the world such as the *Global Images*[5] collection, which, sadly, is in storage and the *C-Project*[6] collection, which is in the safe hands of the Getty Museum in the USA. These hologram collections are being saved, but unless specific information on playback illumination and the viewing requirements for the many images is available and understood, it is possible when these are displayed in the future their impact will be diminished and the experience of viewing these art works will be undervalued. Hopefully, the discussion I have presented in this paper will assist artists in creating holograms and designing exhibitions and will advance a dialog to remedy this by establishing more precise exhibition and display guidelines. In the meantime, we may only be seeing part of what is really there.

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Conflicts of Interest: The author declares no conflict of interest.

Appendix A

1. Fino-Radin, Ben. 2016. Art in the Age of Obsolescence, Rescuing an Artwork from Crumbling Technologies. Available online: https://stories.moma.org/art-in-the-age-of-obsolescence-1272f1b9b92e (accessed on 19 July 2019).
2. Benton, Stephen A., and V. Michael Bove Jr. 2008. *Holographic Imaging*. Hobokan: John Wiley and Sons Inc.
3. Bjelkhagen, Hans I. 1993. *Silver-Halide Recording Materials—For Holography and Their Processing*. Berlin/Heidelberg: Springer.
4. Desbiens, Jacques. 2019. The Dispositif of Holography. *Arts* 8: 28.
5. Hansen, Jeannene, Bob Schlesinger, and Fred Unterseher. 1982. *Holography Handbook Making Holograms the Easy Way*. Berkley: Ross Books.

[5] https://www.globalimages-hologramartcollection.com/melissa-crenshaw.
[6] http://news.getty.edu/getty-museum-announces-donation-105-holograms-created-by-20-noted-artists.htm.

6. Hariharan, Parameswaran, and P. Hariharan. 1984. *Optical Holography; Principles, Techniques, and Applications*. Cambridge: Cambridge University Press.
7. Sarakinos, Andreas, and Alkis Lembessis. 2018. Color Holography for the Documentation and Dissemination of Cultural Heritage: Optoclones™ from Four Museums in Two Countries. Paper presented at 11th International Symposium on Display Holography, Aveiro, Portugal, 25–29 June 2019.
8. NLPIP. 2010. Presently, There Are Two Approaches to Creating White Light. Available online: https://www.lrc.rpi.edu/programs/nlpip/lightinganswers/led/whiteLight.asp# (accessed on 19 July 2019).
9. Saxby, Graham, and Stanislovas Zacharovas. 2004. *Practical Holography*, 3rd ed. Bristol and Philadelphia: Institute of Physics Publishing.

References

Crenshaw, M. Melissa. 2009. Visual language and technique in the creative holographic domain. In *Holography—Culture, Art, and Information Technology: Proceedings of the Eights International Symposium on Display Holography*. Beijing: Scientific and Technical Documentation Press, pp. 259–69.

Sarakinos, Andreas, and Alkis Lembessis. 2018. Color holography for the documentation and dissemination of cultural heritage: Optoclones™ from four museums in two countries. Paper presented at 11th International Symposium on Display Holography, Aveiro, Portugal, 25–29 June 2019.

Saxby, Graham, and Stanislovas Zacharovas. 2004. *Practical Holography*, 3rd ed. Bristol and Philadelphia: Institute of Physics Publishing, p. 56.