The Emergent Holographic Scene

Compositions of movement and affect using multiplexed holographic images

A thesis submitted in fulfilment of the requirements for the degree of Doctor of Philosophy

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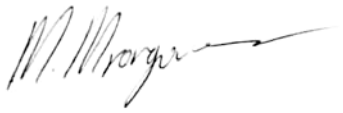
Declaration

I certify that except where due acknowledgement has been made, the work is that of the author alone; the work has not been submitted previously, in whole or in part, to qualify for any other academic award; the content of the thesis is the result of work which has been carried out since the official commencement date of the approved research program; any editorial work, paid or unpaid, carried out by a third party is acknowledged; and, ethics procedures and guidelines have been followed.



Martina Mrongovius
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Conventionally, a hologram offers a view into a single space; a window onto a scene. The term 'hologram', refers to both a method of encoding a spatial image within a physical surface and the reconstructed optical image that is produced through the diffraction of light as it meets with that surface. A holographic window of perspective allows for bio-ocular depth perception and for the viewer to move as they look from different angles through the hologram. When the recorded visual perspective matches the viewer's perceptual sense of space the holographic image produces a visually-realistic volume: a 3-dimensional light sculpture.

This research explores the multiplex or stencilled hologram, which divides the perspective window so that the viewer moving around the hologram perceives a composition of views, superimposed into a holographic scene. Because of this assemblage of perspective views the multiplex hologram has the potential to actively engage the spatial experience of the viewer in a way that departs from the conventional deployment of holograms. In this project-based research the multiplexed holographic scene is used to remap the viewer's gaze by connecting it to a composition of multiple, hinged photographic views. This required the development of ways to anchor these multiple perspectives into a holographic structure, achieved through connecting points of visual attention and lines of movement that are then traced into a spatial arrangement of views. The research led to an experimental practice where the composition of holographic images and their installation in physical spaces highlighted and affected the disjunctions and fusions between different systems of perception in embodied act of looking.

This research aims to convey a series of techniques for the expansion of holography through a design and installation practice that focuses on a visuo-spatial choreography. These choreographies aim to heighten an awareness of the perceiving body – both in the process of capturing images for a holographic scene and during the viewer's exploration of this scene. The projects seek to work actively with the role of movement and multiple perspectives, mapping perceptual shapings and virtual extensions that inform the experience of urban navigation. 'Perceptual shaping' here refers to the perception of an undulation and/or rhythm of dimensions and forces: 'shapes' or diagrams that are mapped through qualities and trajectories of movement. These diagrams or 'shapes' become important in working with 'a complex sense of location', an idea developed here to describe how multiple spaces and orientation systems are enfolded. The multiplex hologram then becomes medium for conducting a diagram of movements.

This research articulates a design practice of holography that focuses on the relationship between bodily movement and the experience of space, where the hologram becomes a device that guides and structures a felt relation between movement and spatial experience. As well as developing the field of display holography, this project-based research aims to point to broader issues relating to the contemporary infusion of visual media and how image-systems and ways of looking, such as a holographic view, shape experience.

Acknowledgements

The research environment of the Spatial Information Architecture Laboratory (SIAL) at RMIT University allowed me to develop a creative practice into doctoral research. This would not have been possible without the guidance of my supervisor Dr Pia Ednie-Brown and advice from Dr Andrew Burrow and Dr Inger Mewburn.

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I would like to express my gratitude to the collectors and libraries of holograms where I have been able to view holograms:

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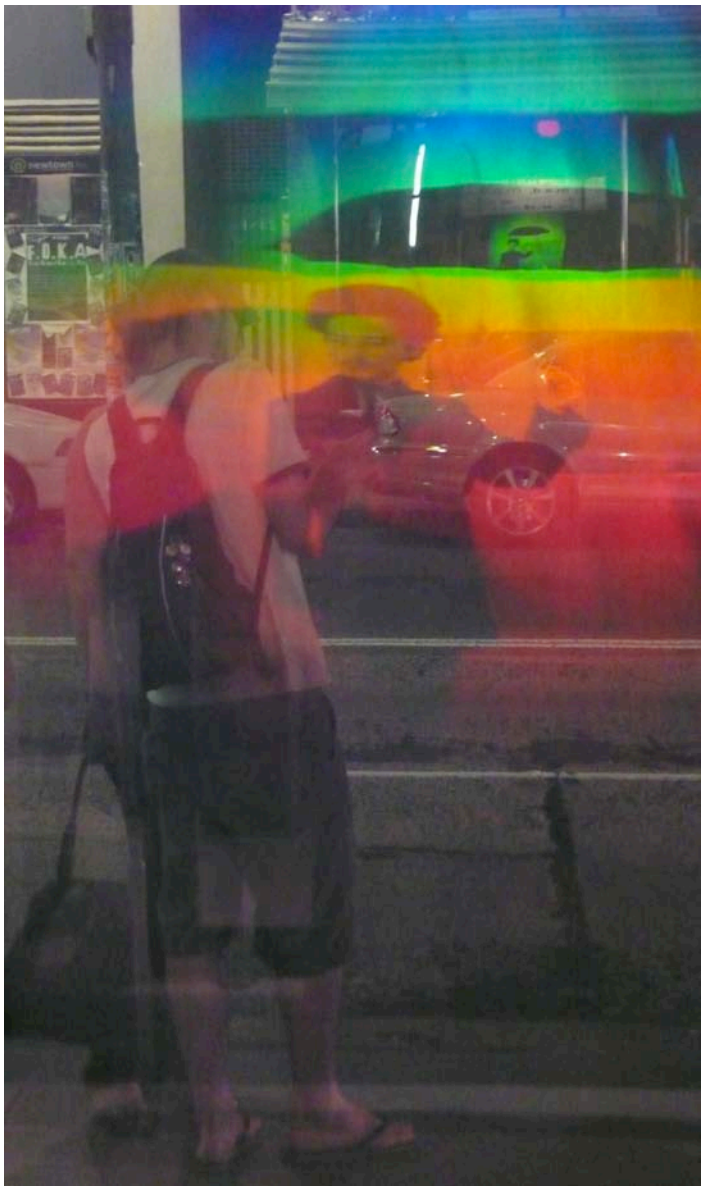
[Centre for Art and Media Karlsruhe]
MIT Museum, Holography Collection, Boston
www.holonet.khm.de hosted by Academy of Media Arts (KHM), Cologne

And to all the artists, scientists and authors who have been such an inspiration.

–Thank You.



Viewer, reflection and hologram, *Unfurl*, 2004/5

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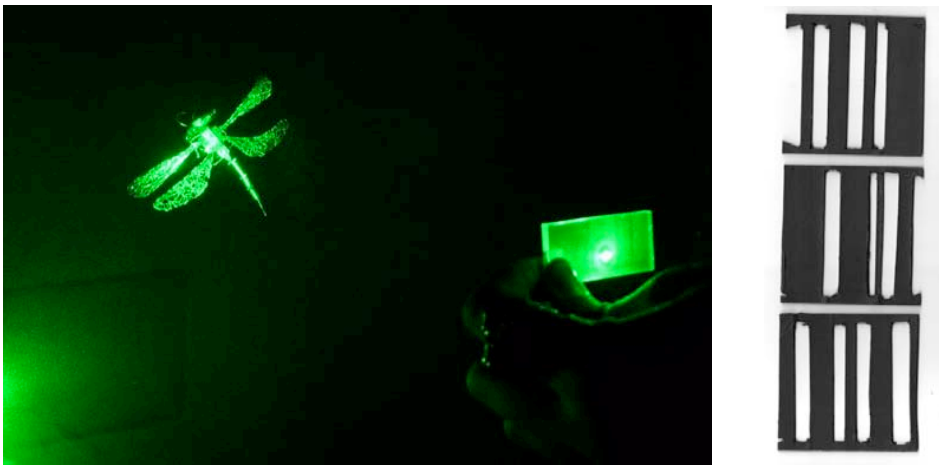
Introduction

1. Research background and methodology

As long as I can remember I have been experimenting with the capture of images. Making shadowgrams with my father in our laundry-turned-darkroom, I became fascinated by the suggestion of form by shadows and the shaping of light with optics. My work with holography began in 1999 while studying Applied Physics, where I learnt to manipulate optical geometries and therefore the spatial properties of images.

While having taught it, I have never formally studied holography. My knowledge has been accumulated through practice. I learnt the basics from Graham Saxby's book '*Practical Holography'* and through trial and error in the RMIT holography laboratory, as well as unofficially attending some of Associate Professor Philip Wilksch's holography classes. From the outset my work was experimental, such as my holograms of light caustics that attempted to record the folds of light emanating from broken glass sculptures. But the light patterns caught in these holograms were frozen, so began I to incorporate techniques of scanning and tiling multiple images perspectives. Having made stop-motion animations in high school I also decided to apply this procedure to my holography of objects. My Honours project in Applied Physics included the production of a series of stenciled holograms that were then scanned by lasers to project the animated image of a dragonfly.

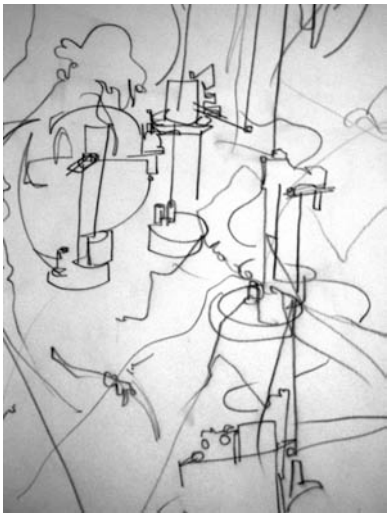


Laser projection of dragonfly for *'Hover',* 2004, and stencils used to make the animation

In 2005 I was invited to the Academy of Media Arts (KHM), Cologne and given the opportunity to make multiplex holograms from sequenced digital images, enabling me to incorporate photography and video into my holograms. Before I used photographs to make holograms, my photography often played with long exposures to trace movement and intensify stillness. I photographed visually ambiguous images, such as the visual folding of spaces via reflections, to produce complex spatio-temporal readings of visual space. Social and candid images were often shot at arms length, allowing me to include parts of my body in the frame giving a perspective that was not a simulation of an ocular view but referenced to my physical presence. These experiments in photography and the visual 'mechanics' of the image evolved into my holographic image compositions.

The processes experimented with – in the making of holographic images – have significantly defined the evolution of my practice. My research emerged from physically manipulating optics in the laboratory and through photography and video into a design practice of holographic image installation. Through approaching holography with an emphasis on process, the work does not try to fit content into the

medium. Rather, it asks how the activity of capturing and composing images can be explored with this medium, to then become part of the process of engaging with a hologram. This has led to a practice of developing compositions and designing installations in order to work with and reveal the potentials of holographic image construction.



Left: Part of a movement-tracing sketch by Briony Barr of me working on the optical table, 2006

Right: Traces of the optics positions on the table, 2009

Center for the Holographic Arts, New York

I have also never formally studied art or art history but developed an artistic practice as an extension of my explorations and fascination of physics. An education in physics provided a research framework to explore structural and formula-based systems, which I expressed in the form of visual narratives, imagery and installation. My early experimentation with holography formed part of my creative investigations of modern physics and non-linear narrative construction. Holography enabled me to explore fragmented and superimposed spatial dimensions by considering perspective as a projected field across which multiple views could be recorded. The works produced highlighted the structural folding of an assembly of perspectives through the multiplex hologram.

Parallel to this laboratory work, I was developing a way of understanding how encounters are mediated by maps and cognitive images, which I began to consider as a process of cross-referenced folding. I made maps of my encounters by tracing patterns of visual references and paths of movement through architectural spaces with photography and video recordings.

Five of the 36 photographic-film sequence *Approach*, London 2002

This sequence can be read as both a virtual movement along the balcony and/or the animate difference between images.

In 2006 my focus shifted as I became involved with the research environment of the Spatial Information Architecture Laboratory within RMIT University's School of Architecture + Design. Previous concerns regarding the content-structure with which the holographic image was encoded migrated into an investigation of the processes of recording and creating installations to capture and unfold a structured activity of viewing.

The discourse around spatial design practice brought a different understanding to my research. It immediately spoke to the spatial montage and activity of mapping that I had been exploring through holographic images. Despite their different motivations, both my research in Applied Physics and with the Spatial Information Architecture Laboratory emphasised 'doing' and observing what came out of these experiments. Working at this common juncture, the research has been approached primarily through a process of reflective practice, more-or-less as described by Donald Schön in his book '*The Reflective Practitioner: How professionals think in action*'.[1] As such, this research has operated as a process of experimentation: through making and installing/exhibiting holograms, reflecting upon the affects and outcomes, and feeding this back into subsequent experiments.

Over the course of this research I developed at least 16 projects into exhibitions, each an experimental approach that fleshed out conceptual and practical questions. These questions developed around my attempts to understand and articulate how the multiplex holographic scene could be used as a tool for expression.

Exhibiting the holograms was critical to the development of this research. The major exhibitions, *'Explorations of the holographic gaze'* (2010) and *'The Emergent Holographic Scene'* (2011), were installations of a number of different but related compositions. Juxtaposing the different compositional tactics embedded in the holograms meant I could observe and compare viewers approaching and engaging with a range of different virtual movements and structures. A catalogue of projects including those presented as the exhibition *'The Emergent Holographic Scene'* – a component of this thesis examination – can be found in the appendix.

During the course of the research I began to photograph common gestures of viewers, such as pointing at the holograms as well as video recording viewers as they moved through the installations. The exhibitions also allowed me to ask viewers about their perception of the holographic images as well as engage in related conversations around image culture and navigation. My direct observations and recordings of viewers as well as the conversations triggered by the holograms were used qualitatively to direct the research.

The primary method of investigation was self-observation. The recording and viewing of images were a means to locate myself and to see myself in relation to my surroundings. The visual dynamics of moving through an urban environment was one of the main inspirations for recording. Tracing a sequence or structure of views with a camera also coaxed my movement – often producing a heightened physical awareness – such as the strain of repetitive actions or the 'giddy' disorientation and disembodiment of seeing through the camera.

The act of photography guided and articulated my observations while the camera enabled a perspective external to my eyes. As such, the photographic recordings enacted a reflective thinking that I used to visually isolate, track and extrude the dynamic relationships that formed my conceptualisation of place.

The visual tracings were composed into holographic scenes as a conceptual and aesthetic mapping. Viewing the holograms allowed an experience of the dynamics that emerged through the processes of sampling and structuring – dynamics that reminded me of the sense of perceptual shaping that I experienced in navigating and recording. To connect a sense of dynamics or shapings between the activity of recording and viewing, I referenced and structured multiple views around 'anchors' – to hinge the visuo-spatial relationships into a scene. The development of this process was ever-folding. Many

[1] Schön (1983) – full references in bibliography.

issues and fascinations emerged, submerged and re-emerged as I explored the potential of holography for configuring relationships between embodied awareness and different ways of structurally composing space and movement.

Terminology and articulation have been the most difficult aspects of conducting research across artistic, scientific, theoretical and technical domains. While finding myself spread across many different languages and modes of understanding, the process of experimentation through making holograms and ways of installing them consumed most of my energy and attention. This practical process provided the primary reference point, or anchor, between a range of often conflicting epistemological perspectives.

The development of my holographic practice has involved the acquisition of significant technical skills, the construction and maintenance of holographic laboratories as well as becoming proficient in the visual language of holography. The necessity for specific technical apparatuses in producing holograms means that access to particular laboratories defines many of the parameters of any given hologram. Each facility and my travels between them shaped the development of my holographic practice significantly. Developing and maintaining the facilities to produce holograms has been both a demanding challenge and a source of inspiration.

2. Research focus and contribution

This research makes its clearest contribution to the field of artistic holography. The work of this small field has struggled to be recognised as either a valid form of media or be valued as artwork. Holographic artists have explored a wide range of concepts[2], often revolving around perception and presence. The possibilities of expression through a feeling of perceptual distortion and by an affect of coupled virtual movement has, however, been neglected. This research seeks to address these possibilities of expression by working with the activity of viewing and composing holographic image structures.

Using the medium of holography this research also offers a new way of addressing our concept of place as a cross-referencing of perceptual experience. In particular what the projects seek to elicit is a notion of location that is complex and forms through a process of referencing.

My work deals largely with multiplex holograms. Conventionally, a hologram offers a view into single space; a scene captured through a window. This window of perspective allows for bio-ocular depth perception and requires the viewer to move to look from different angles through the hologram. The recorded and replayed visual perspective of the holographic image can match the viewer's perceptual sense of space to produce a visually-realistic, virtual volume. A multiplex or stencilled hologram is a particular kind of hologram that breaks the perspective window into multiple perspectives such that the viewer moving around the hologram perceives a composition of views, superimposed into a holographic scene. The method of creating multiplex and stencilled holograms enables a re-arrangement of perspective that is perceived as movement or a warping of space. This process makes it possible to animate the image such that it becomes a dynamic rather than a static virtual sculpture or space. Typically a multiplex hologram has horizontal parallax (and sometimes also vertical) that is used to either create stereo-depth perception[3] or to record an animated sequence, such as a segment of video or animated object. For the most part, I do not use the multiplex hologram to show a '3D'[4] scene or traditional animation/time-based images. Rather, my compositions bring together multiple linked

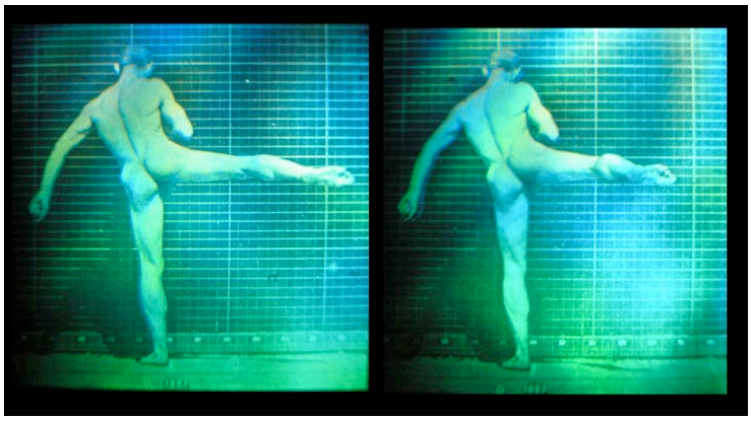
[2] Such as described in Garcia-Robles (2008).

[3] This is why multiplex holograms are also referred to as 'stereograms'.

[4] Through the text I will use 3D where an image appears to have depth, such as a stereographic 3D film or an illusion of depth by point perspective. This is distinguished from 3-d, which I use to refer to 3-dimensions.

perspectives, to imply virtual movements and/or dynamics of spatiality to suggest a 'shaping' by cognitive and embodied activity. In these ways, I have been exploring the potential of the multiplex hologram to establish other spatial, animate qualities and modes of engagement compared with that of the single, holographic scene.

There has been very little written about the potential of holographic multiplexing. As David Pizzanelli outlines in his PhD thesis *'Aspects of Spatial and Temporal Parallax in Multiplex Holograms*[5] the multiplex hologram allows for the recording and perception of motion as well as volume. Pizzanelli's dissertation draws on techniques of chronophotography and is accompanied by a series of holograms using Eadweard Muybridge's photographic studies of motion. The contribution of Pizzanelli's thesis is a demonstration of how recordings with temporal parallax enable a graphing of motion. The holograms he created map this temporal parallax into the spatial perspective-views of the hologram. Pizanelli's work was concerned with representing continuous movement and space through a sequence of frames, whereas I am drawing together different perspectives to produce virtual movements that never existed physically.



David Pizzanelli *Arabesque*, 1989.
From photographs by Eadweard Muybridge
Mirror-backed achromatic white-light transmission, multiplex hologram 10 x 8" [25 x 20 cm]
"The stereo should be viewed with the images no larger than a post-it note (62 mm between similar image points) as the hyper-parallax, caused by the fusion of temporal and stereoscopic parallax (the extended right foot) is really hard to fuse in this pair", email instructions from David Pizzanelli that accompanied the image, 15 November, 2010.

Another instance where holography and movement has been explored is holokinetics, a merging of holography and kinetic art that is described by artist Ruben Nuñez as "a fluidity of time and space"[6]. Nuñez used holograms as a way of dynamically shaping light and was an advocate for abstract holography. In writings and interviews Nuñez describes the development of his practice through experimentation with vibrations, considering "light is an elastic substance which gives us the possibility to express"[7] and giving importance to a "artistical conception of space"[8] that considers the cosmic nature of humans through a poetic that extends beyond the visible.

These key examples show how movement can be encoded within the holographic image, which has otherwise largely dealt with static scenes. However, both pursue a particular kind of movement: a

[5] Pizzanelli (1994).
[6] Catalouge for the exhibition *Holokinetics*, Museum of Holography, New York, 8 September – 26 November, 1978.
[7] Ruben Nunez interviewed by K-soul in the video *Holokinetism,* quote at 3:31min, [source: http://vimeo.com/5040648].
[8] Ibid, 14:39min.

continuous movement of the visual form. Despite a long and rich history in visual culture – especially in painting, photography, and film – in which continuous movement has been dismantled into compositions involving fragmentation and discontinuity, this is rarely discussed or explored in holography. As mentioned earlier, this research has been motivated by an interest in how the multiplex hologram offers the potential for an exploration of non-continuous forms of movement via holographic imaging.

The interference pattern that is fundamental to holographic recording can also be used to map movement as a change in position. Margaret Benyon began exploring techniques of interference in her art before coming across holography. The hologram Benyon created with John Webster *Counting the Beat* shows the differences in her saying "yes" and Webster "no". Two holographic exposures were recorded, each a reference to the other to capture a topography of movement. This piece is described in the MIT Museum Collections as: "An interferometry of the emotions, rather than the non-destructive testing for which the technique is more commonly used."[9]

Left: *Counting the Beat*, Margaret Benyon and John Webster, 1981
Transmission double-pulsed laser exposure – twenty billionths of a second apart, 12 x 16" [30.5 x 40.5 cm]
"Master made at CEGB in collaboration with John Webster; transfer made in MoH Gabor lab during an AIR"[10]
Photograph by Margaret Benyon. [source: MIT Museum Collections, http://webmuseum.mit.edu/detail.php?t=objects&type=browse&f=maker&s=Benyon%2C+Margaret&record=8]
Right: Margart Benyon, *Tigirl* 1985
Reflection hologram and reproduction, 30 x 33 cm
[source: The Jonathan Ross Hologram Collection, http://www.jrholocollection.com/catalog/benyon.html]

Equally, another kind of movement, intrinsic to all holograms, remains under-explored: the movement of a viewing body in order to move across and through the holographic scene. There are some notable exceptions. A text written by Bob de Marrais for Sam Moree's exhibition *'Flux'* (1982) compares the movement of viewing a hologram to the execution of dance-steps[11]. The concept that viewing a hologram requires mobility is further developed in the publication that accompanied the exhibition *'Mehr Licht'* (1985), particularly in relation to Douglas Tyler's holograms that are inspired by the footprints left on the moon[12]. Examples in which holography intersects and works with actual architectural space, rather than simply being a virtual replication has been significantly[13] covered in only one paper: Andrew Pepper's *Architectural Holography: Building with light, decorating with space,* which points out the

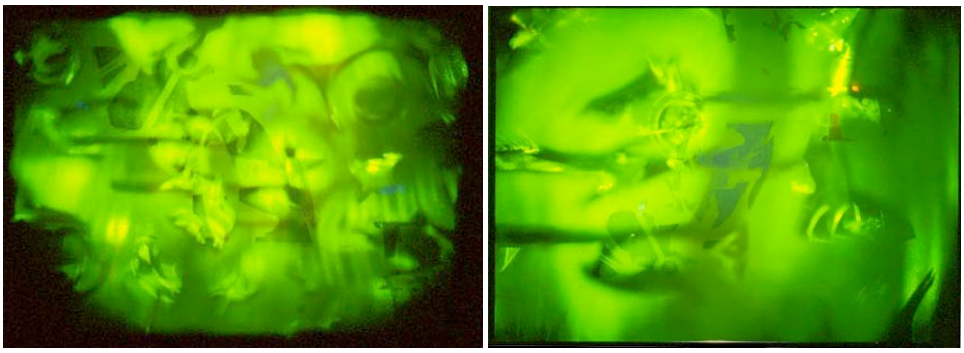
[9] MIT Museum Collections
[http://webmuseum.mit.edu/detail.php?t=objects&type=browse&f=maker&s=Benyon%2C+Margaret&record=8]
[10] Ibid.
[11] See [Ch3.B1].
[12] See [Ch3.B2].
[13] Vito Orazem also wrote about using holography in architecture. His paper *Holography as an Element of the Media Architecture* focused on technology. The conclusion, however, points to one sense of viewing that I explore – "Maybe with these developments, we shall finally reach the multi-perspective space feeling" Orazam (1995).

potential for the expansion of holography into architectural installation, by describing a number of holographic image installations that work with an architectural process of design. However, most texts on holography are limited to a discussion of the illusion of volume, ignoring how the installation space and movement of viewing affects the reading of the scene

By creating holographic scenes that link a dynamic perspective to physical movement the research projects are designed to tackle the relatively ignored role of a shared movement between the scene and the viewer. The way in which vision and motion can operate together is extended and shaped by the image installations to produce 'a complex sense of location'. A large part of this investigation has been to explore the perceived and conceptual spatiality of experiences. I am particularly interested in the way an encounter with urban environments might be shaped by conceptual diagrams and maps, and how this implies that we hold together co-existing, multiple understandings of being located.

Artist Brigitte Burgmer in her publication *'Holographic Art – Perception, Evolution, Future'* relates the viewing of a hologram to the dis-union of the modern view:

> "Holograms do not offer the viewer one established perspective but rather they contain 'Dis-Union' because of the way in which they are produced. A single observer can see different perspectives of a holographic object while moving through space and time. Thus holograms can underline the 'Perceptivity' of our modern life."[14]



Photographs of Brigitte Burgmer's *Future Perfect I* and *II,* 1988
Reflection holograms, 32 x 43 cm
[*Sammlung Lauk* [Lauk Collection], source: www.lauk-collection.com]

Burgmer's holograms *'Future Perfect'* were created by masking the master recording in some places leaving only a tiny windows so that artifacts can only be seen from a very particular positions.[15] A negative of the mask was then applied to a flipped master, filling in the voids with a pseudoscopic[16] view of the scene. Burgmer describes this diptych as "visually very complex and a challenge for perception"[17]. When I viewed this work at the artist's house what became apparent to me was the way that the visual complexity charged the viewing space. The tiny virtual windows required me not only to look into the hologram at a particular angle but also from a particular distance – to place my eye within the virtual window. The ideal distance to view the orthoscopic (normal) and pseudoscopic (inside-out) parts of the image however differs resulting in a moving back and forth as well as side to side to try and decipher the scene. Setting-up this activity of viewing I consider as part of the holographic image design.

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[14] Burgmer (1987), p75.

[15] A diagram of the master-transfer process is in the *Appendix: Chapter 0 – The holographic print.*

[16] A pseudoscopic image appears inside-out – that is, the foreground has a visual depth that makes it seem as if it is behind the background. See also *Are You Here* [Ch1.A2].

[17] Burgmer (1996), [http://www.art-in-holography.org/papers/burgmer.html].

In designing holographic scenes I assemble a non-Euclidian 'perceptivity' by establishing a mimetic reference to the spatially dynamic imagery. These compositions employ visual 'landmarks' and often include a visual-protagonist as a way of referencing the viewer into the holographic scene. An activity of mapping via landmarks and patterns is combined with the suggestions of a viewing body (through shadows and reflections) to form sense of located agency in the exploration of the scene.

Left: Four overlaid photographs of a barge, 2006
The barge was moving in the same direction that I was walking along the Hong Kong waterfront.
Right: One image from a 'vertical-stereo' video recording, Karlsruhe, 2011

While this research is primarily focused on the link between visual experience and movement, the multiplex holograms I could produce were mostly limited to 30 x 40 cm prints, with 200 frames of animation. This limitation of scale and movement (both in the animation and by the viewer) motivated me to explore how large-scale scenes could be structured around patterns and how the viewing experience could be intensified through a heightened physical awareness. This motivation and my other compositional aims revolve around how to establish holographic scenes that communicate an awareness of a perceptual process.

The contribution made here feels both exciting – due to the considerable work to be done in the field – and problematic – because the relevance and poignancy of the field beyond itself is not well appreciated. It is because of this that I hope to point to ways in which holography as a medium has great potential for exploring broader issues relating to contemporary image making, interactivity, spatial navigation and structures of viewing.

3. Holography and media theory: Getting beyond the fake

Media theorists have largely ignored holography. Unlike digital images it is only through engagement with the physical hologram that the holographic image can be experienced. This has resulted in a generally limited exposure to and understanding of holographic images. The type of experience that an installation of holograms can produce has, however, become more prevalent with programmed interactive and responsive environments as well as projected image augmentation and the compositional possibilities of multi-screen 'expanded' cinema. The discourse surrounding these works has enabled a new way of understanding embodiment as well as the extension of the viewer as participant in the installation. Anna Munster argues that the aesthetics of digital culture "have reconfigured bodily experience and reconceived materiality".[18] My work with holography speaks directly to this area of enquiry. The hologram has something unique to offer in that the 'responsive' image is not generated from a digital process but is physically enfolded by the hologram and its appearance depends

[18] Anna Munster (2006), back cover.

on the viewer's position and movement. The spatially-dynamic image is optically unfolded into the environment, producing a non-material presence that is sensed by the viewer.

The relative lack of attention to holography by media theorists is perhaps because when the hologram has been addressed in philosophy, it is used predominantly as a way to describe the deception of an illusionary volume, largely characterising holography as a cheap trick of the real that de-values physical reality. This is exemplified in Umberto Eco discussion of holography in his 1975 essay *Il costume di casa* (*Faith In Fakes*).[19] Here, Eco describes holograms as the ultimate 'hyperreal' medium, a replica that seeks to be more vivid than the original. While using holography in his attack on the American culture of 'more' and manufactured authenticity, Eco's writing disregards any practicalities of holographic imaging and in doing so continues the ignorance of artistic experimentation with the medium. As such, other potentials of holography are suppressed by the ideal of replication.

Jean Baudrillard gives another account of holograms in the essay *Simulacra and Simulations - XI. Holograms* (1981). Here, Baudrillard discusses the hologram in term of a surface illusion, in the context of a cultural trend of valuing appearance over substance and spirit. While Baudrillard goes further into the qualities of the medium, his argument is also fixated on "this race to the real and to realistic hallucination".[20] In his 1999 lecture *The Murder of the Real*,[21] Baudrillard warns of a society of delusion. This warning is an important philosophical stance which questions the sanity of seeking realistic augmentation and what is lost in virtual relationships. Again, the hologram is primarily characterised as a realistic illusion.

In popular culture the concept of a hologram has been used mostly in the genre of science fiction to allow for immersive virtual-reality environments such as the 'holodeck' in the television series *Star Trek: The Next Generation* (1987–1994) and for the holographic presence of a virtual character, such as Arnold Rimmer in the television series *Red Dwarf* (1988–1999). In both cases the 'holographic image' is indistinguishable from physical reality. A more feasible representation of holography is the holographic recording of Princess Laia in *Star Wars* (1977) and the holographic video chips in the film *Minority Report* (2002). In these two films the hologram is considered a medium for the recording, storage, and retrieval of information. Since 2006 'hologram' has become synonymous with a partial reflection of video images, as the term was applied to the widespread marketing[22] of the Pepper's ghost technique. John Henry Pepper demonstrated this technique in the 1860s using a partially reflective surface to overlay visual elements (often a 'ghost' figure) onto the stage. Using video projection it has become a trend to use a partially reflective surface to mix imagery with the scene beyond. Such as the anime character Hatsune Miku's appearance 'live' in concert[23] in 2009. The reflected elements and characters are often described as holographic – or even incorrectly as holograms, because they have an optical presence and are perceived as floating in physical space.

This typical characterisation of holography rests on thinking about it as primarily a mean of representation – that is, standing in for something not actually present. The problem with thinking of holograms in this way has been raised indirectly through related issues in photography. Vilém Flusser (1920–1991) discussed related issues in his writing, posing images as mediations between the world

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[19] This essay was updated and published as *Travels in HyperReality* in 1983.

[20] Baudrillard (1981) 1994 ed, p107.

[21] Baudrillard (1999), recording from Wellek Library Lecture Series, University of California, Irvine, [source: http://www.egs.edu/faculty/jean-baudrillard/videos/murder-of-the-real/].

[22] Such as the 'Musion Eyeliner 3D Holographic Projection System' [www.eyeliner3d.com/].

[23] Hatsune Miku is created by computer graphics and music synthesisation and made a debut performance at *'Animelo Summer Live'* festival at Saitama Super Arena, Japan, 22 August, 2009.

and humans: "They are supposed to be maps but they turn into screens: Instead of representing the world they obscure it until human being's lives finally become a function of the images they create."[24] This quote suggests the viewer is not aware of their active engagement with images, which is something I disagree with yet consider important. To address this concern I attempt to heighten the viewer's awareness of a perceptual activity in the viewing of holographic images.

Susan Sontag (1933–2004) in *'On Photography'* describes how the photographic act gives the observer a false sense of security and connection. Sontag questions the ethical sensibility that is proliferated through the photographic medium relating it to obsessive consumerism as well as a false sense of 'reality', connection and detachment,

> "Needing to have reality confirmed and experience enhanced by photographs is an aesthetic consumerism to which everyone is now addicted. It would be not wrong to speak of people having a compulsion to photograph: to turn experience itself into a way of seeing."[25]

I do not disagree with Sontag's warnings about an image-based culture, but having grown up within such a culture, what I consider crucial is to develop a 'way of seeing' and as John Berger points out "The relation between what we see and what we know is never settled".[26] This ongoing relation is integral to my motivation to develop a practice of using holograms as a means of probing and provoking an awareness of embodied visual experience as an activity.

Without an awareness of augmentation the virtually induced and extended experience slips towards deception. Flusser warns, "Human beings forget they created images in order to orientate themselves in the world...Imagination has turned into hallucination"[27]. While these ideas can be used as an attack on holography and image culture, these media can also be used to illuminate ways through and around the perceived problems. As Massumi has argued, hallucination and perception may have more in common than many would like to believe, with each of these experiences arising through a type and intensity of self-referencing:[28]

> "The difference between dream, experimentally induced hallucination, and pathological hallucination from each other and from 'natural' perception pertains to the kind and complexity of experience's self-referencing to its own ongoing event."[29]

This research considers a particular type of experience that I seek to define in terms of "the kind and complexity of experience's self-referencing" in the viewer's encounter of an enfolded scene. To do this, visual landmarks and mirroring operations are employed to establish the holographic scene as a system of relations that is engaged with by a mobile viewer. Relationships between vision, cognitive mapping and motion in this limited situation can then be used to explore the self-referencing of perceptual activity and how this activity can be extended into a virtual scene, while enabling an awareness of the process.

In order to establish the holographic image as a 'scene' with animate and spatial qualities, I assume that in the viewer's everyday experience vision and motion are intrinsically linked. For example in the experience of seeing a moving object, reaching for it and grasping it. In this action space and motion are perceived from interrelated visual elements and their physical referencing – particularly the sensations of touch and movement (proprioception and kinesis). With the hologram however the established space remains virtual – it cannot be entered into. A perception of movement through the

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[24] Flusser (1983) 2005 ed, p10.
[25] Sontag (1977) 2002 ed, p24.
[26] Berger (1972).
[27] Flusser (1983), 2005 ed, p10.
[28] Massumi (2002), p156 &182.
[29] Ibid, p156.

scene is a virtual movement, in the way that a tactile sense of texture that arises from visual suggestion is virtual.

The idea of using images to orientate is important to this research, and I will argue that the image is part of the sense of feeling located and for planning action. Anna Munster addresses in '*Materializing new media'* how digital embodiments produce a perspective that is both from sensation and via an outside (third-party) view, such as through visual media[30]. As the boundaries of the body have become blurred by extended perceptions, interactions are harder to define, or as Munster describes;

> "The interface between body and technology is no longer locatable within the sphere of corporeality or of code. Yet it has not disappeared. It exists as an aftereffect of the dynamic encoding of bodies."[31]

I consider this 'aftereffect' as the infusion of encoded processes and their dynamic shaping into the perceptual feedback loop that establishes experience. The extended experience then co-emerges through sensory perceptions and the encountered system. The composition of holograms that reveal a physical action of recording and/or conceptual structuring are intended to show how these processes establish the perceived scene.

The combination of spatial dependency and the hologram's visual encoding can simulate the perception of physical space. Because of this simulation, holography has primarily been considered as a means of representation that can trick perception. When we experience such a trick and then become aware of it, we understand that there is a gap between what we perceived and the physical reality. By understanding how this gap was created we learn something about how we perceive. The tendency of commercial holographic and virtual-reality media has been to try and hide the mechanisms through which the illusion is produced, and in doing so remove the viewer's active role. The viewer becomes a spectator of the virtual. When holograms are employed to explore perception as an activity of composition, the aim is to set-up an experience where the viewer engages with the image as an expressive extension of visual perception in which they are reflexively aware of the extension and take part in establishing the scene.

4. Movement as holographic materiality

The ephemeral aesthetic quality of optical holographic images produces a sense of form and structure without materiality. It is as if we can look around an implicate structure[32], into a scene of relationships that create forces and forms. At first, in the process of making multiplex holograms, I always felt that I lost a lot; the subtle details and colours of digital source files did not come through in the lower 'fidelity' of the holographic print. Yet something else emerged: dislodged from material implications, the animate forms and forces elicited by the holographic scene become the active 'material' by tapping into our sense of physical movement.

Through this research I came to consider how a holographic scene can be diagrammed around experiences of movement. Daniel Stern, in developing a framework for analysing inter-modal communication and the perception of qualities (in particular 'aliveness'), describes the 'how' or 'manner' of actions as 'dynamic forms of vitality'. While considering these forms as emerging between modes of

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[30] Munster (2006), p142.

[31] Ibid, p143.

[32] As David Bohm defines: "The word 'implicate' means to enfold – in Latin, to fold inwards. In the implicate order, everything is folded into everything" [Bohm (1985) 1987 ed, p12]. I use the term 'structure' to emphasise that the multiplex hologram is a limited and distinct form of implicate folding.

action, Stern gives movement a primary role: "The experience of vitality is inherent in the act of movement. Movement, and its proprioception, is the primary manifestation of being animate and provides the primary sense of aliveness"[33]. In this sense, we can think about movement as a kind of living force. By contrast, one common response of viewers looking at a static hologram such as a pulse-laser portrait is to express how 'creepy' the image is. The detailed 3-d form is completely static. There is no reading of movement and this lack of aliveness combined with a spatially realistic, yet non-material presence can be unnerving. An image can separate motion from vision – particularly a frozen photographic view or a linear Albertian perspective. What I am doing is linking images back into physical experience, rejoining vision and motion but with a transformation or shaping.

Stern draws on the work of Susanne Langer, particularly in developing his idea of 'vitality affects', which informed his early work analyzing interactions between mothers and babies. Langer proposed that art could be considered in terms of abstract patterns or complex forms of movement. In particular the postscript to '*Feeling and Form'* (1953), *A note on the film*, written for her 1967 edition, offers an important insight. In this text Langer describes how the movement-image of cinema came into its own as a medium when; "The moving camera divorced the screen from the stage."[34] The moving camera allows the viewer's perspective through the film to be de-coupled from their seat in the theatre. The film is no longer just an assemblage of shots but contains an activity of virtual movement. With my holography I propose a similar de-coupling between the movement of the viewer and the resultant animation of the holographic image. The de-coupling of virtual movement in holographic images, however, is still intrinsically linked to the viewer's motion, establishing a relationship that can be used to express a dynamic form, such as acceleration or twisting.

In the exhibition catalogue foreword of '*Mehr Licht'*, Günther Fielmann points out the mobility required to view a holographic artwork:

> "Only the mobile spectator can appercept[35] the work of art. My point of view determines what I see: new colours, new space, new imagery."[36]

If the mobile body is a prerequisite for holographic artwork, it is also the case for much interactive new media work. In relation to new media environments Munster describes the condition of dual spatial agency:

> "The physical body of interactants in immersive new media environments is not a clumsy body, lacking navigational skills. It is a body working overtime and over two spaces, producing gesture in the very differential that is the interval between information and the physical world."[37]

In relation to what I am exploring through my holographic installations, this 'gesture' that connects the virtual and physical is something I infuse, or guide, with a 'diagram' – a structuring of relationships between vision, motion and space. By linking the visual perspectives of capturing and viewing through a diagram of movement, the aim is to encourage an awareness of connections, disjunctions and transformations in perceptual experiences.

My design approach considers the intrinsic role of movement of equal importance (and linked to) the hologram's potential to record and reconstruct a spatial scene. By working with movement I aim to develop the potential for the communication of dynamic forms in relation to holography as a medium.

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[33] Stern (2010), p9.

[34] Langer (1953) 1967 ed, p411.

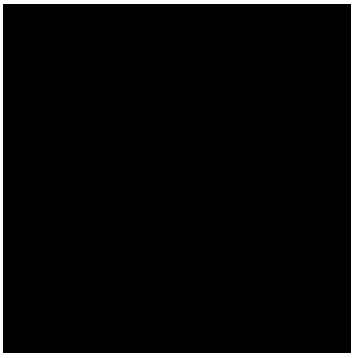
[35] 'appercept' is usually apperceive or apperception in English – a process of perceiving which makes use of past experiences. This is a translation from the German word *erfasst*, which implies a recording or capture.

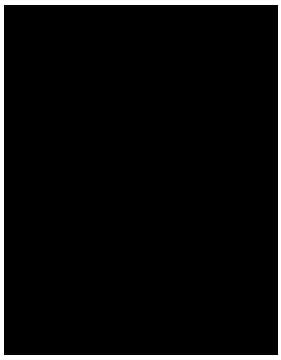
[36] Lipp and Zec (1985), p13.

[37] Munster (2006), p146.

5. Important precedents for structuring movement in images

If we look back at photographic and mechanical imaging practices as a precursor to holography what is conceptually important is how these mediums enabled an exploration of the relations between movement and vision. Construction by direct light – an optical approach to image making that also underpins holography – was pioneered by László Moholy-Nagy (1895–1946) and significantly developed by Man Ray (1890–1976) through experimental photography and by György Kepes (1906–2001) who used scientific devices to make images





Left: György Kepes, *Flame Orchard*, 1970–1972

"*Flame Orchard* consisted of six units like the one seen here, each housing a 2' x 2' x 3" gas container and a sound speaker that vibrated the gas. As composer Paul Earls' music played, the flames vibrated and leapt."

[source: http://museum.mit.edu/150/106]

Centre: Man Ray, *Lingerie,*1931. Photogram 'Rayogram' [source: http://www.surrealists.co.uk/gallery/Man_Ray]

Right: László Moholy-Nagy. *The Light-Space Modulator*, 1922–1930, gelatin silver print, 1930

This mechanical sculpture produces animated light effects and was used as a prop for the film *Ein Lichtspiel schwarz weiss grau* [A Lightplay black white gray][38]

László Moholy-Nagy, [source: http://museum.icp.org/museum/exhibitions/moholy_nagy/page2.html]

László Moholy-Nagy. *The Light-Space Modulator*, 1922–1930

Stills from *Ein Lichtspiel schwarz weiss grau,* 6mins, 1930

[source: http://www.youtube.com/watch?v=fANcou3sRjM]

Moholy-Nagy is most well known for his mechanical-optical image installations. He also wrote a number of manifestos including *'Vision in Motion'* which examines the role of both moving images as well as the mobile viewer. Moholy-Nagy's artwork and writing show an understanding of perception as a dynamic quality that dances between the mechanical, the optical and the active viewer. The assertions of *'Vision in Motion'* are comparable to my own questioning and understanding of the multiple roles of movement in my holographic scenes, I have added my terminology for each concept in square brackets:

> *"vision in motion*
> is seeing while moving
> [the moving viewer]

[38] The punctuation and capitalisation of this title is ambiguous from the film. I am quoting as published by The Moholy-Nagy Foundation [source: http://www.moholy-nagy.com/Bibliography_2.html].

vision in motion
is seeing moving objects either in reality or in forms of visual representation as in cubism and futurism. In the latter case the spectator, stimulated by the specific means of rendering, recreates mentally and emotionally the original motion
[a perception of movement – virtual movement]

vision in motion
is simultaneous grasp. Simultaneous grasp is creative performance—seeing, feeling and thinking in relationship and not as a series of isolated phenomena. It instantaneously integrates and transmutes single elements into a coherent whole. This is valid for physical vision as well as for the abstract.
[an experiential gestalt – the emergent scene]

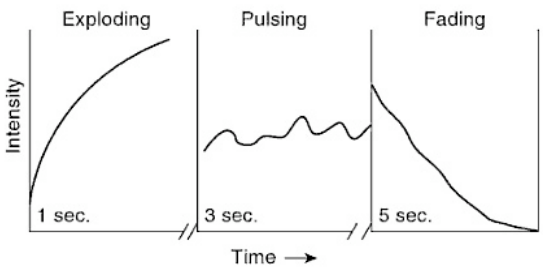
vision in motion
is a synonym for simultaneity and space time; a means to comprehend the new dimension.
[the multiple perspective gaze – a holographic view]

vision in motion
also signifies planning, the projective dynamics of our visionary faculties.
[the potential for movement and how this effects agency and poise]"

László Moholy-Nagy (1947), *'Vision in Motion'*, p12.

My compositional approach brings together these understandings of 'vision in motion' to structure the relationships between them and suggest how these are co-emergent aspects of perception.

Similarly, the work of Sergei Eisenstein (1898–1948) is instructive. My mappings of movement are often approached as a form of 'montage' as established in Eisenstein's film composition techniques. There are differences, particularly due to the nature of each medium – my structuring of perspectives and conceptual connections is through a spatial arrangement, whereas film is often concerned with the emotive thread developed through a tempo of associated images. In both cases the fused experience over a rhythm of correlations and disjunctions plays an important role in the composition process. To produce a structured dynamic perspective of space my compositions couple a montage of visual perspectives to the movement of the viewer. The transformations and resonations between the viewer's experience and the holographic scene are designed to produce felt and observed spatial dynamics, a shaping that folds reflexively around the activity of perception.



Left: One of Eisenstein's composition diagrams
The last row 'Diagram of Movement' is similar to Daniel Stern's graphing of vitality forms (right)
[sources: http://socks-studio.com/2011/04/21/sergei-eisenstein-sequences-diagrams-for-alexander-nevsky-and-battleship-potemkin/ ; Stern (2010), p8]

David Hockney's photomontage process of creating images from journeys and extended experiences helped me articulate the representation of perception in imagery. Hockney's experiments with the creation of photographic collages, '*joiners*', take the photographic perspective and map this into an image that is enfolded with the act of perception. Hockney describes how the act of looking occurs twice in the composition of these images, the first in the taking of the photographs and then in their assemblage. The viewer of my holograms who looks through the encoded photographic perspectives while moving around to assemble their own experience of the image also encounters a kind of two fold looking. My aim is to use the similarities and differences between these experiences of recording and reconstruction to produce a reflection on the affects that feed and shape perceptual processes.

6. Affect and the embodied encounter: Drive, awareness, agency

"By EMOTION (affectus) I understand the modifications of the body by which the power of action of the body is increased or diminished, aided or restrained, and at the same time the idea of these modifications."

Spinoza (1677), *Ethics. III*, def.3.

My approach to holography with an emphasis on movement, and in particular relationships of bodily and perceptual movement, led me to consider the contemporary discourse on affect as a core component of the research.

According to Nigel Thrift "there is no stable definition of affect"[39]. Thrift points out the term refers to a domain of emotion and feeling while emphasising that "*affect is understood as a form of thinking*"[40]. Spinoza's concept of 'affect' is then tied to an understanding of the 'embodied mind'[41] – in that thought is intrinsically linked to the physical body of the thinker. Thrift also identifies affect as a concept that incorporates the notion of 'drive' – such as "the Freudian understanding that one's physiological drive – sexuality, libido, desire – is the root source of human motivation and identity"[42]. While highlighting the different philosophical implications of the term, Thrift sketches affect as being a result of a composition of relationships. Brian Massumi highlights the activity of feedback within any such composition of relations: "In Spinoza it is only when the idea of the affection is doubled by an idea of the idea of affection that it attains the level of conscious reflection."[43] For example, when swimming in water, the affect could be thought of as both the changed ability for movement and the awareness of the modified forces on the body (such as buoyancy) that is ascertained through physical feedback as well as the comparative knowledge of what it is like to move on land.

Munster draws on Massumi to clearly describe affect in the media encounter – "Affect arises relationally and is produced out of the difference between being *in* the body and representing/mapping the body from the outside"[44]. Through compositional tactics such as coupling, mirroring and dislocating perspective I developed the goal of establishing a bodily relationship to the scene while exploring how a sense of body and location can be shaped by such a visual encounter. Drawing on all of these understandings the installations are a means to produce affect by activating 'drive', 'awareness' and 'agency' in the encounter with the holographic scene.

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[39] Thrift (2004), p57.

[40] Ibid, p58.

[41] Lakoff and Johnson (1999)

[42] Ibid, p59.

[43] Massumi (2002), p31.

[44] Munster (2006), p142.

Drive

The idea of 'drive' manifests in my practice as an activity of 'exploring'. Exploration in my work draws on the tendency, both in terms of tropisms and the ingrained human curiosity, to 'look around' as well as a desire to conceptualise experience. Exploration becomes important not only to experience new places but how concepts of place are changing due to evolving media technologies. With our cultures increased mobility and accessibility to information my impetus to explore is coupled with a desire to feel located. Through my practice I seek an active engagement with place, using holographic structures to diagram the movements and visual attention that underpin my encounters with new territories. In exploring the holographic image installations, the encoded relationships of looking and activity of composition are revealed by the viewer's own drive to explore.

Awareness

Many of my holograms depict a visual-protagonist whose activity anchors and arranges a multi-perspective gaze. Presenting relational structures through the holographic scene, I have sought ways to amplify and play with the viewer's awareness of their own perceptions. One effective tactic for eliciting this awareness is through a disruption, exaggeration or warping of established perceptual assumptions. A good example of this can be found in a story told by Brian Massumi in his book chapter *Strange Horizon: Buildings, Biograms, and the Body Topologic*[45], where such a disruption elicited an in-depth reassessment and consideration of perceptual processes. Massumi reflects on the experience of mis-matched cognitive and proprioceptive sense of orientation to develop an argument for navigation based on habituated movement that is then interrupted and re-calibrated by cognitive maps. With my holograms I suggest an experience of space that does not fit into a conventional cartographic mapping. The conceptualisation of the physical and virtual movement instead produces a kind of 'diagram' of visuo-spatial relations, something that I use to express a perceptual process. Viewing the holographic composition is designed to trigger a re-alignment of assumed visuo-spatial relations to bring awareness to the activity of perception.

Agency

Literary theorist and philosopher Michael Hardt identifies the role of agency in affect –

> "Spinoza also, secondly proposes a correspondence between the power to act and the power to be affected"… "—the increased autonomy of the subject, in other words, always corresponds to its increased receptivity."[46]

The viewer physically participates in my installations and in doing so animates the holographic image through movement. Thus, the scene unfolds through their agency. The viewer however is not a point in space replaying the scene. They are an embodied individual – present, thinking and feeling, with a sense of place, bodily inhabitation and personal tendencies.

Shaun Gallagher identifies the sense of embodied self as being comprised of both a body image – "a system of perceptions, attitudes, and beliefs pertaining to one's own body" and a body schema – "a system of sensory-motor capacities that function without awareness or the necessity of perceptual monitoring". Like the concept of an extended mind[47] where cognitive processes outside of the body are adopted, "The body schema functions in an integrated way with its environment, even to the extent that it frequently incorporates into itself certain objects—the hammer in the carpenter's hand, and so forth"[48].

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[45] Massumi (2002), p177-207.

[46] Hardt's foreword for Clough and Halley (2007), px.

[47] Clark and Chalmers (1998).

[48] Gallagher (2005), p37.

My projects focus on bringing awareness to how the body schema can be extended with coupled imagery and how this produces a complex sense of location and agency to act.

In anchoring and coupling visual perspectives to the viewer's agency of movement, there is not only a felt extension of body schema but this coupling is observed and produces an awareness of affective experience.

7. Interactivity, mobility and virtual worlds

The activity of physical mobility is a key part of my practice, informing my capture and composition of urban explorations as well as the installations. Image practices and media communications are producing new kinds of mobility that are no longer limited to the physics of the body or physical transportation. The *Aspen Movie Map* (1978–9)[49] allowed a seated viewer to navigate through the virtually represented town of Aspen. This cartographic visual tracing is a predecessor to *Google Street View*. Now, *Google Street View* and all the other mappings on the Internet can be accessed while in motion and 'on site', becoming tools that can connect into physical experience, thus augmenting it. This augmentation involves a cross-referencing and folding of virtual navigation/system/information into experience.

Left: *Aspen Movie Map* (1978–9)
[source: http://www.inventinginteractive.com/2010/03/18/aspen-movie-map/]
Centre: *Google Street View* car being pulled over by police
[source: www.google.com/streetview]
Right: Photograph of a friend using locative navigation, Brooklyn, 2011

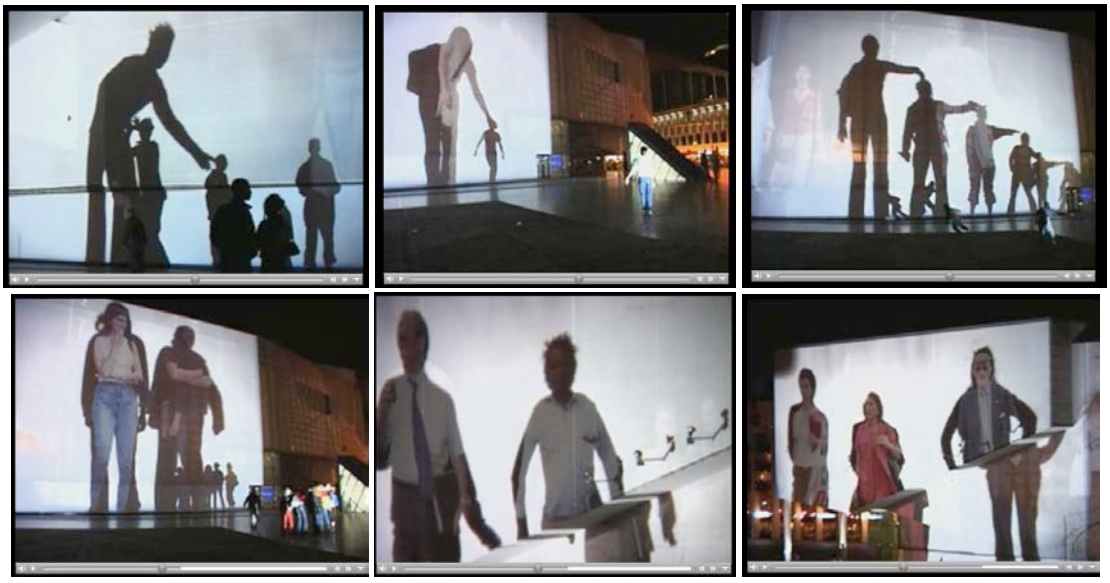
In the 1990s new media technologies opened up the possibilities of gestural interfaces, establishing virtual-reality environments that one engages with via physical movements, such as the breath-based interactive experience[50] of Char Davies' *Osmose* (1995) and in the 'Bodyshelf' interface of the Transmute Collective's *Intimate Transactions*[51]. Ultimately however, without 'locative' or social engagement the 'environment' of virtual-reality has become less interesting, as exemplified by the elaborately constructed but deserted landscape of *Second Life*[52]. There is however, an ever-growing integration of interactive 'worlds' into the everyday, and movement based technologies are increasingly becoming part of these everyday interactions. Within the duration of my doctoral candidature gyroscopic sensors became the heart of the Wii controllers and iphones, revolutionising personal digital interaction to incorporate movements to allow new ways of engaging with places and information systems. The gyroscopic sensor and access to Global Positioning System (GPS) information gives devices an external referencing ability. These devices alter experience by adding an extended

[49] *Aspen Movie Map* was created by a group from MIT led by Andrew Lippman.
[50] I experienced *Osmose* and *Ephémère (1998)* at Australian Centre for the Moving Image, Melbourne, 2004.
[51] [http://www.embodiedmedia.com/#/page/intimate-transactions]
[52] Collins (2010) and Hansen (2009).

referencing system to the mobile body. Responsive and locative technologies enabled visual media to become part of physical encounters through new ways of attaching information to place and our movement.

A feedback response, such as is enabled by sensor technology, programming and camera-screen operations, is one of the central aspects that defines 'new media' practices. A culture of interaction has developed considerably since I started making holograms in 1999. On multiple occasions I have witnessed viewers assuming that they have seen a hologram after looking from only a single perspective, although this is becoming less common. With the growing prevalence of interactive systems viewers tend to poke and prod the image, moving around to seek other dimensions. Audiences have become more accustomed to physically engaging with artworks.

New media practices, perhaps most clearly exemplified by interactive technologies, have helped shift conventions of engagement with artwork away from a viewing of finished artifacts and toward a participatory experience. This setting-up of experiences is inherent to artistic interventions that work with social and public space. Installations of relational architecture, such as Rafael Lozano-Hemmer's *Body Movies* (2001), open up social interactions as movement and gesture are provoked. Engagement between participants occurs through the programmed system, as well as transversely in the sharing of social space.



Video stills I selected from the documentation of Lozano-Hemmer's installation *Body Movies*, 2001
The top row shows people (often groups) created their own shadow games and sculptures, almost completely ignoring the projected figures. The relation of the shadow's scale with distance to the screen sets up a kind of vectorisation to the open space.
Another kind of interaction occurs when people respond to the projected figures, and in doing so they relate to the other people who are also engaging with the programmed image (bottom row of screen shots).
[source: http://www.lozano-hemmer.com/body_movies.php]

Responsive installations allow for experimental and creative forms of engagement that inform our understanding of how technology has enhanced the urban encounter. I consider the image as a means of weaving virtual information and processes into the experience of public space. A fascination with navigating both the physical and conceptual landscape of an urban setting drives my capturing and mapping with images.

The hologram has suffered not only from an under-developed culture of viewing, but also because many artists and art professionals have treated the hologram as a 3-d 'picture' rather than a distinct medium

that allows for dynamic visuo-spatial exploration. One of the key aspects of holography is that the image is mapped into the physical space of viewing, and thus requires the viewer to inhabit multiple locations to see the whole scene. This attaches the virtual space and animate qualities of the holographic recording to the viewer's embodied sense of moving around. The spatial encoding of the holographic scene results in a different sense of visual presence in the experience of programmatically driven encounters because of this direct physical correlation between the image and the act of viewing. An argument of my thesis is the role of movement in holographic imaging has been under-developed, and the contribution I seek to make lies in developing this potential.

Thesis structure

While the research evolved in a non-linear process, I have arranged the thesis in terms of the different stages of experiences that inform a project. I first consider the experience of being within the urban environment. In particular how images inform our sense of place and can be used to develop a sense of location. A 'mapping' through images is used establish a conceptualisation that pertains to the possibilities of holographic image recording. Using a process of 'mapping' perspective through the holographic composition I then focus on the concept of orientation and referencing – how a relationship can be established between our embodied sense of space and the extended virtual territories of the image. The image is, however, encountered within a physical environment. How the viewing experience affects the reading of the image is addressed in terms of designing installations as well as being used as a comparative to the feedback of recording experience.

In *Chapter 1 – The experience of being lost*, I establish a practice of mapping multiple perspectives into the holographic scene. The coherence of being 'here' in physical space and the knowledge of being 'here' on a map is explored to demonstrate the concept of feeling located as a complex relationship between virtual information and physical experience. Reference systems that are used to determine location are related to my mappings of encounters and places with holographic images.

To develop these concepts, I investigate the experience of being lost, in which the mental concept of place conflicts with the surroundings and/or body orientation. In the visceral and cognitive intensity of this situation, such as when we feel our orientation shift, it is apparent how strongly the sense of body is linked to the sense being located. In describing experiences of being lost I aim to show how visceral and cognitive warpings, drifts and jumps can shape a sense of space. Through the composition and installation of multiplexed and stencilled holograms I begin an investigation into how this 'shaping' can be communicated or transduced.

To capture the conceptual structures of my real-life encounters in urban landscapes, I develop methods of emergent photo-choreography. This activity of capture uses my physical and psychological tendencies to structure sequences of photographs and direct video-recorded lines of movement. The visual anchoring that is first used as a technique for establishing a reference to 'read' a dynamic holographic scene, is pushed further, into a technique for 'coupling' the viewer's movement to the enfolded virtual movement.

In *Chapter 2 – Linking the holographic view to the body*, the suggestion of a bodily connection to the scene is used to forge an affective link between the holographic image and the viewer.

The combined perspectives through a holographic image I describe as a holographic view and distinguish this from the 'holographic scene' – which I came to consider as also having internal relations. The spatial, graphical and conceptual relationships that formed the 'scene' comprise a kind of 'diagram'.

The operation and application of such a diagram in establishing the scene from the perspective of a viewer or a composer, I describe as 'diagramming' and relate this to the process of mapping. For example, the viewer explores the structure and dynamics of looking that are recorded into the holographic image with their own agency and spatial awareness – they unfold the diagram by exploring the scene. The diagram then both elicits and depicts a 'shaping' of the encounter.

My experiences of a perceptual shaping in 'looking through the camera lens' is used to inform my concept of an extended understanding of embodiment. I consider how the implied and visually present body of the photographer in the holograms is an avatar/protagonist connecting the viewer to the visual space and its encoded shapings of movement and attention.

Chapter 3 – In and through the Paternoster traces the development of my installation practice as a way of bringing bodily awareness into the unfolding/reading of the holographic scene.

The hologram *Paternoster* created in 2006 was a turning point in the research, shifting my focus from an exploration and mapping of place through patterns, to an investigation of the role of movement in perception. The coupling of the vertical motion in the composition with the viewer's movement is used to activate this animate dynamic, emphasising the viewer's sense of balance and awareness of gravity. This resonance of motion and affect connects the viewer to the holographic scene and protagonist through a 'felt' experience. Structuring a 'feeling', through a shaping or diagramming, became an important aspect of the compositions and installation designs.

To entice the viewer to move around the hologram and heighten their bodily awareness of proprioception and spatiality I employ various devices and techniques including: confinement, lighting that creates reflections and shadows as well as the architecture and implicit action of staircases. For example, one of my installations *Jumping Jellyfish* uses a trampoline on which the viewer jumps to animate holograms of jellyfish. A discussion of the proprioceptive reading emerges from this work and develops into an understanding of movement as an active part of visual cognition. In addition to these devices, I consider the coding and conventions of the installation space. Choreographing movements around the holograms and my movement through the urban landscape becoming a reflective design process, with the aim of using movement and gaze to establish a physical script or a diagram of forces to trace and induce a sense of 'shaping' or 'dynamic form'.

In concluding, I reassess the approaches explored throughout this thesis with the understanding obtained from the entirety of the research. Specifically I address the ideas that developed throughout this work:

- The idea of being located as a complex intensity of different referenced systems of perception and knowledge, and
- The development of spatially montaged compositions that enfold multiple perspectives into dynamic structures to suggest an active perceptual, cognitive and embodied shaping of vision.

These understandings are drawn together into the notion of an 'emergent holographic scene', where coupled dynamics and 'shapings' extend and affectively resonate the viewer's sense of embodied action.

Chapter 1 – The experience of being lost

This chapter discusses how multiple reference systems play into the feeling of being located and the disagreement of perceptual and conceptual senses of location in the experience of being lost. Informed by the experience of moving through urban environments, a number of holographic image compositions were created as ways of 'mapping'. These recordings are structured around an activity of navigating place, to explore a conceptual structuring of impressions and establish a sense of location. The structuring of the compositions draws on the spatial fragmentation of the multiplex hologram to re-arrange visuo-spatial perspectives into an animate scene. The fusing of perceptual jumps enables a dynamic conceptualisation, such as an animate scene and/or virtual movements through it. I consider the fragmented views of my multiplex holographic images in terms of the experience of being lost, and how this can be used as a way to connect the 'virtual' space of a hologram with the actual, physical space and event of viewing that hologram. I explore this process as a way of understanding complex located embodiment.

A : Are you here?

A1 : Lost

"The alarming physical sense we feel when we realize we are lost is a bodily registering of the disjunction between the visual and the proprioceptive."

Brian Massumi (2002) '*Parables For The Virtual: Movement, Affect, Sensation*' p182.

The sensation of being lost can rise slowly or hit you suddenly – as a vista smacks away the mental image of what you are expecting to find. In the collision of where you think you should be, and where your surroundings suggest you are (or aren't), you are lost. Being lost is being within a state of disorientation, an experience where the concept of place conflicts with the evidence of the surroundings.

Recently, I was writing a text message and walking to a favourite lunch spot, my steps moving my body semi-consciously towards food. Having turned into the cobbled lane that the restaurant was on, I looked up from my text and yelped with a jump – the street I knew so well was all wrong. It took a moment for me to 'see' what was in front of me as I was so sure of my knowledge of what should be there. I back-tracked and walked further in the wrong direction – I could not believe that I had already passed the street that I wanted.

Brain Massumi describes a similar experience of re-aligning a mental map with the environment in his essay *Strange Horizon: Buildings, Biograms, and the Body Topologic*. Using an account of a particular experience in which he spent months looking out an office window and wrongly assuming the direction of view. The essay explores the cross-referencing of different modes of orientation, the cognitive and proprioceptive. In the experience Massumi describes, his sense of direction has been mis-attached to an embodied sense of facing: "I was looking east onto rue St-Marc. But I was seeing north onto rue Baille."[53] His (misplaced) sense of location was so strong that he does not 'see' what is in front of him. The experience lead Massumi to question how we conceptualise location; "No matter how consciously overcoding we like to be, our mappings are riddled with proprioceptive holes threatening at any moment to capsize the cognitive model (like the empty quarters filled with sea-monsters on medieval maps)"[54].

[53] Massumi (2002), p178.

[54] Ibid, p177.

The internal process of cross-referencing is usually an unconscious synthesis into a functional, embodied cognitive model of space. But different systems of spatial orientation can become separated. We are often unaware of their drifting apart until – with a jolt – it is clear that perceptions are in conflict. Re-alignment then requires assumptions to be detached and re-arranged, which can be an unsettling feeling. This has happened to me when riding my bicycle through Cologne. The concentric rings of roads that structure the city cause my path to drift off my sense of direction. Arriving at a junction with landmarks not where they 'should' be I feel my map of the city morph, as I rotate it back into alignment with what is clearly in front of me. The tendencies of the body, like the subtly curved streets, pull and push on the conception of location, until the felt conflicts with the observed.

In the moment of being lost, our cognitive map and sense of an orientated body detach from the terrain; we transform our sense of located orientation before it settles back over and into the surroundings. There is a visceral intensity as the sense of located embodiment shifts and scrambles for orientation. In this moment we lose definition. The orientation and the potential movements of our body are jumbled. Action, if attempted, would probably look like a drunken stagger or indecisive maneuver. It is in these moments of disjunction that we become aware of the active perceptual shaping of experience. There is a 'bodily registering'[55] of both the disjunction and the process of re-aligning our cognitive map to what we see before us.

In the experience of being lost, it becomes apparent how strongly a sense of being located is linked to embodiment. The situation I create with holographic image installations aims for a similar kind of perceptual potency to an experience of being lost. Viewing the images destabilises sensory unity, and then as elements are recognised and located in the image there is a pleasure of connection.

On discovering that we are not where we expect to be, most of us will seek some form of known self-oriented reference. Massumi describes this: "Oddly, the first thing people typically do when they realize they are lost and start to reorient is to look away from the scene in front of them, even rolling their eyes skyward"[56]. Reorientation requires detaching from the visual surroundings to reset orientation and the cognitive map with what referentially is available: "To do that, we have to interrupt vision, in the same way visual awareness interrupts proprioception"[57].

Navigating the urban landscape is both the referenced application of external spatial knowledge, such as a map, and the development of a concept of place from experience. In an effort to feel located within cities and understand how the urban landscape shapes my psycho-physical conceptualisation, I began mapping places and encounters. These mappings had to be simplified to give a structure of relationships that could be recorded into a multiplex hologram. The process of doing this made me question the underlining assemblage and activity of my spatial sense, and how this shifted as I moved through the urban environment.

A2 : A mapping

Are You Here is a hologram I created in London in 2002 while assisting at The Holographic Image Studio.[58] The title is a scrambling of the familiar 'You Are Here' marking on maps, suggesting a

[55] Massumi (2002), p182.

[56] Ibid.

[57] Ibid.

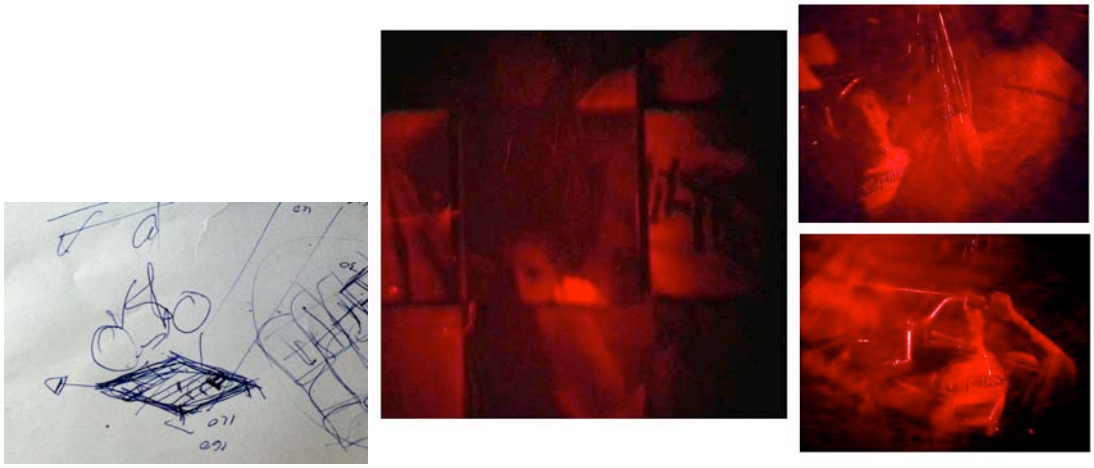
[58] The Holographic Image Studio is run by Dr Martin Richardson. When I worked there in 2002 it was located at Oxo Tower, in South Bank on the Thames in London.

questioning of the act of feeling located. After moving across the world I was seeking a sense of connection to my newly adopted East London neighborhood, so I explored the streets on my tiny bicycle from Japan, building my knowledge of the place to intensify my sense of location.

The act of bicycle riding, particularly in the windy city of London, has a very particular dynamic. There is the rhythm of your legs and wheels, the projective mapping of the path ahead and glimpses down streets, through openings and into moments only grasped once you have cycled on by. While riding and reflecting on my rides I asked: How do I understand myself as being here? The action of peddling was part of my knowing of location, as was my fledgling cognitive map of the area.

Each morning I would draw a map from memory of the local area on an old bed-sheet, the blanks towards the edge of the map became my planned destinations. When my memory of intersections became tangled with each other I would consult the *'A-Z Street Atlas'*, straighten out my mental image, and keep drawing. *Are You Here* was about this mapping process and sense of location gained from developing a mental map. The bed-sheet map became the background in the scene.

The scene was recorded into a hologram by placing holographic film on a sloped floor over which I pretended to ride my bicycle. Behind me was the bed-sheet map. The film was masked in square segments like the grid of a map. Different moments were exposed with the pulse laser by removing two of the square tiles at a time. The final laser-illuminated transmission hologram comprises 36 squares through which the viewer can peer into the recorded space.



Are You Here, 2002
Left to right: A working sketch. Video-still of hologram documentation
Photographs through two different squares of the hologram

The laser-viewable tiled exposure captures the act of exploration in both the visual content and through the action of viewing the hologram. There is no single view of the scene; rather the scene is something that requires active viewing. The fracturing and re-combination of perspectives occurs at different stages in the holographic image construction.

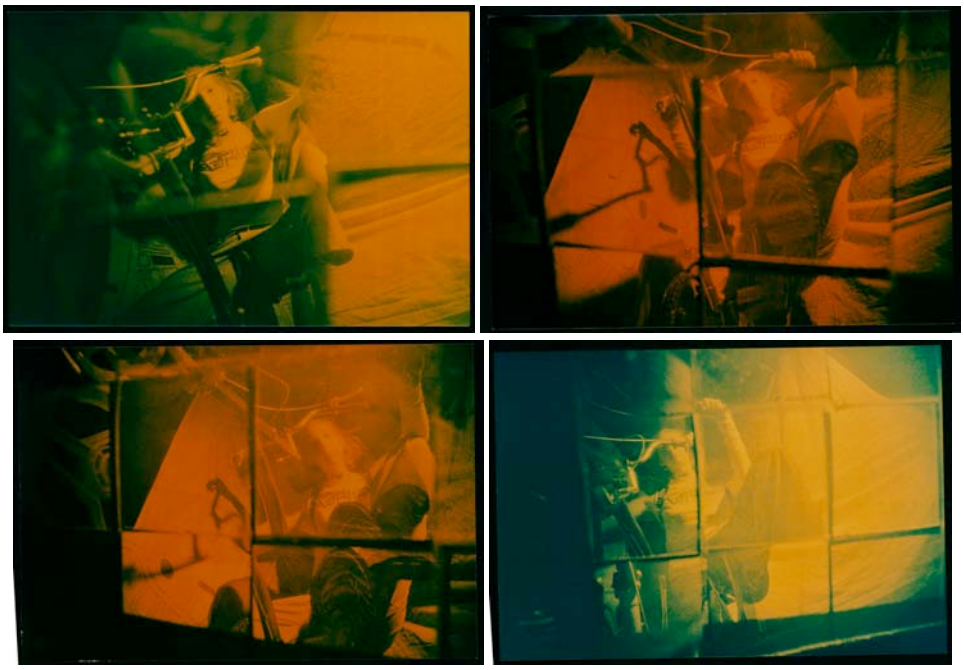
In this hologram I wanted to create a feeling of movement as the viewpoint shifted from one square into another. To do this, the hologram print was transferred from two masters; one reconstructing an orthoscopic image – with normal depth-cues – and the other a pseudoscopic image. The optical pseudoscopic image has an inside-out spatiality. This means that as you move left the perspective

seen shifts as if you had moved to the right. This reversed parallax[59] makes the background appear to be infront of the foreground, and yet objects in the foreground occlude the background producing a conflicting reading of space.

The overlaid pseudoscopic and 'normal' orthoscopic holographic images appear as voluminous layers, with the viewer shifting focus between these spatial systems. The different perspective geometry of the layers makes the moving viewer aware of the two layers of the image, each layer providing a grounding for the other.

When the viewer approaches the hologram they often take a few moments to see anything other than a grid pattern on the film. Optically the holographic image comes to focus in the volume behind the film-plane. The orthoscopic image is much deeper than the pseudoscopic image, but is easier to find because it appears as you would expect physical space to behave.

The animation between the 36 squares of the final hologram is clunky – they are like different snapshots of the scene. Because there is no rhythm of pedaling the animation between frames is not a visual representation of the action of riding. However, there is a sense of the act of my riding and the mapping of territory through both the visual content and its structure.



Four photographs into the hologram *Are You Here*, 2002
Laser-viewable transmission hologram of 36-stencilled double exposures, 60 x 60 cm

Are You Here is not a snapshot of time and place, but a documenation of activity. The hologram is a recomposition of the experience of exploring London on my bicycle that highlights the process of assembling a conceptual map of place. While my hand-stencilled animation for *Are You Here* is clunky, there is a comparative dynamic with the activity of mapping. Moving past the hologram, the two layered views of the scene move in different ways. The pseudoscopic geometry, with its unexpected animate quality, brings an awareness to the viewer's movement in the act of the looking. Each square allows the viewer to peer around in either of the spatial layers. These squares are also like pauses, snapshots that

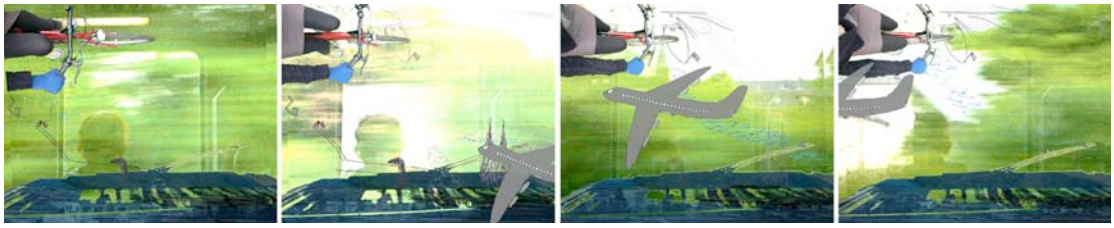
[59] Parallax is the change of relative visual position in relation to a change of perspective.

fuse location. To view the hologram evokes the orginal act of capture, both through the depicted scene in the studio and the structure of the holographic image.

Are You Here encapuslates the questioning that became the focus of this reserch. That is, how the holographic image could be used to diagram and conceptulise a sense of location. In this case a fractured perspective and layering of different spatial arrangemnets allows for an activity of mapping to be conveyed.

A3 : *map of Here and There*

When my work was divided between New York and Cologne in 2009, I decided to make another hologram map to sketch my paths to work and the connections between them. *map of Here and There* was created using a multiplex process from digital images that combine a hand drawn picture map, photographs and video.



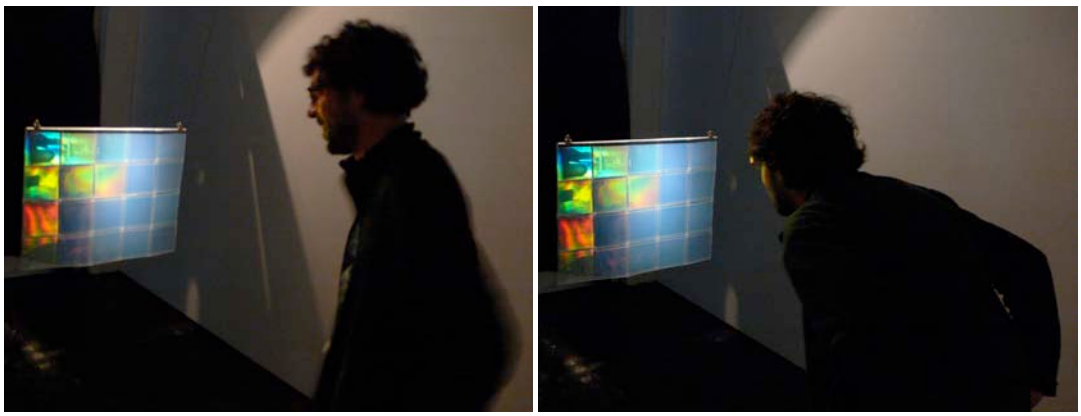
Frames from the compiled sequence used to print *map of Here and There*, 2009

The final hologram is made from 20 squares, taped together to physically resemble a map and enable it to be folded and easily carried. Each square replays the image at a slightly offset angle, which accentuates the concept that the whole holographic image cannot be seen from any one position. Only by moving around the hologram can the whole image be read. The 'speed' of the animation is determined by the viewer's sense of movement in relation to the movement of elements across the image. The closer the viewer is to the virtual window of image, the smaller the distance between frames – a little movement causes a 'fast' animation. The airplane in the images moves quickly across the map so that it is difficult to resolve unless the viewer stands back from the image. The animation activated in viewing the multiplex hologram is a relationship between the viewer's movement, their distance from the hologram and the recorded dynamics.

Two photographs of *map of Here and There,* 2009
20 squares of holographic film and sticky-tape, 60 x 48 cm

While I describe *Are you here* and *map of Here and There* as 'mappings', their function is quite different from that of a modern cartographic map. Rather than enabling navigation through place, they depict my processes of cross-referencing between spatial experiences and tracking them via maps. These

processes are used to develop a located relationship to place. What is important with both of these works is that a structured image is assembled in relation to movement – something that is mapped by the composition and then enacted by the viewer.



Viewer looking at *map of Here and There*, 2009
-1/MinusEins Experimental Labor, Academy of Media Arts (KHM), Cologne

B : The mapping process

B1 : What does the map do?

> "Yet maps are not, nor have they ever been, replicas of physical spaces. Instead they deploy a multitude of codes, from scale to color and orientation, to produce representations of space, which in turn affect the way we conceive of and navigate our way back through the places they depict."
>
> Anna Munster (2006) *Materializing new media: embodiment in information aesthetics*, p101.

> "And this is what maps give us, *reality*, a reality that exceeds our reach, our vision, the span of our days, a reality we achieve in no other way. We are always mapping the invisible or the unattainable or the erasable, the future or the past, the whatever-is-not-here-present-to-our-senses-now and through the gift of maps, transmuting it into everything it is not ... into the real, into the everyday."
>
> Denis Wood with John Fels and John Krygier (2010) *Rethinking the Power of Maps*, p15.

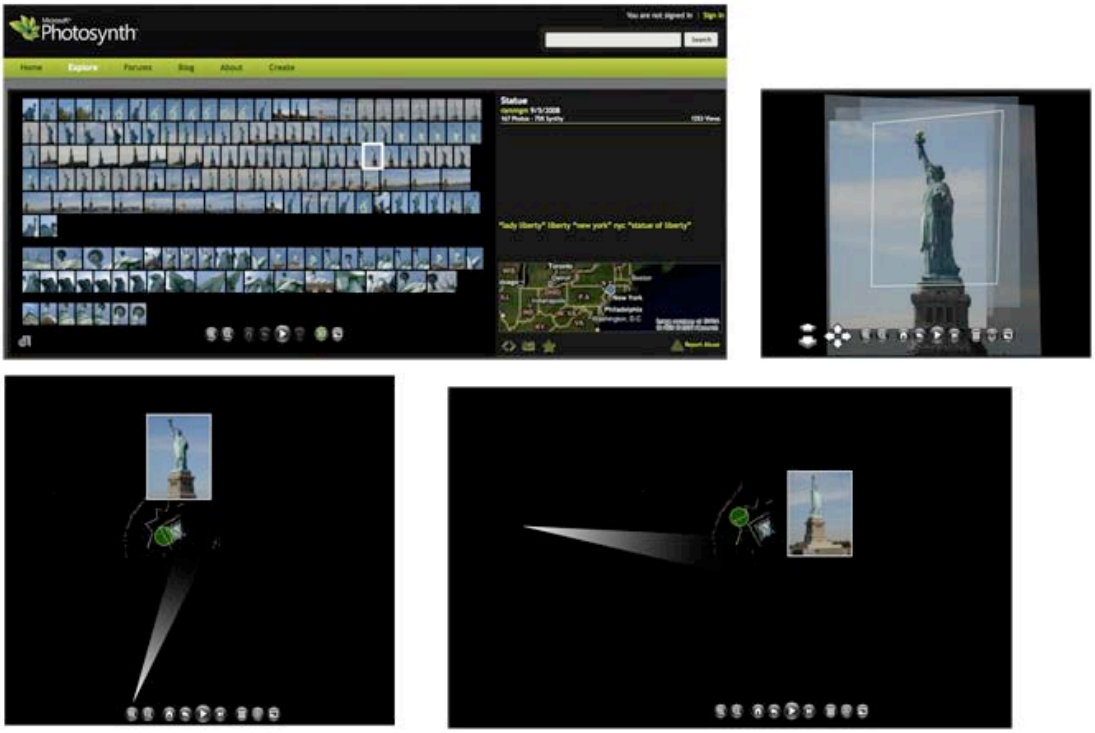
> "…to stay interesting a map must contain many things we do not know and some we do."
>
> Robert Harbison (1997) *Eccentric Spaces*, p133.

Mapping is most often considered as activity of conceptualising and recording place and experience, while also being an operation of navigation – of unfolding a map into action, or a concept into a plan. In hand drawing a map while giving directions, a diagramming is encoded. The map points to the intended path while simultaneously acting as a reminder of the oral and gestural directions. The map operates between these activities, while also being an image with an aesthetic that reveals qualities such as intention and/or a contextual bias. With holographic images I am creating a kind of mapping, a diagram that links interrelated virtual and physical aspects of movement. These holographic scenes are not only a structure of visually implied positions, but are also gestural encodings of movement.

In contrast to my approach of sketching an encounter through an arrangement of images, the Microsoft program *Photosynth* integrates separate images into a navigable image as seamlessly as possible. This

software is an example of photometric mapping used to generate digital 3-d cartographic information from multiple uploaded photographs. The program compares the images to calculate 3-d point information and places the photographs so that the closest photograph to the virtual camera position is shown as the user navigates the virtual image-space.

Conventional multiplex and digital holography can be used in a similar way to generate a smooth continuous space and/or movement from multiple views, allowing the viewer to peer around a 'realistic' scene.



Screen shots from *Photosynth.net*, 2009

When I first heard about *Photosynth* I was excited and thought that I would incorporate this process into my imaging making practice. However there is no feeling of action, no imagination driving the exploration, no sense of the body's relationship to place. The activity of photographing was that of being a surveyor. If anything, this program pushed my interest away from cartographic mapping in search of perceptual hiccups and intensities. What I was attempting to map were jumps and fusions between discontinuous perspectives to create a rich activity of orientation. Rather than a seamless virtual space, I was approaching the holographic scene as a seething foam with moments of connection and disorientation.

The practice of *ostranenie* [making strange] during the 1920s and 30s sought to question the 'automatised'[60] consciousness of the photographic image. As described by Simon Watney in his essay *Making Strange : The Shattered Mirror*, Alexander Rodchenko's photographs exemplified this technique in "his various strategies for producing 'difficult' images which delay the usually spontaneous act of recognition".[61] Rodchenko's prolonging of the act of recognition allows the viewer to be engaged in a dynamic perception before the image settles into its reading.

[60] Referring to Sergey Tretyakov's "concern with the 'tenacious' nature of 'automatised' consciousness", as is considered by Tretyakov and Watney to be affirmed by the direct nature of the photographic image. [Watney (1982), p164].

[61] Watney (1982), p164.

Alexander Rodchenko, *Driver*, 1929
Silver gelatin print, 6.5 x 8.5" [16.5 x 21.6 cm]
[source: http://www.russianavantgard.com/Artists/rodchenko/rodchenko_driver.jpg]

Looking at Rodchenko's photograph *Driver*, my referencing of perspective shifts between that of the 'driver' and the photographer. With my compositions I was also seeking ways to allow the viewer to move around inside the dynamic perceptual process by establishing multiple references to a complex scene – a concept that I develop further in the next chapter.

B2 : Mapping movement

As well as stretching out the perceptual process, my holographic image compositions address the active role of the body in conceptualisation. In '*Philosophy in the Flesh'* George Lakoff and Mark Johnson describe how the 'logic' of bodily experience enables a visual perception of motion: "the body is not merely somehow involved in conceptualisation but is shaping its very nature."[62] In considering my multiplex holograms as a map, their 'scale' is a relationship of physical movement of viewing to the virtual movement reconstructed by the montage of perspectives. When the suggested motion by visual perspective exaggerates or transforms the viewer's motion it is perceived as a dynamic coupled to their activity. To express my conceptualisation in the experience of place I map transformations and dynamics through a process of diagramming that combines spatial relationships and visual rhythms.

In drawing a map from memory, or using a map to show particular aspects of a space, the important features are often exaggerated, and are shown with an expressive scale. With the multiplex hologram an 'expressive scale' can be applied to the spatial rhythm of virtual movement thereby encoding a transformation, such as a 'dynamic form of vitality'[63]. Another technique I used to evoke a sense of an embodied human perspective is to make hand-held recordings.

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[62] Lakoff and Johnson (1999), p37.

[63] Stern (2010), see also [Intro.4 & 5].

Patrick Boyd, who now works as a photographer, made a number of multiplex holograms in the early 1990s using a process of hand animation with image slides and stencils over the hologram. He describes the duration enfolded within his multiplex holograms – "The work is essentially an interactive experience for the viewer, but during which he remains in control, deciding for himself the speed with which the image is revealed and explored, frame by frame."[64]

Boyd's approach is interesting because he was not concerned with an illusion of space or smooth animation:

> "Using only 36 exposures does mean that the image is slightly jumpy and loosely restricts me to landscape as opposed to portraiture, but the pixilation effect [jumps between frames] gives a hand made element to the work which I really like. Otherwise it could be too uniform and sterile."[65]

There is a casualness of photography to these holographic images that capture everyday events, which was uncommon in holography in the 1990s.[66] In *Bartus Takes a Downtown Train* the visual appearance of the photographic film boarder also reveals the process.

Patrick Boyd, *Bartus Takes a Downtown Train,* 1990
Reflection multiplex hologram, 8.5 x 9" [21.6 x 22.9 cm]
Three photographs that I took of the hologram at MIT Museum, 2008

In contrast to Boyd's approach, artist Jacques Desbiens creates digital holograms from computer graphics. He describes these multiplex holograms as 'synthetic' holograms and the scene as a holographic panorama – comparing the way that the viewer moves past the image to the reading of a scroll. Desbiens uses 'nomadic perspective' to describe this path of reading that relates to both the moving past of the viewer (such as when reading a scroll) as well as a 'moving through' the scene. Desbiens argues that in this way the holographic panorama prompts an alternative way of thinking about spatial representation, rather than a traditional western (Albertian) perspective: "The artist and the observer are not in the center of the world anymore, they are passing through the environment."[67]

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[64] Patrick Boyd *A short note about my work* [source: http://www.holonet.khm.de/boyd/aboutmywork.html].

[65] Ibid.

[66] Paula Dawson also captures everyday subject matter, however her holograms are large laser-viewable recordings that are staged in vibration isolated environments.

[67] Desbiens (2006), p10.

Jacques Desbiens, *The Broken Window*, 2006
Two digital images used to make the hologram
[Images courtesy of the artist]

Viewing Desbiens' holographic images, I do not feel a sense of 'nomadic' wandering about. Instead, the path of movement past the hologram and through the scene is treated mathematically. The perspective is from a linear camera movement within the computer-generated environment, which is designed to produce an "illusion of volumes and presence".[68] I consider Desbiens' compositions a formal way of understanding the spatial dynamics that can be recorded into a multiplex hologram.

In contrast to rendering a computer generated scene my practice of multiplex holography was developed by working with stop-motion animation and hand cut stencils. So that rather than breaking the scene into a regular tiling of different views I considered how a mapping of perspectives over the surface of the hologram could determine the rhythm of animation. This line of inquiry developed into the consideration of how movement could be conducted through the hologram with a dynamic or sense of transformation. The animation of the image sequences being played-out by the viewer's movement while allowing a comparable sense of 'dynamics' in relation to an expected change of visual perspective.

B3 : A composition of movements

The hologram *I followed a box of matches to the Halászbástya but it was under construction* (2008) was part of my investigation of ways in which images and maps inspire us to travel and how images are constructed by recordings and memories of these experiences.

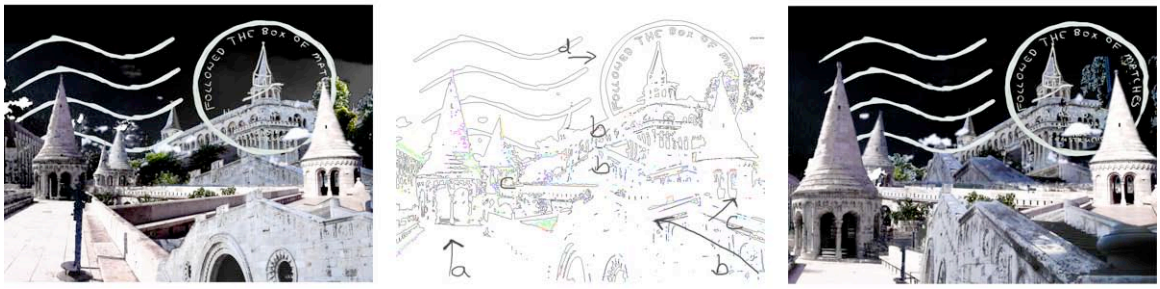
[68] Desbiens (2006), p7.

While investigating architecture in Budapest for a proposed commission, I came across images of the *Halászbástya* [Fisherman's Bastion]. From images I found of this place on the Internet, I sketched out a holographic scene. After talking with a Hungarian friend about the building, she returned from one of her trips to Budapest with a box of matches that pictured the Halászbástya. The matches sat in my kitchen for the next two years – I would look at them and imagine this place until I found myself in Budapest.

Being at the Halászbástya had a surreal over-coding. I had walked into an imagined image, but now it was filled with tourists, and most of the place was covered in scaffolding. While I could not capture the main tower that had dominated my mental image of the place, I found breaks in the crowds and glided around other parts of the structure with my camera.

Capturing the Halászbástya, 2008

The holographic image that I created is an in-frame montage of sequences, each animated with a different line of movement. The viewer simultaneously moves towards, along, and up through the scene. Through this composition I wanted to express the folding of the experience of moving through a place into an impression of it. The recordings of climbing the stairs, following the wall walks, as well as a postmark annotation, are all combined into a single postcard like scene.



Lines of movement in capturing and composing
I followed a box of matches to the Halászbástya but it was under construction, 2008
a- walking towards the tower, b- walking up the stairs, c- walking along the wall, d- parallax shift of drawn postmark, which is read as being behind the film plane with a depth that matches the far tower.

In the title and text on the postmark; 'under construction' refers both to the fact that the view I had imagined of the Halászbástya was now covered in scaffolding; and that the act of visiting, and then again of making the hologram, caused a reconstruction of the image I had of the place. The reconstruction of the composed images by the viewer moving around simultaneously activates multiple lines (directions and rhythms) of movement. The relationships between these lines of movement establish a movement-diagram that is both structural and dynamic. As with many of the other compositions, this hologram experiments with the process of assimilating different movements and perspectives into a spatially dynamic scene.

C : The shape of experience between the map and location

A number of artists have emphasized the sculptural quality of the holographic image by creating installations that incorporate the image into their physical assembly. Artist Rick Silberman took this concept a step further with the project '*Artifacts From Descartes' Dreams'* (1982), by creating a virtual sculpture between a number of holograms placed across North America. Each recording is a shadowgram of a tent hook with a tether that projects out several feet from the hologram. The tethers of the holograms converge to a vanishing point in the stratosphere, tracing out an equal sided cone shape or tent that is hooked into the ground by the holograms.

This diagram of a tent or cone can only be conceptually perceived, and Silberman created this structure "with the use of maps and computer generated coordinates"[69]. The holograms then also become a kind of map that points to something beyond its own dimensions. As well as making and placing the holograms across North America he made a number of artifacts – navigation tools for the "exploration of the XYZ nature of holograms, and their projections"[70].

Rick Silberman, '*Artifacts From Descartes' Dreams'*, 1982
Left: The artist and his motorbike beginning the journey.
Centre images: Installations of the *Hook and Tether* reflection holograms 8 x 10" [20.3 x 25.4 cm]
Right: Rick Silberman, *Holography Magic Set*, 2007
[Images courtesy of the artist]

Silberman was and still is "interested in defining and extending the boundaries of the qualities that are unique to holography alone"[71]. By using multiplex and stencilled holograms as a kind of map I am interested in the how a spatially-dynamic diagrammed structure can be inhabited.

C1 : Mapping complex topographies

A starting point for understanding higher dimensional theory often involves a thought experiment: imagining how a 3-d object could be projected into 2-d world and then applying this understanding of projection to diagram 4-d shapes by considering their 3-d projections.[72] I am using a similar strategy by considering experience in terms of a path of movement woven with visuo-spatial connections. An analogy to the topography of these mappings is to consider a game of *snakes–and–ladders*. A player of the game can move on a path with a single egocentric direction – forward. Though this single direction is one dimensional to the player, it will weave across the 2-d board.

[69] Silberman, personal correspondence, 3 May 2012.
[70] Ibid.
[71] Ibid.
[72] Such as the classic '*Flatland: A Romance of Many Dimensions'* by Edwin Abbott (1884).

My mapping of the potential movement of two dice rolls in *snakes–and–ladders*

Each solider represents an equal possible position. Starting from square 3 (top row) and 46 (bottom row) the shape of the potential movement after one (centre) and two rolls (right) of a dice is shown. Due to the 'hyperlinking' snakes and ladders the mapping/diagram of the potential movement from square 3 is different to that from square 46

The topology of action is a numbered path of steps skewed by the hyper-connections of 'snakes' and 'ladders' over the two-dimensional board. The board is embedded with a woven topography through which the action unfolds as a path. The player's 'field of potential' emanates from their position on the board and is structured by both the discontinuous and equal proximity of the next six possible positions, determined by a roll of the dice and the potential hyperlinks that fold the path.

The enfolded recording of the multiplex holographic image is a potential structure for the viewing experience. Potential structures are a feature of game space and multiple-choice narratives in which the 'player' can choose one of a number of possible paths. With the hologram these possible views are spatially encoded, whereas interactive installations and computer games script the 'game-space' or potential domain is unfolded through an algorithmic program.

In many ergodic[73] and Oulipo[74] texts the potential of the structure is as interesting as any single reading. The script or algorithm that generates the multiple possibilities can be implied through the patterns of multiple readings, or by a direct visual communication such as an equation, the text layout, or a diagram. In navigating through the text there is a dynamic play on the viewer/reader's awareness of structure and depiction.

Massumi draws on physics terminology to describe the shifting topology of possible unfolding as a 'field of potential'. In one analogy he uses the potential shaping and flux of a soccer game: the goals "are inducers"[75] and "polarize the space between them"[76], while the ball is the "catalysis-point".[77] The

[73] Such as the *I-Ching.*

[74] The Oulipo (Ouvroir de Littérature Potentielle) movement was founded by François Le Lionnais in Paris in 1960. The group began with ten members: writers, mathematicians and academics, whose intention was to explore the function(*f*) of literature. *Invisible Cities* written by Italo Calvino, a member of the group, in 1972 is both a narrative and a folding of perspectives. This text while having a structural element, is more narrative-based than many of the other Oulipo works. Queneau, who was influential within the group, describes the objective of Oulipo as "To propose new 'structures' to writers, mathematical in nature, or to invent new artificial or mechanical procedures that will contribute to literary activity..." [Motte (1986) 1998 ed, p51]. By cross-referencing ways of thinking the group were seeking new forms of expression.

[75] Massumi (2002), p74.

[76] Ibid, p72.

[77] Ibid, p72.

system of the soccer field is understood as relativistic: the point of (un)folding being the reference of a potential framework. "When the ball moves, the whole game moves with it."[78] The viewer's negotiation of the holographic scene has some diagrammatic similarities to a player with the ball on a soccer field. The field, however, has a discrete structure more like a game of *snakes–and–ladders*.

Priscilla Monge, Outdoor installation, *Untitled*, 2006
[source: http://www.sportsbabel.net/2009/09/on-massumis-logic-of-relation-field.htm]

Like the movement through the game of *snakes–and–ladders* my photographically captured paths are not continuous but consist of jumps or steps. The holographic compositions weave together these hops into a path by connecting visual elements and by creating patterns of visual difference. The holographic scene emerges from – and is encoded with – the resulting perceptions of movement.

My mental image of space is constructed from experiential paths. To make the bed-sheet map for *Are You Here*, I rode my bicycle down every street in my area to trace out the place (this was before www.openstreetmap.org, but was similarly a process of generating a map). With the multiplex holographic images I am able to use a path of perspectives-views, with jumps in base parallax to trace out a space or motion. Through this process I became increasingly interested in the way my perceptions warp around sensation, conceptual relationships, and physical effort; an activity of attention and movement weaving through the landscape defining the experience.

Bernard Tschumi asks in '*Questions of Space':* "Is topology a mental construction toward a theory of space?"[79]. This research has lead to the construction of a similar questioning but through considering the shaping of spatial conceptualisation and how this is related to an embodied cognition. The experience of walking on a moving walkway has a sense of elation. With every step I am propelled forward and the environment seems to slip by. There is a kind of warping to my sense of space, which seems to be opening-up ahead and curve around me. My habituated spatial rhythm of walking incorporates the propulsion of the walkway into my spatial reading of the environment. In a cross-referencing of perception and previous experience, there is a sense/conception of space that is warped – 'shaped' – by the augmentation of movement.

I consider the movement that is perceived by the viewer as they look through the multiple perspectives of a hologram to be a complex experience arising from the montage of linked perspectives. The viewer's sense of space and movement is extended into and reflected by the holographic scene. As the viewer explores the coupled dynamics the scene offers another type of spatial connection into the semblance of knowing. The sense of being located extends, shifts and re-folds around these external, referenced moments.

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[78] Massumi (2002), p73.

[79] Tschumi (1996), question 1.72 in the essay.

C2 : The shape of experience between location

I'm tired and distraught and with my disorientation comes a very particular feeling, my body itself starts to lose definition. It is the sense of being tumbled through a wave, there are forces acting on me but they pull in different directions smearing my concept of place. I no longer trust my intuition, my feet ache and head feels spinny, I am in a state of lost.

Reflecting on my experience of being lost in Limassol, 2007

The mapping projects with holograms allow for an exploration of folding multiple perspectives into a sense of place. I became increasingly interested in the physical and psychological tendencies of this process – particularly the drifts and folds of embodied cognition. With my enacting and photographic capturing I am structurally addressing conceptual aspects of image and memory composition. These compositional diagrams are a seed of my conception of place; they are the enfolded form of what is traced out through movement and the recorded gaze. These visual tracings involve stretching out the experience before it can be composed into the hologram. This stretching-out can involve laborious acts of capture and/or digital compilation that induce their own drifts and nuances into the composition.

The holographic scenes I have discussed in this chapter are based on the patterns and rhythms that feed into and out-from an experiential gestalt. With these works I suggest that a perceptual synthesis has aesthetic qualities that might be described in terms of 'shape'. The quality of such a shape emerges from both a conceptual diagram – a cognitive mapping – and the activity of moving around the scene.

In the experience of being lost, spatial knowledge does not synthesise into agreement with located sense. Different reference systems clash and interfere bringing awareness to the drifts and discontinuities of psychological and physical perception. By working with spatially dynamic composition I am coupling physical and virtual movements to explore an activity of perceptual shaping.

Media theorist Vivian Sobchack uses scenes from cinema and Sigmund Freud's recount of being lost in a dream to describe the 'shapes' of being lost, distinguishing:

- The *round* – 'going around in circles' – which occurs when there is a bias or drift to the heading, something that that I have experienced in the large ringed streets of Cologne and Canberra.
- The *un-anchored* [my terminology] – not knowing where you are on the map or being unable to translate the map. For example when north points downwards, or having no reference point to a map, such as in my experiences described in section *C4 – Here on the map*.
- The *vertiginous* – the 'existentially dangerous' experience of being completely lost, in which one loses the ability to orientate or the confidence to navigate.

Sobchack draws on phenomenological geographer Yi-Fu Tuan's account of the experience of being lost in a forest in which he gains directionality upon seeing a light.[80] Tuan describes the shift of perception upon seeing the light: "space has dramatically regained structure"[81]. In this moment the perception of forest is no longer an unknown of inflicting darkness and obstacles but is structured by the conceptual diagram of a path, a direction. Massumi describes a heading as a 'vectorial structuring' that "gives the space of orientation a *qualitative* dimension, expressed as a tropistic preference"[82].

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[80] Tuan (1977), p36. First encountered as quoted by Vivian Carol Sobchack, [Sobchack (2004), p19].

[81] Tuan (1977), p36.

[82] Massumi (2002), p180/181.

The holograms that I compose from 'paths' set up scenes with qualitative dimensions that feed into a conceptual mapping. These scenes are 'shaped' by implying and restructuring movements, forces, and attention. Virtual movement elicited by the image; the proprioception of coaxed movement; and cognitive resonance are all part of an experience that *folds back on itself.*[83]

C3 : Here in the fold

"The fold will provide us with a useful concept for inscribing the creases, doublings and separations that characterize the differential relations of bodies and code within information aesthetics."

Anna Munster (2006) *Materializing new media: embodiment in information aesthetics*, p32.

"Where we go to find ourselves when we are lost is where the senses fold into and out of each [other]. *We always find ourselves in this fold of experience.*"

Brian Massumi (2002) *Parables For The Virtual: Movement, Affect, Sensation*, p182.

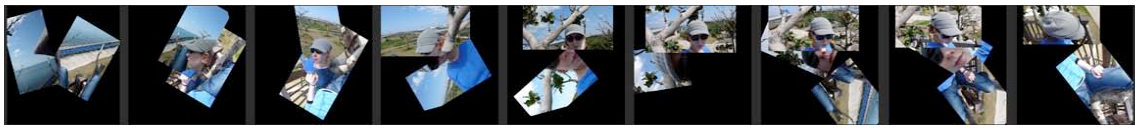
My approach to holography was changing, I could feel it shifting. I wanted to communicate something more than a showing of the visuo-spatial dynamics from a mobile view. And having for the first time experienced sea-sickness, was reorientating myself in a tree on the edge of the East China Sea.

I sat for a while in this strange place that I had not known I would be visiting before seeing the boat's route painted with a thick red line on the map above the ticket office in Osaka. We had sailed south for a few days and I was still wearing too many clothes, having come from the northern winter. Sunburn was threatening my exposed neck but the cool breeze kept me in the tree.

The branches pressed onto my thighs and I leaned back into the uneven trunk, having been moving for days I sat in this locus looking out at the sea. The ocean showed no signs of the journey I'd been on or the path ahead. Glancing back over my shoulder I could see the blue stripe of the boat Hi+Yu – my connection to this place.

I shifted my weight in the branches realising that no view could explain my emotion of being here but still reached for my camera. I had come this way to photograph a bridge, but it did not fit into my camera lens and my movement through it felt disconnected from the pattern that had caught my eye while sailing in, so I lifted my camera and squeezed as much of myself into the lens as was possible from an outstretched arm. The landscape swept around me as the camera arched around, hinging images into this moment in the Ishigaki tree.

Reflecting on my experience up a tree in Ishigaki, 2007



Sequence from the first layering of photographs for *Up a Tree on the edge of the East China Sea,* 2007

With the image sequence from Ishigaki I experimented with a number of different montage compositions, assembling the scene around a pasted together bodily awareness. The hologram I printed was made from overlaying two of these montage sequences. The background sequence is based on the direction of camera view, the looking out from the tree. On top of this is a different

[83] Massumi (2002), p158 &196.

arrangement of the images that are placed so as to trace out my body. But each photograph (and even each montaged view) is only a fragment, a suggestion. Only by moving around does an impression of the scene form.

Five of the images from the sequence used to print the hologram, 2010

It was not until 2010 after making a number of different animations and sequences with the images that I printed this work.

Photographs of hologram *Up a Tree*, 2007/2010
Achromatic transmission 200-frame multiplex hologram, vertically animated, 40 x 30 cm

One understanding of my location on the island of Ishigaki was a point on a map. However, my sense of being located was something between this knowledge, the immediate territory, a memory of the journey and the sensation of sitting there in the tree. I was located within and between these 'knowings' while looking out to sea. Within the inflected arc of my camera-arm my extended gaze traced my body, looking at me and out from me. The camera view was part of my embodied understanding, the recording an attempt to establish location and inhabit a tiny dot on the map.

In discussing the implications of 'virtual windows' that are part of media encounters, Anne Friedberg describes the potential of a dualistic or multiplistic inhabitation: "Multiplicity, I will argue allows us—in ways that neither Bergson or Einstein[84] could have foreseen—to inhabit, in a virtual sense, two or more spaces at once, and equally, two or more times"[85]. With the holographic image installations, I suggest that we can also inhabit a structure of multiplicity that brings together multiple perspectives and abilities of motion. That we inhabit a map by thinking with it.

My cognitive map of the city is woven from different ways of moving. Vehicles change my sense of distance while the viscosity of traffic (and frequency of trains) undulates with time. These different senses of space are anchored at certain places – on landmarks and at junctions as well as attached to events and times of day. Envisioning into action – whether plotting a journey or moving through the recorded holographic image – the possible paths of movement changes the preferencing of action. As my potential for movement changes, I feel my poise shift and adjust my sense of location.

The diagrams that guide and emerge from my photography and video recordings are not calculated, as in typical camera-arrays. Instead the camera moves around my body – as in the hologram *Up a Tree* – or it is positioned on architectural elements. These sequences in the act of recording get interrupted by physical obstacles and events (phone calls, running out of memory/tape, being stopped by people in the street). In the process of shooting, I observe how the visual landmarks on which I set my bearings sometimes drift across the frame. These drifts and interruptions are part of what I am exploring. The diagramming is an act of drawing out my cognitive and physiological tendencies that shape the image-mediated encounter.

Through the reflective iterations of the composition and viewing of holographic images, my photography has become more tuned to the nuances of what can be conducted through the hologram. I approach urban encounters with a 'holographic eye', considering how lines of movement and patterns could be woven into a scene. The compositions are based around anchored elements and various lines of movement.

Exploring the holographic scene, or indeed any unknown territory, begins like developing a working sketch. There are 'headings' – directional relationships and movements – as well as 'anchors' (which I discuss further in *Chapter 2*) that fuse to create a scene. In stretching out – or providing challenges to – the process of establishing an impression of place, I am attempting to draw the viewer's attention to that process. By engaging through a 'looking around' this awareness tends to involve a sense of the body and, as such, makes more explicit the connection between the holographic 'place' – the 'there' and the physical space and event of viewing – the 'here'.

[84] The concepts developed by Bergson in *Duration and Simultaneity* (1922) address the philosophical implication subjective time in Einstein's theory of relativity. A dialogue between the two on 6 April 1922 at the Société de Philsophie in Paris, shows the difference in their thinking: Einstein considers the physical possibilities for multiple non-human observers, such as clocks; Bergson questions how the human observer faced with this duality develops 'new ways of thinking'.

[85] Friedberg (2006), p146.

C4 : Here on the map

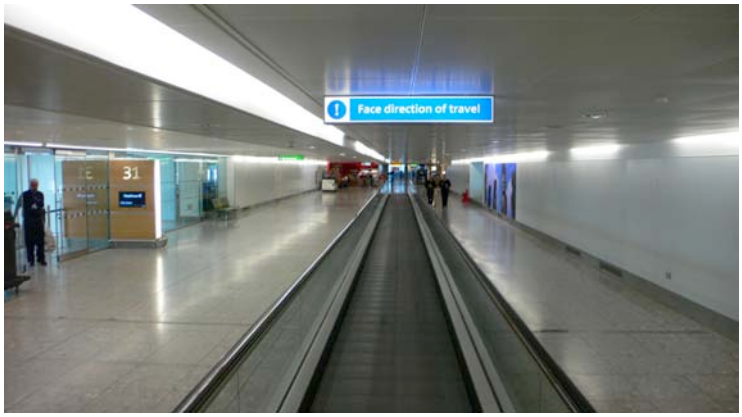
"We're not lost, I'm just not sure where we are on this map"
Photographs by John Rogers of me navigating Amsterdam, 2011

"What does it mean to be in command of space, to feel at home in it? It means that the objective reference points in space, such as landmarks and the cardinal positions, conform with the intention and the coordinates of the human body."

Yi-Fu Tuan (1977), *'Space and place: the perspective of experience'*, p36.

Sobchack describes the transition from a childhood belief that north was whichever way she was facing to an external reference system of orientation. "When I was a child, I always thought that north was the way I was facing"[86]. Sobchack argues that an egocentric sense of space comes before we are socially 'estranged' from this self-reference:

> "Later, of course, north's shiftiness—its 'lie'—is recognized in its inherent abstraction from one's body, its arbitrary designation as a fixed and standardized direction meant to guide that body, but no longer emergent from its purpose."[87]



Photograph I took on a moving walkway in an airport as it reminded me of Sobchack's sentiment.

The feeling of being 'here' involves superimposed layers of knowledge, often only revealed when they slip out of phase. One experience of this disjunction I had was at a train station, standing in front of a huge map having just arrived in Shanghai. Scanning the map, I found where I needed to get to, but there seemed to be no indication of where I was – the 'here' – on the map. Without the little red dot there was no anchor between the navigable path that a map offers and the immediate territory. Another such experience was at a subway station in Seoul where, for a good couple of minutes, I puzzled over

[86] Sobchack (2004), p13.
[87] Ibid, p20.

the map of an area I thought I was familiar with, even checking that I was indeed at the right station. By tracing a path between two landmarks, I realised that north was downwards on this map – just for a change.

Photograph of map in the Seoul subway, 2010

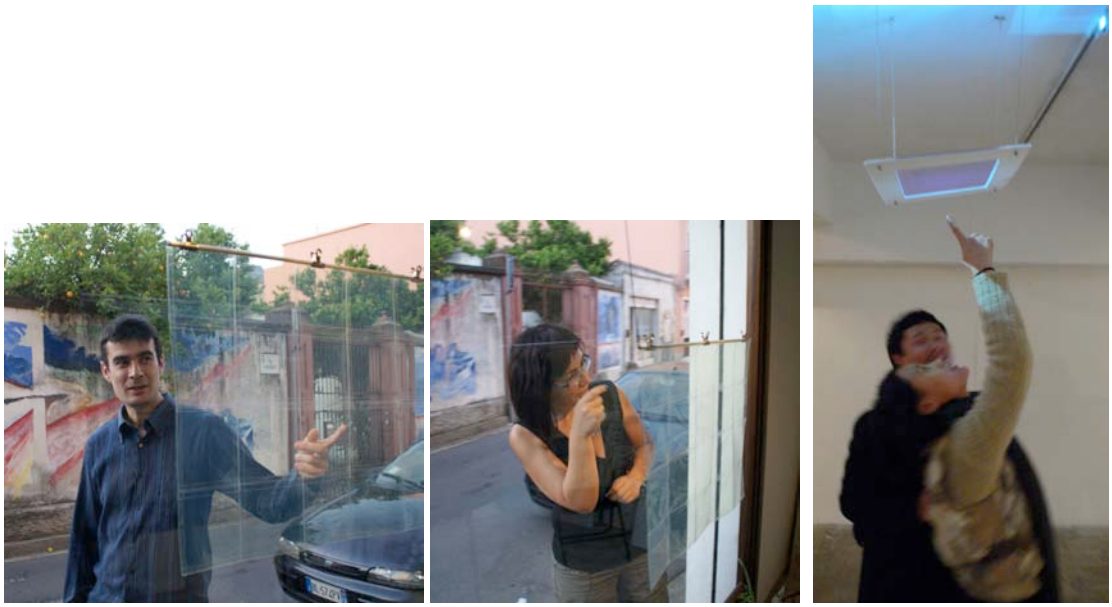
A sense of location then requires not only an anchor of 'here', but also a sense of orientation – the alignment of 'facing' and 'movement' with an allocentric concept of the physical environment. Mapping allows for our allocentric knowledge of place to be stretched. The located moment 'here' and 'now' is a complex interweaving of knowledge and sensory perception. There is a desire for unity between cognitive mapping and a physical sense of location. This is achieved through a connecting of reference systems – a cross-referencing – which is enacted in the touching of a map.

Tracing a finger over a map is a way of imagining a journey. The photographs below show how people have touched not only where they are currently located on these maps but also their possible destinations:

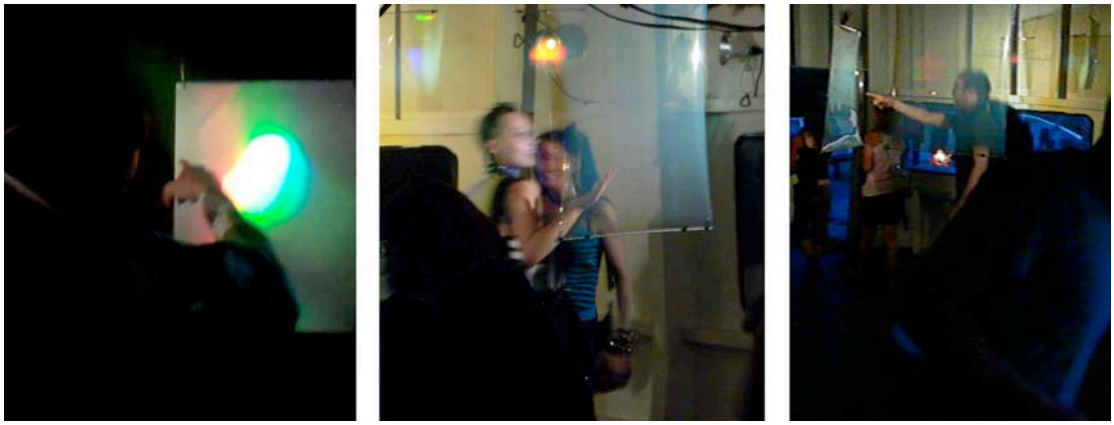
Left: New York City Subway Map at 23-Ely Ave, 2008. Right: Map in carpark, La Vignasse, France, 2006

Exhibiting holograms in an art context prescribes the convention of 'do not touch'. As such, when adults[88] engage with the installations they don't tend to touch the holograms in the same way that they will trace a finger over a map. The desire to define a point of connection within the scene is shown through the tendency of viewers to point at the hologram. This gesture physically focuses attention, and seems to be an attempt at sharing a place/moment in the scene with another viewer. In pointing into the scene the viewer connects themselves to a virtual location, 'here' in the image.

[88] Children sometimes try to touch the holograms but are restrained by their guardians.



Left and centre: Viewers pointing at *map of Here and There*, Paese Museo, Sardinia, 2009
Right: Viewer pointing at *This morning on the balcony reminded me of a dream 'Explorations of the holographic gaze',* Gallery 175, Seoul, 2010



Viewers pointing at holograms in the installation *Jumping Jellyfish*
Left: ZKM | Centre for Art and Media Karlsruhe, 2011. Centre and right: Bushwick Boat, New York, 2009

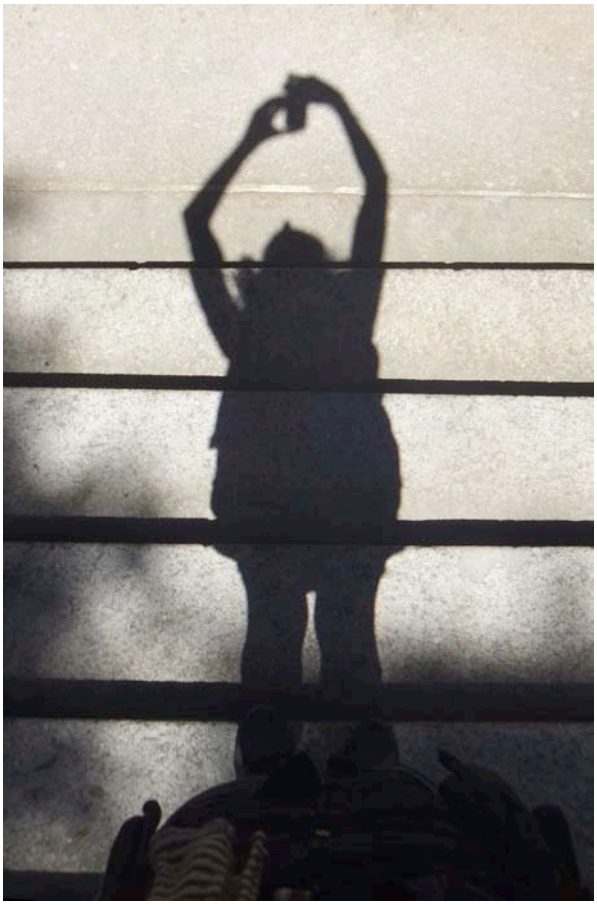
When observing viewers, I have noticed two distinct (yet connected) modes of engagement. One often involves pointing and an identification of landmarks / key elements within the holographic image allowing for references within the image. The other tendency is for viewers move around the hologram to reveal unexpected dynamics, which can give rise to expressions of surprise and jerky movements. The revolving activities of locating elements and exploring relationships builds up an impression of the scene through its experience. This impression is connected to an embodied sense of space and yet highlights how perceptual activity can lead to a complex 'non-Euclidian' conceptualistion of location. The construction of holographic scenes with referenced spatial dynamics is an attempt to tap into the complex process of locating oneself so as to extrude emergent shapings in the experiential mapping of place.

"The space of experience is really, literally, physically a topological hyperspace of transformation."
Brian Massumi (2002) '*Parables For The Virtual: Movement, Affect, Sensation*', p184.

Chapter 2 – Linking the holographic view to the body

The last chapter focused on pulling apart an assumed continuity of spatial experience and a singular notion of location by considering experience as an enfolding of multiple perceptual systems. This chapter considers how an anchored visual reference to the holographic scene enables an experiential connection, or affective reading, of the spatial image structure along with its suggestions of shaping and virtual movement.

While the virtual volume of the hologram has been primarily considered in terms of puncturing surface and alluding to immaterial form, the potential for linking movement to a holographic scene has not been significantly developed. To establish and engage with different forms of virtual movement I consider how a bodily awareness can be connected to the holographic view.



One image from a 'vertical-stereo' video recording, Karlsruhe, 2011

A : Anchoring the gaze into a holographic scene

"I know when it's a hologram because it gets into my eyes"

Danica Sladic, explaining how she can tell the difference between a hologram and other types of visuo-spatial images, personal conversation, Melbourne, February 2010

A1 : Looking at and within a holographic scene

The holographic 'scene' is a term I use to emphasise the structure of spatial and/or animate qualities of a holographic 'image'. The scene in theatre involves a number of players who activate the props and space through movement and dialogue. The stage is a physical space, and yet as the imagination is drawn through the actors it becomes a dynamic place of events shaped by forces of movement and attention. Holographer Dan Schweitzer, whose background was in theatre and film, made an analogy

between the hologram and stage, describing both as spaces where there is a border – a 'space barrier'[89] – between the observer and scene. This 'space barrier' delimits the accessible and the inaccessible, perceived space. A perception of something that cannot be fully experienced, such as an inaccessible space or visual rendering I consider as a defining property of the virtual.

Looking at a *trompe l'oeil* painting or around a holographic scene with a singular virtual volume, the continuity of spatial perception allows a sense of space to extend through the surface. Yet this virtual space has different qualities, dependent on the visual rendering. The coupled sense of moving around as you look into a conventional holographic image affirms that the virtual image occupies a volume.

Artist Paula Dawson who has worked extensively with laser transmission holograms describes these recordings as 'concrete' holographic images because they create a sense of physical presence. Dawson defines the 'concreteness' of the laser-transmission holographic image as having properties of "high acuity; a large viewing area with a continuous field of view through the entire range of angles in the horizontal, vertical directions; the size of the image volume to be the same as living spaces familiar to the viewer; and, temporal effects possible through holographic phenomena"[90]. An example of this kind of image is Dawson's triptych hologram installation *'To Absent Friends'* (1989), which captures a bar at three times during a New Year's Eve party. The works are a kind of crystallized memory. The viewer can peer around the scene, examining details, and is able to reconstruct the event from these clues. Dawson tries to make her work "as cosy as possible"[91] using dark installation environments where the viewer can come right up to the film and be drawn into what she describes as "a kind of aesthetic force field"[92].

Paula Dawson *To Absent Friends*, 1989
Left: One of the laser transmission holograms, 150 x 95 cm
[source: www.pauladawson.com.au courtesy of the artist]
Right: Two perspectives showing the details of the scene from small holograms 4 x 5" [10.2 x 12.7 cm]
[source: The Jonathan Ross Hologram Collection, http://www.jrholocollection.com/collection/dawson.html]

A 'force field' occurs when the viewer is activity engaged in looking. In contrast to peering around the details of Dawson's holographic scenes, I am interested in how the viewer senses a virtual composition by being connected to multiple viewpoints, visual landmarks and movements. The mapping and revealing of a photographer's perspective is aimed at extending the experience of movement and a sense of a viewing body into the virtual scene.

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[89] Dan Schweitzer quoted by Achim Lipp in the catalogue of the exhibition '*Mehr Licht'* [Lipp and Zec (1985), p143].

[90] Dawson (2000), p335.

[91] Interview with Paula Dawson in 1992 [Coyle and Hayward (1995), p68].

[92] Ibid.

Working in a small scale, Schweitzer and his studio partner Sam Moree incorporated miniature figurines into their compositions; the figures are a kind of avatar suggesting a perspective within the holographic scene. In the catalogue of *'Mehr Licht'* Achim Lipp describes Schweitzer's figurines:

> "At the same time they draw attention to themselves and prepare the observer for the appearance of the holographic image."[93]

The figures provide a scale reference to the scene. They also allow the viewer to imaginatively cross the 'space barrier' by adopting the suggested act of viewing within the scene.

Dan Schweitzer and his holograms

Left: *The Tunnel*, 1979 (with my gloved hand). White-light transmission hologram, 38 x 28 cm
Photograph I took at ZKM | Media Library, Karlsruhe, 2011
Centre: *Thendara*, 1978. White-light transmission hologram 14 x 9.5" [35.6 x 24.1 cm]
Right: Schweitzer with *Thendara* and the model used for the hologram. Photograph by Nancy Safford
[source of centre and right images: The Jonathan Ross Hologram Collection,
http://www.jrholocollection.com/collection/schweitzer.html]

A2 : Orientating through the image

In 2004 I was thinking about how my cognitive map of a city informs and is shaped by my experiences. On my last day in New York I decided to go to Coney Island, partly because of its reputation but largely because it was always there at the bottom of the subway map. Called an island but obviously not, this place was part of my concept of New York City but not my experience. I was somewhat emotional and distracted, yet I was determined to get to the seaside amusement park. After taking the wrong subway in the wrong direction, which did not work out as a linear double negative may have, I resolved that the Rockaways would have to do for my beach adventure. Luckily I had my video camera, and my confused orientation heightened my connection to what I found through the lens.

Annotated map of path to Coney Island →

After some time at the beach I felt grounded and I decided to head back, but first I wanted to record this moment; to turn through myself, to not feel displaced or confused, to be self-anchored. So I held the video camera at arms length, turning my camera-view back on myself and looked into its lens and at its screen. I spun around this visual loop with the camera, letting the world beyond slide by. In spinning I let go of my established (and somewhat faulty) sense and concept of

[93] Lipp and Zec (1985), p144.

direction. I spun to enter the fold of experience and reference myself again.[94] This footage became the hologram *Emotions for the Seaside.*

Four photographs of the hologram *Emotions for the Seaside*, 2004/2005
Achromatic transmission 200-frame multiplex hologram, 30 x 40 cm

Emotions for the Seaside was one of the first[95] multiplex holograms that I made from digital images. There are some technical peculiarities to the image, such as the morphing of the buildings caused by retiming the video to create enough frames for the hologram. But the handheld view, morphing buildings and dramatic lighting create a sweeping vitality to the piece.

Emotions for the Seaside is structured around an extended and reflexive 'looking'. The hologram shows the photographer/avatar/protagonist through their camera. The protagonist is both the director of the viewer's gaze and its subject. I show this hologram by suggesting[96] that the viewer hold the hologram at arm's length and move around to find the correct angle of illumination and to play the animation. One tendency I observed was viewers matching their reflection to the protagonist's silhouette (right image).

Viewers with the hologram *Emotions for the Seaside*
-1/MinusEins Experimental Labor, Academy of Media Arts (KHM), Cologne, 2011

The act of viewing the hologram mimics and strengthens the empathic reading of the act of holding the camera to make the recording. This resonance of the recorded act through the installation is developed further in the next chapter. This chapter is concerned with what happens when we simultaneously look at a visual-protagonist and through their recorded perspective.

Being able to create holographic images from digital images opened up my practice, which had previously been concerned with animating the physical scenes that I constructed in the studio. While this explosion of possibilities led me to experiment with layering virtual image spaces and the spatial dynamics of montage, I came back to my intention of seeking a reference into the holographic scene (as in the recording for *Emotions for the Seaside*).

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[94] As discussed in the previous chapter and in relation to Brian Massumi's essay *Strange Horizon: Buildings, Biograms, and the Body Topologic* [Massumi (2002), p177-207].

[95] The other hologram produced was from a fixed camera perspective and in comparison did not have a strong dynamic quality.

[96] This was done with a sign and gloves at the SIAL Project Gallery, RMIT University, Melbourne, 2006 and then by demonstration at -1/MinusEins Experimental Labor, Academy of Media Arts (KHM), Cologne, 2011.

B : A reflexive looking

A photograph out a tram window, 2007

This image has number of visual references to the activity of capture: the finger in front of the lens, the shadow of the tram with photographer in the window and a very faint reflection in this window of the photographer's arm.

B1 : Suggesting the activity of capture

As a child I remember watching slideshows of people's holidays. On one occasion, while trying to remain awake through multiple carousels that seemed endlessly to unfold a distant place, it was an accidental finger that kept creeping in front of the lens through which I gained a sense of their holiday experience, and how the camera was part of this.

Journal note: *thinking about photography*, 2010

Shadows and reflections fold an awareness of my visual body into the experience of the urban environment. These visual references provide another way of gauging my movement through the landscape, acting as a reflexive tracing of my body (and/or vehicle). This visual awareness also extends a sense of 'touch' as I watch my projected form scan across undulating surfaces. When capturing images, I use a reflexive awareness of my presences to direct my camera-view. For example, with *Shadow-waves at Safety Beach* (2008/9), I anchor the images around the shadow of the camera. This anchoring connects the points recorded to their reflexive projection, linking the movement and rhythm of the view to the protagonist's implied body.

In composing holographic scenes of urban landscapes, architectural patterns and landmarks were used to hinge multiple viewpoints. The referenced relationship between the frames of these sequences implicitly encoded the photographer's gaze and movement. In contrast in my holograms that formed the exhibition '*Explorations of the holographic gaze',* the photographer is visually portrayed to show an actor of movement and a directed looking – that the camera is attached to the body and action of a photographer. The view recorded into these holograms is hinged on the visual surroundings and physical connections between the photographer's activity, the image of their body, and the scene. With these holograms, the activity of recording is revealed by the combination of the depicted photographer and the recorded view through their lens.

Three photographs of the hologram *Shadow-waves at Safety Beach*, 2008/9
Achromatic transmission 200-frame multiplex hologram, 30 x 40cm

Shadow-waves at Safety Beach, installed on metal stand and laminated to a laser etched mirror
'Explorations of the holographic gaze', 2010

The photographer who appears in my holographic images is a very particular type of protagonist, simultaneously drawing attention while guiding the view. This protagonist is both the subject and operator of the image. Through a spatial montage the viewer's activity of looking around activates the scene connecting the protagonist's view to their own. A shadow is used in several of my holographic images to imply the linked presence of an active viewing body. The shadow suggests an activity of movement that can be inhabed as it is not ascribed onto a separate body. The perceived activity can then be reflexively inhabited by the viewer.

Photographs for holographic images that include the shadow of the photographer
Left to right: *Shadow-waves at Safety Beach, Museum Reflection* and *map of Here and There*

An engendered bodily experience is described by Maurice Merleau-Ponty in relation to the viewing of paintings:

> "The creative freedom of the ordinary body, awakened into action by following the work of the painter, ultimately engenders a reconstitution of the conditions of possibility themselves: new ways of seeing instigated by the body responding to the world."[97]

[97] Merleau-Ponty (1964), p179.

By using the shadow of the photographer, I am attempting to enable the viewer to 'reconstitute' the photographic act in order to 'experience' the recorded encounter.

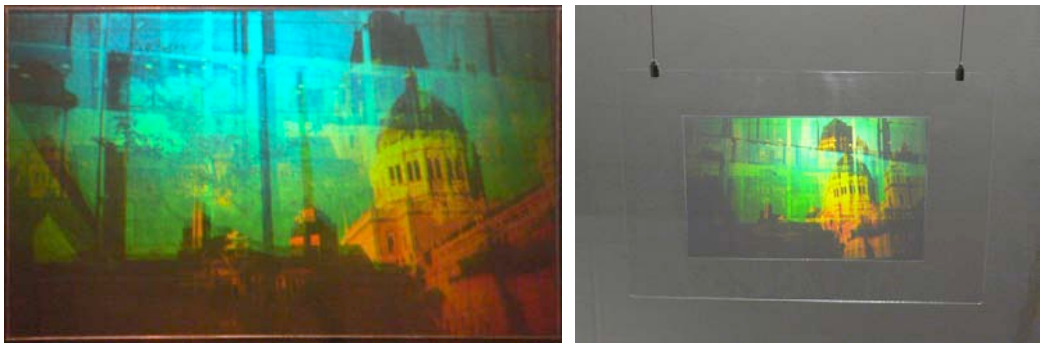
B2 : Museum Reflection

Three source photographs for *Museum Reflection*, 2006

As in *Shadow-waves at Safety Beach,* the sequence of views in *Museum Reflection* (2006/9)[98] are anchored to the shadow of myself and my camera. The captured views of *Museum Reflection* were determined by positioning the camera on an architectural pattern of metal knobs (designed to stop skateboarding) along a concrete block across the front of the Melbourne Museum. The sequence consists of 28 seated positions looking into the museum through its glass façade.

There are two references within the scene of the hologram *Museum Reflection*: the animated act of photographing as shown by the shadow on the glass surface, and the optically overlaid[99] spatial depth captured through parallax (of about 40 meters). Each spatial viewpoint of the holographic image shows a single photographic perspective that optically combines a silhouette and reflection with the view through the glass into a courtyard and reflected again. With the second reflection the building's spatial form shifts about because of the differences in orientation between the glass panels, producing a gentle cubism. Different readings of space and dynamics emerge as the viewer moves past the hologram. The photographer's shadow is anchored to the image frame, which causes it to puncture the virtual image-volume established by the parallax – yet the figure is linked to the rhythm of this animate spatiality.

Referencing the image to the protagonist's shadow as well as through their pattern of movement an entangled structuring of visual space emerges. The cross-referencing of the spatial rhythm of position with the directed view results in the complex strata of different hinged relationships being perceived as dynamics of space and structures of motion.



Photographs of *Museum Reflection,* 2006/9
Three-colour transmission 200-frame multiplex hologram, laminated to plexiglass, 48 x 32 cm
Installed and at the exhibition '*Explorations of the holographic gaze',* 2010

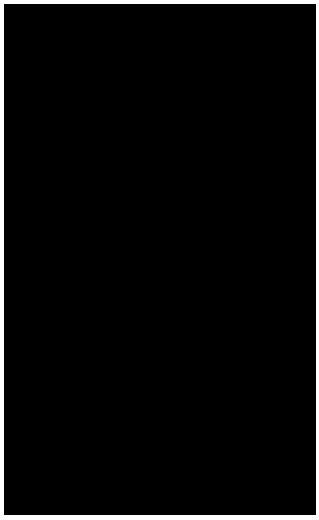
[98] Despite the photographic capturing for this hologram being a key link between my tracing of paths and that of the body I did not print the compiled images into a hologram until 2009.
[99] Further explored in section *B4 : Opening up perceptual space with inflections of the virtual (looking through a strange mirror).*

B3 : A shared experience

The viewer's agency of movement around my holograms is key to establishing an activity of perception. Artist David Hockney considers a sharing of time as crucial for linking the experiences of capturing and viewing:

> "And the reason you can't look at a photograph for a long time is because there's virtually no time *in it*—the imbalance between the two experiences, the first and second lookings, is too extreme"[100].

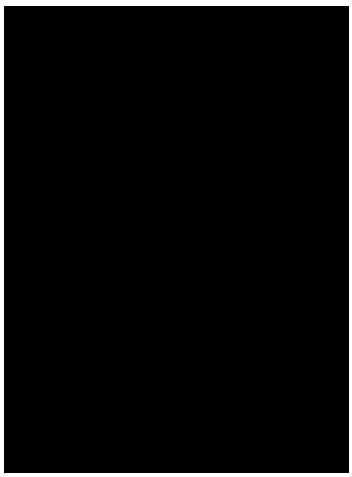
While initially this lead Hockney to disregard photography, he then used this quality of the photographic moment to explore the concept of assembled perception through collages of photographs, which he calls *'joiners'*.



← David Hockney, *My Mother, Bolton Abbey, Yorkshire, Nov. 82 #4*, 1982
Photographic collage 120.7 x 69.9 cm
[source: http://artchive.com/artchive/H/hockney/hockney_my_mother.jpg.html]

In this image Hockney includes his feet, which establishes the presence of the photographer and a relationship to both his mother and the photographic act.

The first series of Hockney's *'joiners'* were captured with Polaroids and assembled as they were taken. This process sometimes took several hours. Hockney would work with the growing composition, 'sketching' in the missing parts of the scene with his camera. A second series was taken with 35mm print film, and thus the capture and composition happened separately: "in effect I end up 'drawing' the collage twice".[101] For the most part the second series has a more cohesive perspective. This 'cohesion of view' is partly due to the overlapping prints. As shooting with 35mm print film offers no visual feedback, I think Hockney was more cautious with his movement and attention – similar to a cautious movement through a familiar space in the dark, or with eyes closed, and relying on a proprioceptive sense of space and memory.



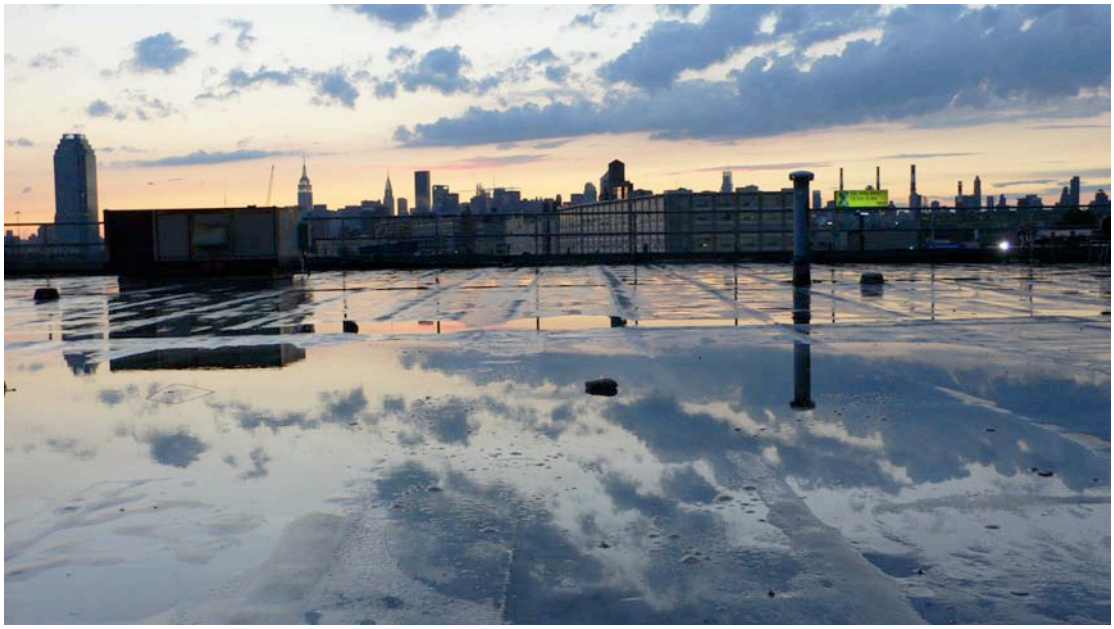
Left: David Hockney, *Don and Christopher*, 1982
Composite polaroid, 80 x 59 cm. [source: David Hockney Collection, http://www.hockneypictures.com/photos/photos_polaroid_01.php]
Right: David Hockney, *Pearblossom Hwy., 11 - 18th April 1986, #2*
Chromogenic prints mounted on paper honeycomb panel, 198 x 282 cm
[source: J. Paul Getty Museum collection, http://www.getty.edu/art/gettyguide/artObjectDetails?artobj=112574]

[100] David Hockney in conversation with Paul Joyce, [Hockney and Joyce (1999), 2002ed, p7].
[101] Ibid, p29.

In making the *'joiners',* Hockney had a rule to never crop the 35mm prints, observing that "the evenness of time seems to be tied up with a regularity in the print size".[102] The visual rhythm of the prints sets a reference frame for the dimensional extent of the scene, which Hockney uses to embed time – a duration of looking. The viewer in taking time to look at the image (re-)enacts a compositional process, reconstituting time into the scene.

In relation to movement and space, the viewer moving around a multiplex holographic image develops a sense of the structure of perspectives that are composed into the scene. The captured movement in my compositions is adopted into the viewer's agency, but is also designed to heighten their awareness of movement. The act of looking establishes a connection between their explorative viewing and my process of capturing the urban encounter. In turn, this reflective extension suggests how our experiences of intrinsically involve our bodily and physiological tendencies.

B4 : Opening up perceptual space with inflections of the virtual (looking through a strange mirror)



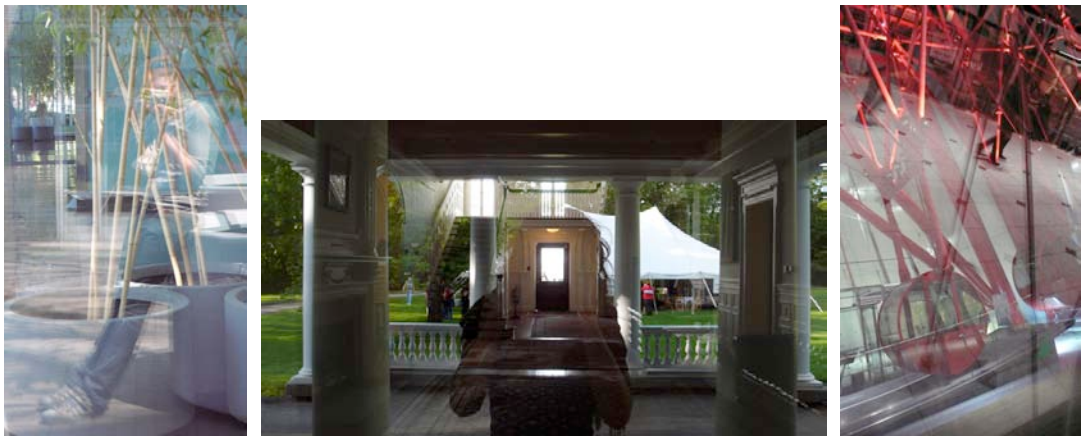
A photograph after the rain on the roof of Flux Factory, New York, 2007

I love it after the rains, when the sheets of puddles reflect my world deep into the ground. I feel like I am suspended between this world and its mirror. I see things separated from the physical allowing other relationships to connect. I am also there in the reflection, there as only a trace among other tracings – I am part of the image. In this virtual place formed by my relationship to the reflecting surface, space extends, creating a place in which I am reflected but not contained.

Journal notes, 2006. Written after crossing the reflected clouds of the wet plaza in front of the Melbourne Museum (edited to reflect my understanding of terminology in November 2010).

Watching my shadows and reflections as I move through the landscape, there is often a particular time of day where the reflection and the space beyond have a similar quality of light, blurring what is reflected and transmitted into a multiplistic scene. Both the reflected view and the space behind the partially reflective surface are physically separate from the viewer, yet in making an image of this visual multiplication, their differences are negated.

[102] David Hockney in conversation with Paul Joyce, [Hockney and Joyce (1999), 2002ed, p29].

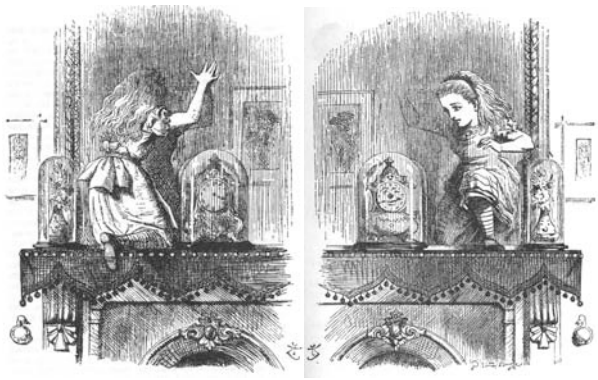


Photographs of combined reflected and transmitted views through glass (un-manipulated)
Left to right : CitiBank building, New York, 2008; Bard College, 2008 and a Ferris Wheel in Osaka, 2006

The implications of such a visual scene are described by György Képes:

> "Transparency means simultaneous perception of different spatial locations. Space not only recedes but fluctuates in a continuous activity."[103]

Through a spatial re-arrangement of perspectives I evoke multiple suggested spatial locations. The captured perspectives are superimposed – suspended in a dynamic relationship between the viewer and view. Multiple references establish a dynamic of surface logics and depth perceptions, in both the photographs and the holographic images. This enables an impression to form through the relational qualities between different spaces and spatial groundings.



Alice and her 'through the looking-glass' self
Illustrations by Sir John Tenniel
Lewis Carroll, *'Through the Looking-Glass and What Alice Found There'* (1871)

Lewis Carroll takes Alice 'through the looking glass'[104] where the characters she meets inflect meaning with language and the world depicted has a strange 'other' logic, that plays on word meanings and on the rules of games. Little transformations of logic and linguistics escalate into Alice's confusion, a disorientation of someone who is not where they think they should be after having been convinced of every turn. Deleuze uses Alice's predicament in *'The Logic of Sense'* to demonstrate how sense is a function of language and can be extended by its possibilities of construction. What Deleuze's Alice found was that "sense already has a foreboding of nonsense"[105] – both being patterns within the

[103] Képes (1944),1995 ed, p77.

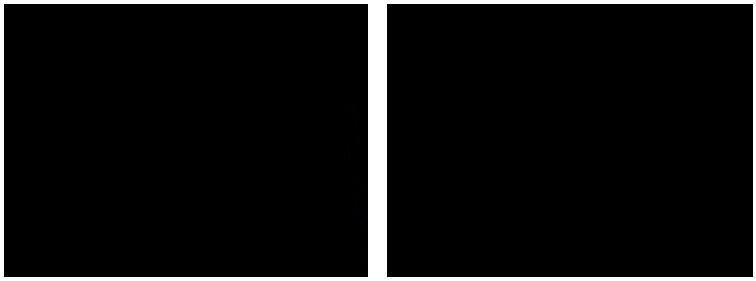
[104] In Lewis Carroll's books '*Through the Looking-Glass and What Alice Found There'* (1871) and '*Alice's Adventures in Wonderland'* (1865).

[105] Deleuze (1990), p117.

structure of language. Many of my holograms play with how our sense of something, such as a place, emerges through the relations between different 'logics' or structures that are both coextensive and disjunctive.

The viewer is not only an operator in unfolding the holographic image but is also an observer of this space with another physics. The perceptual physics of the image space I am exploring as an affective warping, in which physiological and cognitive propensities skew the perceived surrounds – emphasising particular forces as well as polarizing and fragmenting the potential to act. As described in *Chapter 1* in relation to the experience of being lost, this warping can be felt as a visceral de-stabilization and/or that the surrounds are responsively animate.

A sense of warping of space has been described in relation to Robert Lazzarini's sculptural series *Skulls* (2001), shown below. These skull sculptures were created by scanning a skull, generating several distorted 3-d models, and printing them in bone-like medium that has a fidelity of the original object. There is something niggling about these sculptures because, although they are very recognisable, there is no perspective from which they can be resolved 'correctly'. Talking about *Skulls,* Lazzarini describes the compound distortion from multiple transformations along different axes. He makes an important distinction that the "distortions [are] projected through the entire object"[106]. The skull, like the human figure – is a strong indicator of scale and the transformations of space. We intuitively know the proportions of a skull. Lazzarini's other sculptures of distortion also use familiar objects, such as a chair and a hammer. Assumed scale and referencing of proportions is an important aspect in establishing a spatial perception of warping.



Photographs of Robert Lazzarini's *Skulls,* 2001
Posted anonymously on the blog *'ilXor'*, thread: *avant-garde anachronism in old paintings*.
[source: http://tinyurl.com/ilxorthread84427]

The play of the multiple distortions and their application through the whole familiar form suggests that these objects have been exposed to forces or belong to a different physics. Mark Hansen describes his experience of viewing the work in '*New Philosophy for New Media':*

> "You feel the space around you begin to ripple, to bubble, to infold, as if it were becoming unstuck from the fixed coordinates of its three-dimensional extension. You soon become disoriented, as this ungluing of space becomes more intense."[107]

In an extreme case, perceptual distortions can resemble an hallucination, where a sensory conflict can not only debunk the establishment of a grounded reality, but can also cause a loss of confidence in perception, such as a feeling of disorientation. Massumi describes the main difference between perception and hallucination as a matter of referencing.[108] In using a visually-depicted protagonist who is at the core of spatial warping, I aim to assist the viewer of the hologram to navigate through the structure of folds and forces, to sense a different spatiality. The distortions of the image are external, yet also a felt part of movement – pulling, pushing and causing little jumps and folds in the perception of continuity.

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[106] Robert Lazzarini interviewed by Todd Gibson [Gibson (2004), *part 3 of 5*].

[107] Hansen (2004), p198.

[108] Massumi (2002), p156 & 182. See also [Intro.3].

Viewing my holographic images I found the main difference between sensing that a scene is dynamic and the feeling of a perceptual shift depends on how the imagery is referenced. For the most part I arrange the images to employ and connect both egocentric and allocentric visuo-spatial references. This allows for the tendencies of self-referencing (including proprioception and a reflective visual awareness) to be extended into the visuo-spatial scene – a scene, which has its own referenced structure. What emerges from the activity of viewing is a system of relationships, a kind of perceptual physics that is inscribed by the arrangement of relations.

B5 : The reflective gaze

"Therefore, as a modality of embodied perception, vision not only provides us fundamental access to the seen visible world, but it also provides us fundamental access to ourselves–both as seen visible subjects and as seeing and visual subjects"[109]

Vivian Sobchack (1992), *'The Address of the Eye: A Phenomenology of Film Experience'*, p98.

The 'gaze' of the painter and viewer is returned by the subject of these paintings,

Left : Titian, *Venus of Urbino*, 1538
Oil on canvas, 119 × 165 cm. Location: Uffizi, Florence
[source: http://en.wikipedia.org/wiki/File:Tizian_102.jpg]

Right: Édouard Manet, *Olympia,* 1863
Oil on Canvas, 130.5 x 190 cm. Location: Musée d'Orsay, Paris
Photograph by Gautier Poupeau, Public Domain via Wikimedia Commons
[source: http://www.the-art-minute.com/edouard-manet-just-another-nudie/]

As Sobchack describes, the 'gaze' suggests not only a directed looking but the sense that one can be looked at. The 'gaze' is a loaded term, often related to sexual desire. Édouard Manet's painting *Olympia* (1863), and its visual/thematic predecessor *Venus of Urbino* (1538) by Titian, both sparked controversy: the naked woman depicted is looking at the viewer, unashamedly 'engaging' with them as part of the erotic scene. To be engaged is to feel something: the image affects the viewer, causing them to react and/or become aware of themselves. This engagement is key to the bodily awareness that I attempt to establish and extend through the holographic images.

The main sequence of photographs for the hologram *Slide* (2008) was recorded while descending a slippery-dip. It was difficult to keep looking at the camera. The captured expression includes apprehension and determination.

[109] Sobchack (1992), p98.

Slide, 2008
Left to right: Installation view '*Explorations of the holographic gaze*', 2010
Photograph of hologram. One of the 15 photographs used to make hologram
Achromatic transmission 200-frame multiplex hologram, vertically animated with aluminum frame, 46 x 38 cm

Stephen Heath describes the protagonist's gaze as establishing a sense of space in cinema:

> "The character, figure of the look, is a kind of perspective within perspective system, regulating the world, orientating space, providing directions."[110]

I consider this 'looking through a secondary gaze' as an extended gaze. With a number of my holograms, the protagonist looks both at the viewer – establishing a shared visible presence, and around the holographic image space – validating the virtual place through an extended gaze.

One of the holograms for *Unfurl*, 2004/5
Rainbow transmission 180-frame multiplex hologram, 90 x 130 cm
Left to Right: Early background test. Photograph of hologram. Installation at Don't Look Gallery, Sydney, 2007/8

Such is the case with one of the *Unfurl*[111] holograms (pictured above), where the character looks apprehensively but directly at the camera and into the virtual surroundings. The character's gaze establishes a shared visible presence with the viewer, which is extended in their looking down to suggest the visible presence of the holographic scene. Optically, the holographic image of the character appears to be protruding into the viewer's space. The viewer can step into this image, but as they do so it looses definition[112]. While enticing an engagement, the holographic character elusively belongs to a

[110] Heath (1981), p44 .

[111] In 2004 with an Experimenta New Visions Commission I was able to work on the collaborative project *Unfurl* with garment designer Sruli Recht, computer graphic artist Ged Wright, and Mark Ruff who owns/operates a 50-camera photographic capturing array. The two 90 x 130 cm holograms were printed with Dr John Perry at Holographics North – a large format studio in Burlington, Vermont, USA.

[112] When looking at a holographic print, the image forms due to the reconstructed perspective from the virtual windows of the master hologram. If the viewer gets closer to the print than these projected windows the image smears in every direction. The holographic image has not yet formed into an arrangement of distinct views.

different ‘reality’. In the two holograms produced the characters appear to have an uneasy awareness of being watched.

These holograms were installed in Experimenta’s *‘Illusions’* exhibition in Melbourne in 2005. Experimenta attracted a wide audience, and hence it would be the first time that many visitors encountered large-format holograms. The *Unfurl* holograms were designed to be very approachable and to have only a subtle spatial distortion. This distortion was created by using a camera array and digital-composed background with an exaggerated angle of view, causing the image depth to be accentuated and have a slight swing to it. The characters show an apprehension, as if sensing a camera or puncture in their ‘reality’. This expression was designed to reflect the question – ‘how does it work?’ – that we anticipated from many viewers.

B6 : Suspended in a system of looking

Michel Foucault uses Velázquez's painting *Las Meninas* (1656) to consider the place and action of the observer in terms of an invisible rendering. Foucault describes the scene’s action of representation as an “unstable superposition”[113] – an instability created by bringing “two forms of invisibility into the place of each other”[114]. These actions of looking that incorporate the unseen include the depicted painter’s looking beyond the represented space and painting what he sees onto an obscured canvas. Also, if we are to believe the mirror in the background of the scene then the viewer looks into the painting from a position that they do not visibly occupy. Foucault discusses how these visual relationships to place the act of viewing “in that blind point, in that essential hiding-place into which our gaze disappears from ourselves at the moment of actual looking”[115].

Diego Velázquez, *Las Meninas,* 1656

Oil on canvas, 318 cm × 276 cm. Location: Museo del Prado, Madrid. [source: http://en.wikipedia.org/wiki/File: Las_Meninas,_by_Diego_Vel%C3%A1zquez,_from_Prado_in_Google_Earth.jpg]

What Foucault describes as a ‘disappearance’ in the moment of looking hinges the various activities of looking elicited and represented by the scene. As the viewer traces and inhabits a system of gazes – with a “fluttering attention”[116] – they slip between perspectives, repeatedly encountering suggestions of invisibility. A feedback loop of seeing, and in this case not being seen, presents another means of understanding how a system of views fold on themselves, and that in switching between perspectives we momentary inhabit their superposition.

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[113] Foucault (1966), p9.

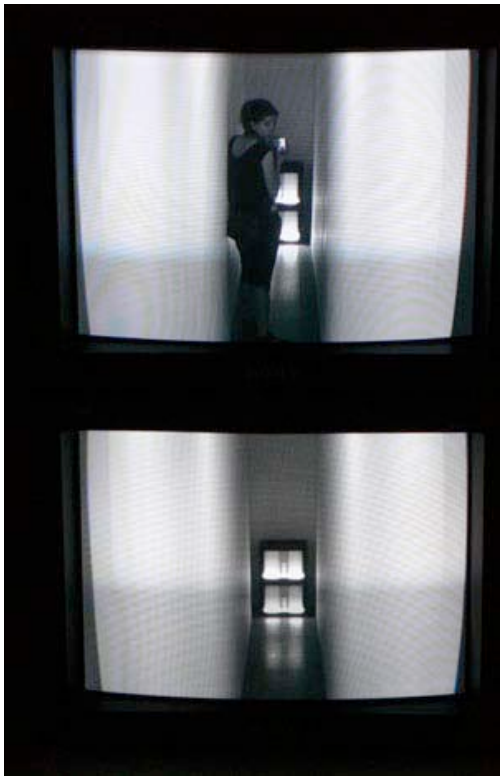
[114] Ibid.

[115] Ibid.

[116] Ibid, p14.

The suspended action of the man on the stairs, who seems poised between coming and going, encapsulates the sense of this endless looping from which the viewer emerges and re-enters.

Video art allows for a feedback loop within the medium. In many early video art works the camera and monitor are used to establish a reflective system both for the production of tapes and in installations. One example of this that I experienced was Bruce Nauman's *Performance corridor* (1969) in which two monitors are placed at the end of a narrow corridor. The top monitor shows the view of a camera at the opposite end of the corridor while the bottom monitor is the same pre-recorded scene. The absence of the viewer's image in the lower monitor produced a sense of invisibility – of being within a parallel visual looping that is inaccessible.



Photograph of myself in the monitors of *Performance corridor*, 2010
'Dream Passage' a Bruce Nauman retrospective
Presented by the National Gallery in the Hamburger Bahnhof – Museum für Gegenwart, Berlin
28 May – 10 October 2010

The top monitor produced another sensation, a dislocation caused by the separation of visual feedback. As you approach the monitor your image gets smaller, preventing the convergence of physical and visual identification. This tactic is also used by Peter Campus in his video installations *mem* and *dor* (1974), described by Rosalind Krauss in *Video: The Aesthetics of Narcissism,* to contrast a tangential concept resulting from medium's instant feedback of the "the video monitor as a mirror"[117]. Vito Acconci's *Centers* (1971) is used as an example of this reflective-mirroring, a recording that implies a collapsing and looping between the artist and their image. In both cases Krauss considers the psychological aspect of the medium and how it positions the "performer's" body "between two machines"[118] – the camera and the monitor.

[117] Krauss (1976), p50.
[118] Ibid, p52.

Left: Peter Campus, *dor*, 1974, photograph of video installation by Bevan Davies [Krauss 1976, p51]
Right: Vito Acconci, *Centers*, 1971, b&w video recording 22:28 min
[source: http://www.montserrat.edu/galleries/public-programs/index.php?featured_id=120]

The mirroring of capturing and viewing composed in my holographic image installations combines a sense of dislocation – by inserting transformations into visual feedback, and a fusion – by hinging the movement of the viewer to the photographer. These holographic scenes explore folding points and disjunctions in perceptual awareness by offering both a mirroring-reflection and a dislocating inaccessibility. This situates the viewing act within separate but linked processes – the act of recording is accessed through its relationships to the activity of reconstruction. While the differences between these processes highlights the activity of each.

B7 : Multiple embodiments

In the hologram *Exploring under the autobahn* (2010), a single piece of video footage was cut and layered to sketch out an act of walking and looking around. The visually depicted body of the protagonist appears within three different actions of recording: looking around, looking through the camera, and as a shadow moving across the landscape. These visual depictions are understood as a single agent, their activity summing into sense of exploration.

Three source images for *Exploring under the autobahn,* 2010

Here, there is a suggestion of multiplicity and parallel temporalities through the simultaneous appearances of the visual-protagonist. As the scene is assembled through multiple related perspectives, the viewer is dislocated from a single position or action in time. The activity of exploring/recording coheres the viewing relationships.

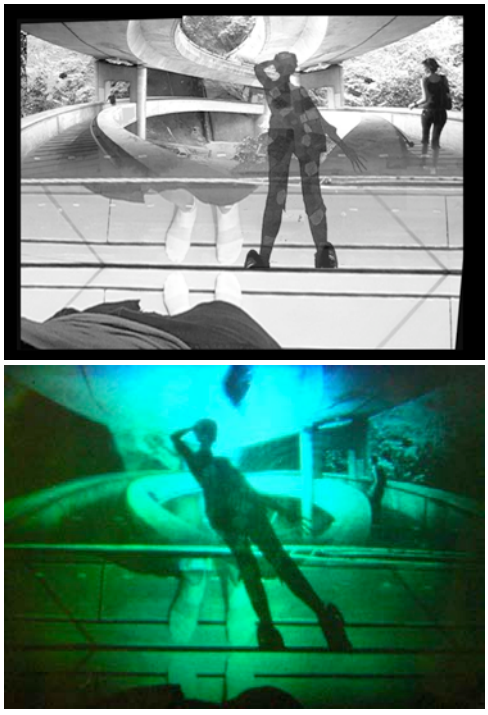
This hologram brings together three ways that I employ the photographer's image, or what I refer to as the visual-protagonist: a direct looking into the camera and therefore at the viewer; a looking into the scene to establishing it's visibility; and the appearance of a shadow or reflection of the photographer showing the action of recording in relation to the scene. In each case, the viewer can connect to the

scene, and with the recording of the scene, simultaneously via different relationships. The viewer is placed within a system of looking.

The shadow became particularly important in my recordings of places and was often used to direct the camera. The appearance of a shadow in the image also reminds the viewer that they are looking from the position of the photographer who also structures the scene with their action.

In July 2009 I spent a week in Hong Kong to explore and capture a hologram from my encounter with this city. I was attracted to the architecture of Hong Kong; with its woven walkways and reflective surfaces, the densely populated city sets up a complex structure of interwoven gazes of inhabitation.

While exploring and capturing the city, I contemplated the psychological shaping of inhabiting Hong Kong. There is a strong vertical aspect to the city and no single grounding-plane. Within buildings, escalators connected different levels of street entrances. A sense of elevation and stacking permeated my psyche. I was constantly looking out of windows to see how high I was; my map-point location had an added dimension of elevation. As Walter Benjamin considered the information density of the Parisian arcades[119] as a forerunner to mass-media culture, I felt that Hong Kong was developing my ability to conceptualise and navigate woven spatial systems. Though my digital scrapbook brimmed with visual tracings that could be hinged into complex holographic scenes, my focus had shifted. I wanted to express how the inhabitation of the city continually multiplied and reassembled my visual sense of self. The hologram *Down from the Peak* brings together different reflections of myself from the city and from the friends that I found there.



Down from the Peak, 2009
Achromatic transmission 200-frame multiplex hologram, laminated to plexiglass, 49 x 38 cm
Top left: Digital source image. Bottom left: Photograph of hologram
Right: Installation at *'Explorations of the holographic gaze',* 2010

[119] Benjamin (2004)-

The holographic image is composed of three parts, each recording a mirroring operation.

The main shadow in the centre is anchored by the feet, to the hologram's image plane along a horizontal axis of reflection within the scene. It is ambiguous whether this shadow is standing up (consistent with the spatial organization of the background) or lying down (as suggested by the paving stones in shadow). The movement of the shadow mimetically reflects and slightly accelerates the side-to-side movement of viewing. I consider this shadow as having an obverse-mirroring role, in that it occupies the traditional place of the subject facing the viewer, and yet indicates the photographer's body that we do not see but are looking from. The shadow shows an arm in front of the face indicating a camera – an epicenter of the composition – emphasised by the rotation of the background around it.

The circling perspective around this shadow is created by two sequences of photographs taken from the same path but different rhythms. One of the sequences I photographed walking towards a friend on a concrete walkway as he walked towards me. Then I gave him my camera and asked him to follow and photograph me as I walked away. This sequence was then mirrored about a vertical axis so that combined there is a circulation of movement between our two figures who look at an unseen photographer, at a role they will also inhabit.

The third part contains a reflection along a horizontal line that also grounds the scene to the physical plane of the hologram. Establishing a 'floor' to the holographic scene this sequence shows my feet and a partial reflection of my body in glass, through which a road can be seen far below.

Photograph of my feet reflected out over empty space, Hong Kong, 2009

The situation of looking down through a glass window I have experienced multiple times with the same vivid feeling, that of being suspended. The contained height intensified by the imagination of the falling. To pull this affect through the image composition into the viewing experience, I designed the installation so that viewers look down into the image.

The photographed view of feet was taken with a similar parallax of perspectives as the recorded holographic window so that it shares a similar spatial quality to the physical viewing space of the hologram. When I first looked at a print of the hologram, it took me a moment to 'see' the body that extends from the bottom of the frame to the feet – the movement was so similar to mine, it did not seem to belong to the animated image, but to me. This reflection/extension of the protagonist simultaneously belonged to the holographic scene and my looking.

The installation at *'Explorations of the holographic gaze'* created a situation where the viewer's reflection, feet, and shadow can all be within their visual field. These different visual suggestions of their own body combine in the way that holograms can combine a structure of viewing relations.

C : Experience mediated by images

Through a practice of making and looking at holographic images I developed an understanding of structured and reflexive viewing operations. Questions regarding the role of photography and image-making in shaping social culture and self-awareness are complex and ongoing – yet what is particularly relevant to this inquiry is how a recorded view propagates a sense of connection. What I am

considering is how visual connections and their dynamic relationships can extend our sense of located perspective and shape our understanding of place.

C1 : Looking through the lens; effects of the device of capture.

My father is an avid photographer, but the accumulation of shoeboxes of photos in our house stressed my mother. When a family outing had paused again for photography, her huffs were met with, "I'm just looking through the lens". I grew up thinking photography was a way of looking.

Thinking about my photographic practice, 2010

My experiments with photography explore different ways of looking. Each camera elicits a different field of view, therefore shaping of the visual field. In becoming familiar with a camera I establish a sense of the perspective through the lens and use this view to guide my movement. In 1999 I developed a practice of arm's-length capturing using a wide-angle Olympus X2 film camera. While the results were often strangely aligned images, parts of my body were often included within the scene giving the photograph an egocentric reference. By not looking through the lens I could separate the camera from my ocular view. The capturing becoming an extrapolated looking that draws on my imagined view through the lens. As the extrapolated act of looking was also recorded, it would become part of my memory of the experience.

I obtained a digital video camera in 2000 and a Panasonic Lumix LX1[120] in 2006, which also had a video function. Both cameras had an LCD screen that allowed me to see the through the lenses' perspective while capturing. I could simultaneously look at the image and the surroundings. These cameras created an instant feedback of extended viewing that guided my movements through the environment. When recording video I developed a way of 'dancing' through urban spaces – a gliding movement something like ice-skating, with the camera view pulling my body through space. The hologram *I followed a box of matches to the Halászbástya but it was under construction* is an example of this kind of movement. In contrast, my photo sequences 'stop-motion' and then reconstruct it based on repetitive patterns, such the architectural elements used to structure *Museum Reflection*.

In 2009 my recording shifted again, as I had access to a SONY Bloggie HD camera with a 360-degree lens. The miniature camera feels like a remote control and captures a larger view than I can see directly with my eyes. As such, the view through the lens is no longer a small window that follows my attention but a sweeping panorama that I can scan around my body and through space. With the increased scope of view, larger/faster movements were easy to accommodate – particularly where these lines of movement maintained a similar relationship to the surrounding space, such as a corridor or pathway. I started riding my bicycle with the camera, capturing my paths through the city.

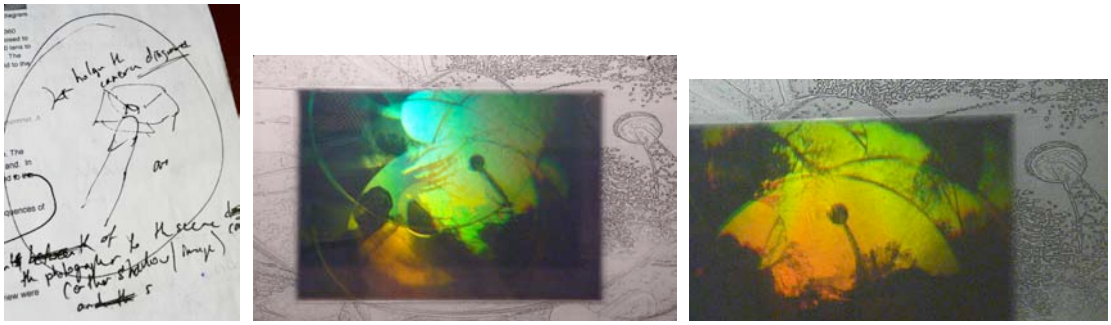
Digital image sequence for the hologram *Wharf Walking*, 2010

The path of the wharf maintaining a similar visual relationship even though I walked around a corner.

[120] The 16:9 aspect ratio and resolution of the Lumix made it easy to freely shoot sequences that could then be stabilised, which often results in cropping the image to the overlapping area, or have elements cut out. The video and photosequence I shot with the Lumix were used to produce most of the holograms up until 2009.

While the panoramic view of the Bloggie camera easily captures parts of my body, the lens has a blind spot right in the middle, where intuitively I would direct the camera. To become familiar with this camera, I practised riding my bike[121] through the park and keeping the *Fernsehturm* [TV-tower] in the field of view. The Fernsehturm, a prominent landmark in my experiences of Cologne, also provided a structural analogy that helped me conceptualise the Bloggie's optics. While I have never been up the tower,[122] I imagine the panoramic view of the Bloggie's 360-degree lens to be like the windows of the tower.

The hologram *Riding under the Fernsehturm* was made from recording a bicycle ride through the park. The layers are anchored to the tower while the stacking order of the layers changes across the sequence, creating a flickering between similar movements.



Top row: Three frames from the 200-frame sequence of layered video footage
Bottom left: Sketch while thinking about the panorama view of the tower and camera
Bottom centre and right: Photographs of *Riding under the Fernsehturm, 2010*
Achromatic transmission 200-frame multiplex hologram, laminated to laser etched plexiglass, 49 x 38 cm

The optics of the Bloggie record the 360-degree panorama into a flattened donut, which distorts the curvature of space. When looking through the camera-view while recording, the optical distortion plays on my spatial perception – something that was made intensely apparent when capturing *On the Roof* (2010).

Three video stills from the footage used to make the hologram *On the Roof*, 2010

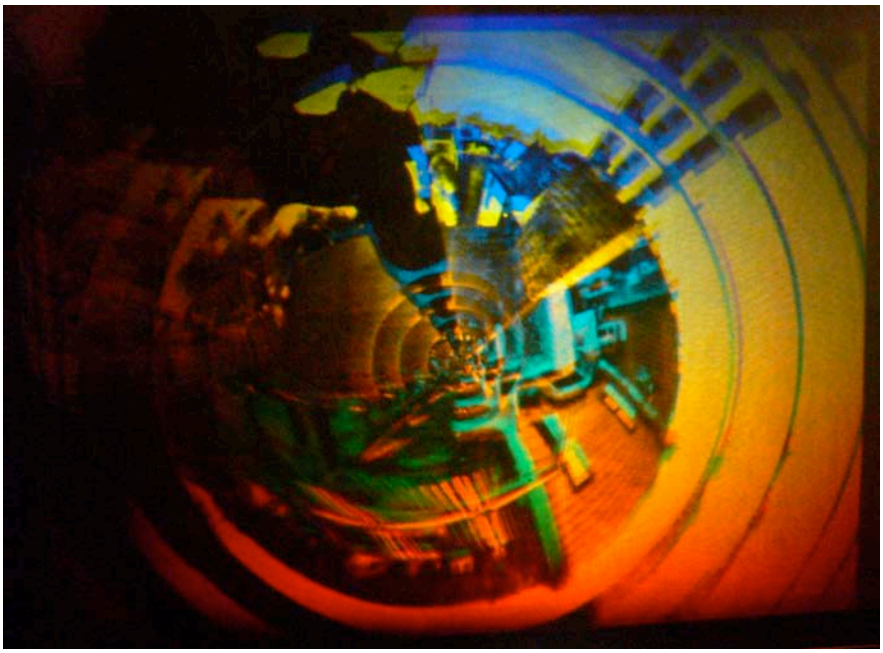
[121] The act of riding a bicycle is itself an adoption of a bodily extension, something that becomes 'second nature' with practice.

[122] The Fernsehturm was closed to the public in 2001 due to structural problems.

The view through the lens, which I used to walk across the roof, elongated my surroundings, causing giddiness as the roof appeared to be a pinnacle on which I was preciously balanced.

Looking up at the camera I could not see my feet. I knew my feet were firmly on the roof but the world I saw through the lens sloped away from me in every direction. Just where my feet should meet the roof I saw nothing at all. With each step my legs disappeared into the visual black hole. My imagination was fueled by the vertigo of this visual distortion. My trepidation of falling exaggerated my sense of movement. I felt like I was stretching into an abyss, that my feet were passing though where the roof should be. 'Looking through the lens' re-shaped my sense of space and body.

Capturing On the Roof, Cologne, 2010



Photograph of hologram *On the Roof,* 2010
Two-colour transmission 200-frame multiplex hologram, 30 x 40 cm

Looking through a lens is an external visual distortion, which in the case of *On the Roof* exaggerated and allowed the recording of my conceptual sense of climbing onto the roof, a place I go to have a top-of-the-world perspective. In composing the image I layered multiple copies of the image with a vanishing zoom to visually suggest the feeling of being on a pinnacle and my feet stretching in search of solid ground.

Bernard Tschumi describes the movement of the body in relation to the architectural experience of space: "Bodies not only move in but generate spaces produced by and through their movements"[123]. I consider a generation of spaces as not only pertaining to the movement of the body but extend this notion to the shaping by the camera when it affects how we move, and how we see. The recording of these movements and shapings allows for the generated scene to be reconstructed. In viewing a holographic scene, recorded spatial implications co-exist with a physical perception of space to extend and contrast each other. The multiplex process of producing the hologram is a hidden operation of recording[124], but one which I have used to reveal how an activity of photography shapes the perceived scene by structuring camera views into movement. The compositional tactics I employ are designed to allow the viewer to access the generative activity of recording.

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[123] Tschumi (1996), p111.

[124] Before this body of work projects including *Hover…* 2004 were aimed at revealing technical aspects of holographic recording.

C2 : A shifting culture of looking – enacting the image

In 1931 photographer Willi Ruge jumped from a plane over Berlin to take *The photographer*. The image is about the act. The image on the left (below) shows the photograph orientated as exhibited[125]. This orientation places the viewer as a witness rather than taking the vertiginous perspective of the photographer. I rotated the image on the right, to show the orientation that Ruge would have seen through the lens.

Willi Ruge, *The photographer,* 1931
Gelatin silver print, 20.5 x 14 cm
Photographed, Metropolitan Museum of Art, New York, 2008. Right image rotated 180-degrees

These different positionings of the viewer highlight a change in visual culture since the early 20th century from an observer looking through a window to a 'participant' who is linked to the scene by the image. A connection to and suggestion of an embodied camera operator occurs in many contemporary recordings – such as looking through head-mounted cameras, or footage with movements associated with a 'hand-held' camera.

A culture of self-portraiture has also developed through vernacular photography and proliferated with digital cameras, the Internet and social media. A classic example of the sense of connection that is established through the photographic act is to photograph your own feet – to declare and record 'I am here'. The act of self-portraiture is like posing in front of a mirror, playing with the image of self, where the imaging process is used to extend and capture other perspectives of oneself. The camera also plays a significant role in contemporary cultures of travel and social interaction.

In Timothy Webster's 'folded time' video installation *Cristo Redentor*[126] [Christ the Redeemer], the tourists animate the scene with the statue as a unifying backdrop. Webster describes the experience of visiting this iconic statue: "The point is that the statue itself is so large that it can only be consumed in these fractured moments".[127] Similarly to this experience, he created an installation of multiple monitors, showing fractured loops of video, that the viewer assembles into an overall impression. *Cristo Redentor* as well as the other sites captured for his *'Wonders of the World'* series are ideal for exposing the process of gathering imagery into the memory of experience, both in the way they are captured and because of the viewers' familiarity with these places. Webster specifically chose iconic sites – "The

[125] On display at Metropolitan Museum of Art, New York in 2008.
[126] Timothy Webster, *'Wonderlands: Cristo Redentor'* Blindside, Melbourne 12–28 March, 2009.
[127] Webster and Douglas (2009), p5.

Wonders fascinate me because of the way my memory and imagination become entwined with my eventual, actual experience of these places."[128]

Left: Video-still from documentation of the exhibition '*Wonderlands: Cristo Redentor',* 2009
[source: http://vimeo.com/3919330]
Right: Nicole Dominic, *Making Memory 2*, 2009
Chroma print, 50 x 70 cm. [Images courtesy of the artists]

At the exhibition '*Wonderlands: Cristo Redentor'* a woman who had visited the site, commented how unusual the place was – dominated by the activity of taking pictures. While photographers had to get down on the ground to fit the huge statue within the frame, many of the photographed stood arms outstretched mimicking the statue. As Webster describes: "They don't look at the statue, they pose like the statue."[129] The tourist ritual of making an image in turn produces a new way of experiencing place. The photographs by Nicole Dominic that accompanied Webster's video installation captured these actions – an activity of 'making memory'.

I often question the protaganistic role of photography. My desire to photograph experiences is analogous to my desire to explore a territory of which I have an image (a map, a photograph, a postcard or a mental image). In both situations the experience is what occurs in the enactment, with the image being a reference to guide and record this activity. The holographic montages are used to suggest an activity of looking that shapes experience. This sense of looking, and therefore the concept that experience is more than an image, is evoked when the viewer is aware of becoming an active participant in the structuring of their gaze.

The uploading of images has also changed the way we capture images. The camera is no longer considered an objective device but a part of the way that we engage with others and express ourselves. In the act of capturing or being visually captured we are aware of the possibilities of publishing (uploading, printing and/or installing). We play up to the camera, recording our experiences and connections in order to establish a memory that can be shared with others.

In her book *'On Photography'* (1977), Susan Sontag addresses how the photographic act has come to interfere with experience and our ethical sensibility: "photography makes us feel that the world is more available than it really is",[130] and that while photographs certify experience, "taking photographs is also a way of refusing it – by limiting experience to a search of the photogenic, by converting experience into

[128] Webster and Douglas (2009), p8.
[129] Ibid p5.
[130] Sontag (1977) 2002 ed, p24.

an image, a souvenir"[131]. Sontag questions how photography has shifted experience, allowing a distancing from a reality perception to that of being a customer or tourist of 'realties'[132]:

> "As photographs give people an imaginary possession of the past that is unreal, they also help people to take possession of a space in which they are insecure."[133]

This taking possession, while sometimes posed as a negative trend towards a deluded society,[134] also allows for shifts of power.

The feminist movement involved a cultural questioning and re-appropriating of the gaze. The movement encouraged women to develop their own way of looking rather than seeking to attract the male gaze[135]. Martha Rosler's photographic work *She Sees in Herself a New Woman Every Day* (1977) illustrates this shift of perspective through the direction of the camera back on herself, becoming the "maker of meaning."[136] In *'The matrixial borderspace'* (2006), Bracha Ettinger develops the concept of a feminine 'matrixial gaze'. This system of looking is complex and co-emergent, allowing an 'intimate sharing' that is created by (and further creates) 'borderlinks'[137] between the subject, object and partially inhabited roles that both direct and attract the gaze. My holographic scenes seek to activate a kind of matrixial gaze through a composition of linked visuo-spatial relationships.

Martha Rosler, *She Sees in Herself A New Woman Every Day*, 1977
Installation view Art Basel 2010, booth Galerie Christian Nagel, Köln/Berlin/Antwerpen
Photograph by Simon Vogel: Courtesy of the artist

What I want to bring out of this shifting understanding of the gaze is that viewers are also makers of images, and as such are able to look through a structured gaze and adopt the activity of its composition. Practices of self-ascribing meaning and 'intimate sharing' are ingrained in the Internet media culture of self-publishing. While often this is considered in relation to personal/social interaction and identity the co-emergent possibilities of content sharing has also radically shifted how society perceives and

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[131] Sontag (1977) 2002 ed, p9.

[132] Ibid, p110.

[133] Ibid, p9.

[134] A concern expressed by Jean Baudrillard and Vilém Flusser among others.

[135] Laura Mulvey, brought attention to the prevalent domination of the male gaze in cinema with the essay *Visual Pleasure and Narrative Cinema*, 1975. In this essay she describes the way that the spectator takes possession of the female character through associating with the gaze of the male character.

[136] Laura Mulvey described the female character as being "tied to her place as a bearer of meaning, not a maker of meaning" [Mulvey (1975) 1990 ed, p29].

[137] Ettinger (2006), p139/140.

organises itself. This shift is captured by the cover of Time Magazine in 2006 showing a computer monitor with a mirror, declaring “Person of the Year : You” … “the engaged citizens of a new digital democracy”.

This image comes from Kiran Jonnalagadda, Bangalore, 2006
Published with quote: “Time magazine’s cover features a ‘mirror’ that distorts more than reflects, and tells a story everyone already knows. This is what you read when you want to get excited despite being late to the party.”
[source: http://jace.zaiki.in/2006/12/]

With my holograms I propose that adoption of an extended gaze can lead to both emergent and reflexive understandings through an affective engagement with the activity of looking.

C3 : A structure of multiple views – looking into and outwards from a fold

Digital images often contain metadata, an additional layer of recording such as a #tag. Metadata records something more than the indexical nature of the visual image that points back at the event or perspective from which it was taken. Metadata is not new. The ‘stories’ triggered by an image, for instance, are also a form of additional information that are attached to and shape the impression. The ‘pooling’ of images on the Internet clusters images based on their digital metadata.

Penelope Umbrico’s *Suns from the Internet* (2006-ongoing) is a collection of images from *Flickr*, using the search term ‘sunset’. The artist describes the work as addressing the unifying experience of the sun. The collection produces a meta-image, which speaks of the nature of our relationship to the sun, being a singular relationship through a multitude of experiences. The metadata #tag ‘sunset’ is the connection used to assembled these images. When they are placed next to each other the impression is a quality or aesthetic of ‘sunset’, while the diversity of the images produces a kind of texture of subtle differences across the range of recordings of this event. Patterns and relationships between multitudes of photographic glimpses produce a new image – a gestalt impression of the whole and the dynamics that form it.

Penelope Umbrico *Suns from the Internet* (Partial), 2006-ongoing
This work has been installed as a gallery piece and was also published as a screen saver
[source: http://www.penelopeumbrico.net/Suns/Suns_Index.html]

The concept of gestalt – a coalescence of impression that remains open – is a key aspect of my holographic images. This openness of the perceptual process allows for a dynamic shifting to the

resolved form. Inhabiting a multiple-perspective act of looking allows for this dynamic through the shift in reference, resulting in a complex spatiality and/or an extension of embodied sensibility. The viewing body can then be considered as a site where the virtual or 'meta' can be accessed and unfolded.
In *Chapter 1*, I considered the player in a game of *snakes–and–ladders* moving over the board where each position has a different potential diagram of movement. While the player moves across the board with a 'gods' eye view' the chance of rolling the dice means that its difficult to conceptulise the different possible paths beyond one or two rolls. The viewer of a hologram however is located at the point of unfolding and can move around to explore the construction of visuo-spatial relationships. To conceptualise an overall shaping or diagrammatic structure the viewer needs to be able to reference these shifting visual relationships into a holographic scene. I attempt to extend, dislocate and reveal the viewer's perspective so that they can obtain a sense of both the overall structure of multiple viewpoints and a sense of the virtual dynamics and shaping of moving between them.

By highlighting the process of folding through a hyperlinked structure that can be engaged with, I aim to bring forward an awareness of perceptual shaping or a conceptualisation of space. Psychological and conceptual relationships have a qualitative dimensionality, connections of 'likeness' and patterns. These are mapped in my holographic images as a superimposition – a structured hyperlink that hinges the multiple perspective-views. The multiple and moving views that forms the holographic scene also shapes the relationship of potential and virtual movement to the physical action of exploring the scene.

The structural relations generated by using the photographer as a mimetic actor of looking allows for a scene that simultaneously looks out from a hinged position and is connected by points of attention. The holographic scene then can be thought of as an interdependent diagram of movements, tendencies, and attention – an enfolding that plays out (and in) through the act of viewing.

The encoded movement of the recording and the suggested choreography of viewing are linked spatial diagrams. I will now turn to several holographic compositions in which the act of recording was a highly structured choreography.

D : Looking through a folded holographic view

D1 : 'we're all looking'

In May 2007 I organised the event *'we're all looking'*, to capture photographs in choreographed formations for a series of holographic compositions. From an open social media invitation 26 participants came with their digital cameras for the afternoon of group photography around Melbourne. Together we photographed a number of sites, using the architecture and urban landscape to position our bodies and direct the camera view. I wanted to see how my techniques of capturing could be extended to a group of people. So that rather than tracing visuo-spatial patterns in the perspective of a single mobile protagonist, I sought for places that could structure a simultaneous gathering of multiple perspectives that would have a visual similarity. The project was designed as a way of creating an architecture of visual perspective, a spatial diagram from hinging different but related views.

Armed with digital cameras, the participants were both the subject(s) and formed the capturing geometry of the holographic images. The 26 photographers were positioned in particular geometrical formations abstracted from the urban surroundings. Both in the act of capturing and the compiling of the photographs, the images were aligned on the participants. The various figures then blended together, becoming a unified visual anchor to the holographic scene. In contrast to the holograms that use the photographers shadow as an incomplete presence that the viewer can fill, the *'we're all looking'* images bombard the viewer with images of different people. The connection is then not to a single body but a type of shared embodiment – unified by the visual act. The structure of and relationship between the superimposed perspectives – the folded composition structure – is then referenced to the multiple

viewing locations of the photographers. While many of my projects considered the holographic impression from a moving view, the *'we're all looking'* mappings produced an animate virtual movement by structuring different, and often simultaneous, perspectives.

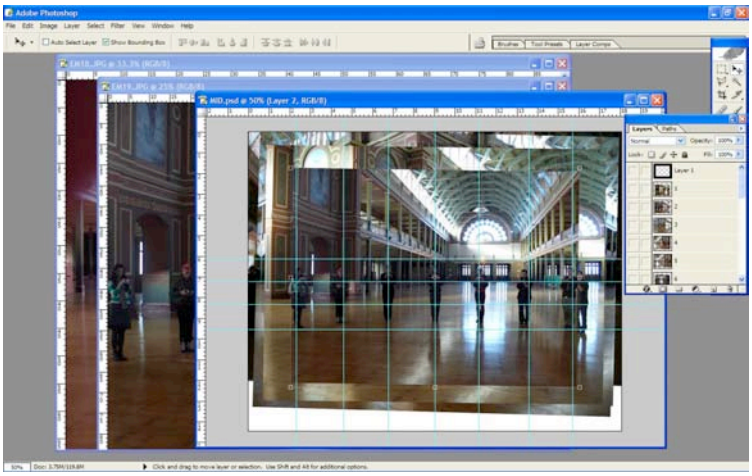
Museum Reflections, 2007. Captured along the front of the Melbourne Museum[138]
Reflection 200-frame multiplex hologram, 30 x 30 cm
Left: Giving instructions for shooting. Centre: One of the source photographs
Right: Exhibited at *'Beyond the Window'*, 2008

D2 : Exhibition Circle

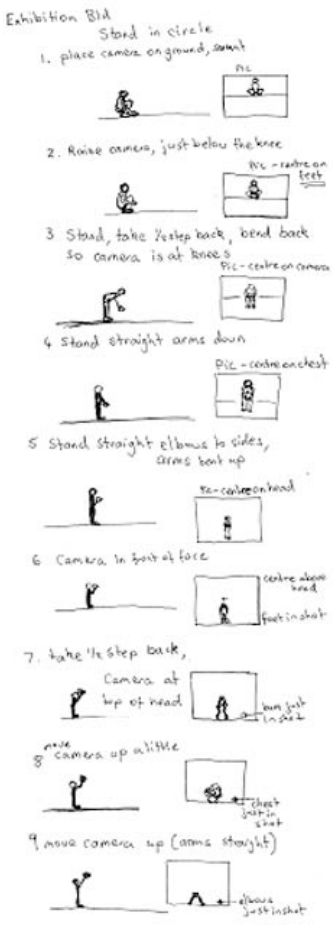
Four photographs of the hologram *Exhibition Circle*, 2007
Open aperture transmission, 1800-frame multiplex hologram, 30 x 40 cm

Exhibition Circle captured the interior space of the Royal Exhibition Building, in Melbourne, composed by the photographers forming a circle under the central dome. While this circle reflected the architecture, it was not a position that the photographers could find from the architecture alone, nor was the dome part of their field of view. To make the circle I had brought a piece of string to trace out the circumference, but it was not very effective. So we held hands and spread out, shouting instructions to the people opposite "a little more towards ___". Each photographer positioned their camera based on a given body position and directed the camera to a part of the opposite photographer's body (pictogram on next page). We took a photograph simultaneously in nine different positions. These positions marked out a movement from crouching with the camera on the ground to stretching the camera up above the head. The photographer's action of standing up is simultaneously an action of directing the camera upwards. Moving side-to-side the viewer sees through 360-degrees around the circle, while moving up and down they see the perspective from nine different positions, their view changes with a visual mirroring of this movement. The blended photographers looking back at the viewer from a position that will subsequently be looked through.

[138] This is the same place that was photographed for *Museum Reflection* in 2006, see section B2.



Above: Screenshot of aligning images to the photographers with *Photoshop*



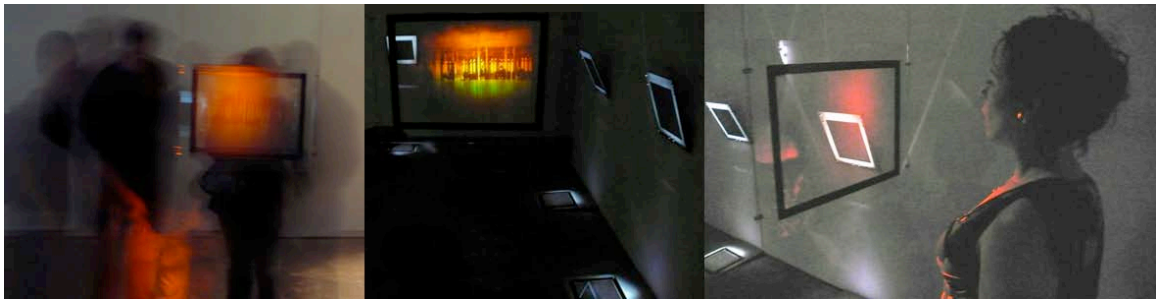
Right: Pictogram plan for the shooting of *Exhibition Circle,* 2007
Stick figures show the nine body positions,
with frame on right showing how to align the camera view

The geometry of the *Exhibition Circle* capture resembles a 360-degree camera array. The centre volume however is empty so that rather than producing a surrounding perspective, the view is directed through this space. The visual superimposing of these views folds the space into a holographic scene.

This holographic scene uses a structure of recording to reveal an aesthetic of the interior architectural space. There is no particular location – what is indicated is a system of relations. A sense of spatially is formed from a layering of perspectival volumes. The walls receding from each view are layered so that they intersect each other yet suggest an architectural cavity. Due to the superimposition of the walls they no longer appear solid but weave into a transparent, diagrammatic containment of space. Moholoy-Nagy describes the transparent quality of superimposing images in relation to photography:

> "The transparent quality of the superimpositions often suggest a transparency of content as well, revealing unnoticed structural qualities in the object"[139].

This transparency of superimposed spaces in *Exhibition Circle* combined with the Victorian detail creates an aesthetic of iron lacework, a voluminous form that weaves through space. There is a distinctive 19th century style and many people assume that the image is of a railway station, probably the most familiar contemporary experience of large interior spaces from this era.



Installation of *Exhibition Circle* at *'Beyond the Window'*
Bus gallery, Melbourne, 2008

[139] Moholoy-Nagy (1947), p210.

In contrast to the other works in the series, *Exhibition Circle* was installed so that viewers stand, as the image contains both horizontal and vertical parallax. The image field slopes upwards from the hologram so that as the viewer approaches they move through the different vertical image channels, playing the animation of the different positions and corresponding change of perspective. Moving up and down the viewer can also play this animation, stretching and bending like the photographers.

The hologram diagrams a relationship between the photographer and architecture. The symmetry of the view folds the large interior space to reveal dynamic aesthetic qualities. These qualities are both indicative of the place and co-emergent with the recording/composition/viewing process.

D3 : The act of the image – Figure8 on Drummond Street

Figure8 on Drummond Street is another hologram produced as part of the '*we're all looking'* project. This image captures a transformation between different types of movement. For this holographic image the photographers were positioned in a figure *'∞'* around two trees on a street of Melbourne terrace houses. The first shot was taken simultaneously of the back of the person in front, then starting at the centre of the figure, each photographer turned around taking a photograph of the face and camera of the person behind them, creating a dominos-action of capturing.

Capturing *Figure8 on Drummond Street,* 2007

Left to right: Diagram used to plan the formation. One of the photographs. A compiled source image, in which the missing parts show the images that are about to be seen if moving left to right infront of the hologram.

In *Figure8 on Drummond Street,* it is the act of photographing – a shared action – that hinges the viewer to the scene. The holographic image appears as 'snapshots' – a virtual blinking that compresses the scene through the action of capturing, while the movement through the perspectives feels continuous. The individual photographs are mundane and aesthetically awkward, but the dynamic of the visual space and the resonant urban forms that emerge from the spatial montage, make the holographic image compelling.

As the viewer of the hologram moves past the image their perspective seems to hop through each of the photographers, seeing them ⇔ seeing what their camera saw. The jumps of visual perspective encode a change of position that fuses into a virtual movement. The visual perspective moves through the twisted figure *'∞'* loop, yet the viewer is moving from side to side, while the effect of seeing through the sequence of perspectives is that of zooming into and out of the image. The virtual movement is diagrammatically coupled into the viewer's sense of physical movement opening up a complex experience of motion.

At the centre of the image, the visual movement changes direction while the viewer continues to move – this flip is like a momentary feeling of 'weightlessness', in that direction loses its vectorial structuring. The affect of weightlessness is similar to the sense of being lost in that there is a bodily sense of losing definition due to a conflict of impingent forces and perceptions. The feeling of zooming in and out and the momentary suspension in the flip, emerge from the cross-referencing between the encoded

movement-figure and physical action of the viewer. In the next chapter, I consider these affects of shifting forces and suspension in relation to the installation design.

Photograph of the hologram *Figure8 on Drummond Street*, 2007
Reflection 200-frame multiplex hologram, 30 x 30 cm

In all of the *'we're all looking'* compositions, aligning the images with respect to the photographers causes the figures to blend together and produce a unified complex view. The choreographed formations set up a multi-perspective architectural inhabitation that was reduced by the selective and commonly anchored photographic view. The large spaces that were photographed are compressed by this hinging into a diagram of visuo-spatial relationships. The dynamic spatiality and virtual movement of each holographic scene was produced from the patterns that emerged between the linked perspectives. The photographer's physical position; their directing of the camera and the camera's imaging optics all influencing the dynamics and shaping of the scene.

E : Looking into and connecting with the holographic scene

In viewing a holographic scene that is hinged to a recording body, the visual image becomes a medium for connecting to this act of recording. The appearance of the camera in the image creates a folding operation – establishing a reference point within the scene that hinges the locations from which the viewer looks at the scene. As such, there is a simultaneous sense of being at the 'core'[140] of a dynamic scene and standing outside it, reading its diagram of structural shaping.

The holograms that comprise *'we're all looking'* and *'Explorations of the holographic gaze'* visually depict the photographic act to emphasise the construction of the multiple-perspective scene. The viewer knows that they are looking into an image (and photographer into a camera) yet this external perspective is incorporated into an understanding of body and agency. By setting up a viewing structure tied to a recording of that view, there is both a looking at and looking with the holographic image.

There are two agents of looking in my images that make up a holographic gaze: my composition of the holographic image, which begins with the act of photography; and the viewer who can move around the hologram. The positioning and replaying of the camera view establishes a structural context between these two embodied gazes – both sites of an (un)folding experience. The viewer uses the photographer

[140] Art historian Sherwin Simmons describes the affect of Ernst Ludwig Kirchner's expressionist paintings:

> "Things became stages of lived experience, and now they no longer lay as distanced forms before the eyes, but acted as forces of lived experience. … One no longer stood in front observing them naturalistically, rather the sensation is that things encircle one, and one lives and operates at their core."

Simmons (2004), p273. Referencing: *Die Kunst des 20. Jahrhunderts*, Berlin, 1926, p138-9.

as a reflexive ‘through the looking glass’ avatar whose body and movements extend their potential to unfold the scene. This reflexive protagonist guides attention into a spatial diagram, enhancing particular connections to shape the experience. My holographic images distill and transmit a shaped and directed gaze, so while the body of the viewer and photographer never physically meet they share aspects of an experience of looking. The recorded perspective of the holographic scene extends the embodied view, which then incorporates the possibilities of virtual movement and dynamic space.

The reflexive act of looking that is established with my holographic image installations produces a shaping through a force of attention. Drawing on the experience of being lost and located, the holographic view disorients, extends, and re-congeals the sense of space. There is a physical attraction and propulsion through the structuring of a referenced gaze. The navigation of the holographic view reveals a perceptual relationship to place, suggesting that the activity of looking is not neutral, but shapes experience.

My holographic compositions work with forces within and between acts of looking. I am interested in the way that a ‘shaping’ by perception can be carried through the image composition – from the act of capturing to the viewer’s experience of looking. As viewing the hologram requires movement, and this movement is coupled to the view, I aim to generate a complex experience of motion and spatiality. As I consider this complex sense of location to be implicitly a part of everyday perceptions of place – where knowledge as well as physical and physiological tendencies shape our sense of movement, orientation and location – my holograms are not trying to create a new kind of experience, but to draw-out and amplify perceptual tendencies embedded in our sense of place and location.

How these compositional acts can be extended and amplified through the design of installations is the subject of the next chapter.

Chapter 3 – In and through the *Paternoster*

An understanding of how hinged diagrams and spatial dynamics could be encoded into a multiplexed holographic scene developed through experimenting with compositional arrangements. From observing people looking at the holograms and thinking about my own viewing, I began to consider the viewer's movement in relation to the movement of the recorded scene. For example, the installations of the hologram *Paternoster* were designed to encourage a vertical motion, animating the vertiginous holographic scene. These installations emphasised how the viewer's physical movement is an active part of perceiving the scene.

A : A vertiginous experience

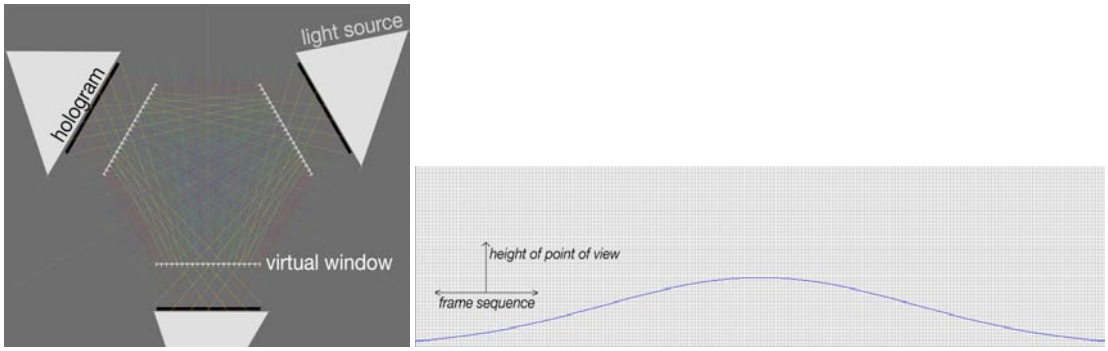
A1 : Evoking internal and external dimensions

The hologram allows a 'peering into and around' another space. This experience reminds me of looking through a keyhole or from an aeroplane because the viewing window is much smaller than both the space in which the body is situated and the space beyond the window. This is particularly apparent when looking into a laser-viewable transmission hologram[141] as the holographic image can be very deep. As such, these images can encourage a sense of an 'over there' that is very distinct from 'here', where my body is. For the holographic composition to provoke a reflective understanding it must trigger an awareness of the viewer's own sense of an activity of perception. One technique I considered was that of a proprioceptive shift, which occurs when virtual movement becomes momentarily de-coupled from physical movement. As discussed in *Chapter 1*, something similar occurs in the experience of being lost before regaining a sense of orientation. I compared this experience to the moment of suspension created in the hologram *Figure8 on Drummond street* [Ch2.D3]. At the point of intersection in the figure '8' of this composition, the viewer can navigate a virtual 'going around a corner' while physically moving in a continuous direction. These are two examples of 'affects' in which awareness is brought to the usually unconscious cross-referencing of perception. The multiplex hologram has only a limited capacity within the viewing field to establish and play on such couplings, so I considered how installation design could heighten both the felt coupling and stretch apart of perceptual referencing.

As part of my investigation on how to suggest a physical body that is animating the holographic scene, I became interested in the visual rhythm of walking. The small rise and fall in perspective[142] with each step was something I wanted to evoke to suggest the action of stepping. *Stepping through Branches*, (2006/2007) was a design for a holographic image installation to create a sense of vertical movement through the change of perspective height in the horizontal animation sequence. The three holograms were to be arranged in an open triangle around the viewer. Each image was rendered with identical geometry to suggest a coinciding rise of perspective in the centre of the triangle. By using multiple holograms around the viewer, I attempted to show how this suggested dimension of movement was linked to the physical viewing space. My plan was to include experiments with a gradient spotlight to illuminate the suggested virtual hill.

[141] Further description in *Appendix : Chapter 0, The laser-viewable hologram* and [Ch2. A1].

[142] People have told me that I had a distinctive lope to my walk. This lopping exaggerates the up-down action I experience with each step.

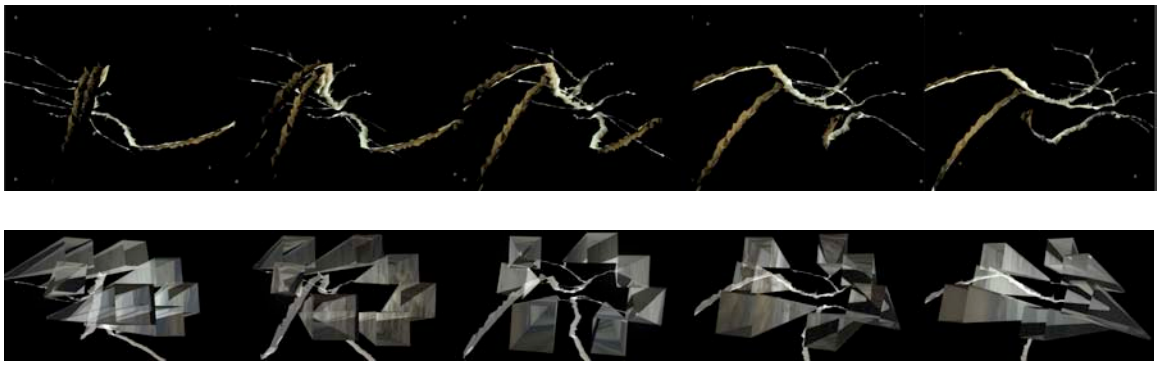


Stepping through Branches, 2006/2007

Left: Diagram of positions for three holograms, Birds eye view. Coloured lines show the frames that divide up the horizontal viewing fields, red being the ends of each image sequence and blue the centre.

Right: Graph of camera path. I created the camera path by observing my vertical motion while stepping, the virtual camera's Y-translation = camera1.translateY=20*exp(-((frame-100)*(frame-100))/4000)

I experimented with 3-d renderings of branches that were positioned on a horizontal plane around the virtual camera/viewer's eye level so their elongated form would exaggerate the shift of camera/view position.



Stepping through Branches, 2006/2007

Five frames of the branches rendered with the camera path graphed above. I added square pyramid extrusions to points on the branch in the lower sequence to extenuate the change of point of view.

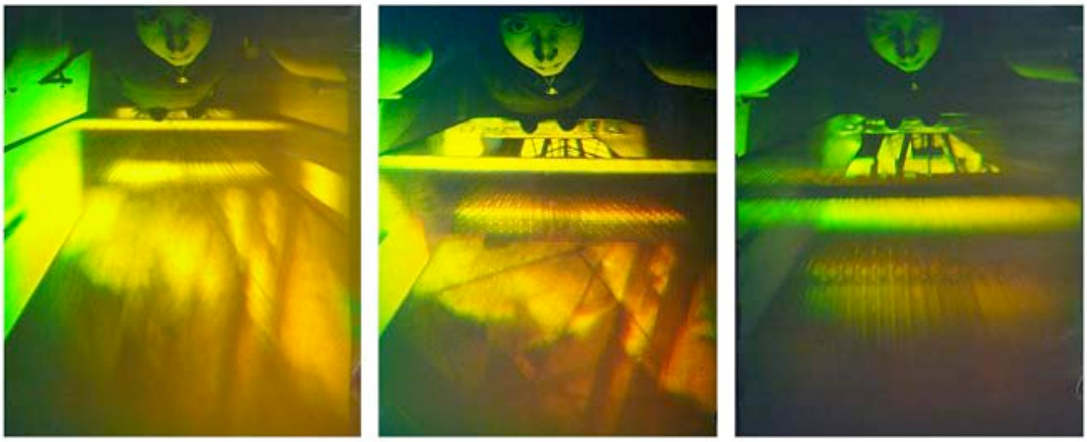
Though the *Stepping through Branches* holograms were never printed,[143] it influenced the direction of my research to consider the physical unfolding of implied movements of visual perspective. However, as I could not print these large format holograms, some questions remained: would people physically respond by bending as if to counter the visual shift in perspective or by stretching to match the shift in perspective; and would this shift cause an internal sensation, be ascribed as an animation of the visual scene, or felt as a warping of the viewing space?

An important aspect of my design for the *Stepping through Branches* installation was the initial question of how to depict the embodiment of someone else's step. My reason for using three holograms was to establish a visual cross-referencing and suggest a virtual dimension within the viewing space – to encode a virtual step into the space. However, in considering the perceptual experience through these explorations, I realised it was not about making a virtual hill but establishing a perceptual quality of 'rising'. The possibility that I was beginning to develop was how the spatial animation could unfold a virtual shaping or movement and how this became an active part of encountering the holographic scene.

[143] I had a residency at the Korean National University of Arts to print this hologram but there were a number of problems with the printing system, which we subsequently rebuilt.

A2 : In the paternoster

A paternoster is an open-faced elevator that continuously moves while passengers step on and off at different floors. My experience of riding in a paternoster resonated with my thoughts about the experience of viewing a hologram installation: a feeling of being on a precipice between two systems of space. As a passenger in the paternoster, moving past floor after floor, my sense of confinement was heightened. This feeling, in turn, amplified my sense of peering through a boundary into what seemed like another world.

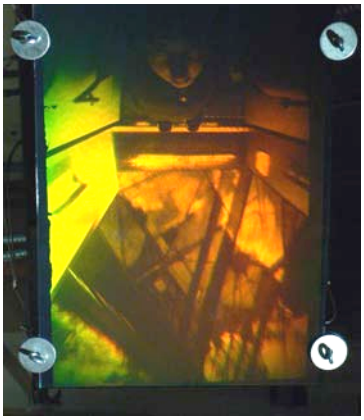


Photographs of the hologram *Paternoster*, 2006
Reflection 200-frame multiplex hologram, 40 x 30 cm

The hologram *Paternoster* was produced at the end of a residency at the Academy of Media Arts (KHM), Cologne in 2006, where I had been printing a series of animate landscape holograms. *Paternoster* was different from the landscapes – the composition engaged with the sensation of the viewing encounter.

Collage of photographs taken in the paternoster, Cologne, 2006

The holographic scene encapsulated a schema of the experience: a representation of the relationships between the physical, the imaginative and the sensory. The grounding visual space is the point perspective into the 'box-shelf' of the paternoster. The viewer is placed as a passenger within the paternoster by being anchored to this reference frame. Within this space, the protagonist holds the camera with outstretched arms that seem to push her body into the virtual volume behind the hologram's surface. The hologram only has vertical parallax, but the virtual volume of the elevator-box is established by 'point' perspective and reinforced by the changing size of the passing ledges.



Paternoster, 2006
Left: One frame of the animation. Right: Installed on a ceiling '*into the holographic landscape'*, 2006
The image was composed with the orientation shown on left, and then rotated when installed on the ceiling so that photographer's body visually mirrors the viewer.

The three floors that the paternoster moves through are replaced by expansive landscapes. The choice of imagery, as well as my application of vertical parallax and zooming, visually suggests that each of these landscapes is a large open space. The elevator box is a reference-frame that allows for local connection to each of the vast landscapes, which occupy the same space yet are delineated by different window openings.

The suggested co-existence of expansive spaces works in a way similar to MC Escher's *Another World* (1947), in which a strong grounding visual-element sets up a virtual reference frame. The bird and horn in this image act as guides, belonging to both the perspective of the grounding space and the orientation of each space through the archways. The two windowed views onto each 'space-scape' establishes them as having a presence independent of the framing arched windows. There is a self-referencing between each pair of views, differentiated by the bird and horn – that also connect each of these perspectives to a singular located viewing position.

M.C. Escher, *Other World* (also know as *Other World*), 1947
Woodcut, 32 x 26 cm. [source: http://en.wikipedia.org/wiki/File:Another_World.jpg]

Like the columned archways of *Another World,* the elevator-box in *Paternoster* grounds the multiple landscapes through their connection to a framing space. Visually exploring the linked spaces creates a conceptual super-positioning. The multiplistic topography I suggest with *Paternoster* also has an analogous structure to the multiplexed hologram. The optical and visual structure of the holographic scene consists of virtual windows where what is seen depends on the position from which it is viewed. Both of these 'space barriers' of virtual windows divide up the relationship of position to the view.
As *Paternoster* is vertically animated, my installations of this work are designed to encourage the viewer to move through the animation, such as rocking back-and-forth while looking up. The movement of viewing *Paternoster* is exaggerated by the virtual motion through the elevator shaft. A feeling of rising or falling emerges with the perception of visual movement that amplifies the viewer's own sense of movement, gravity and balance.

Paternoster was created for '*Ex tempore*'[144] – an exhibition that explored 'space out of time' – as part of The Stairwell Project curated by Danielle Evans. The placement of the *Paternoster* hologram in this exhibition meant most viewers descended through the image as they walked forwards down the stairs. The piece was small in comparison to a path of multiple steps, which emphasised how an extensive scene can be unfolded from a holographic window.

Installation of *Paternoster* and viewer on the stairs
'*Ex tempore*', Melbourne, 2006

There is a 'scaling' to the amplification of virtual movement as the speed of animation in relation to physical movement is dependant on distance to the image. The illumination geometry of the hologram and architecture of the stairs resulted in the viewer being quite far from the hologram. This stretched out the animation, slowing it down, changing the pace to a suspended action closer to floating (rather than a sense of falling if the animation is moved through quickly). Even so, I was a little apprehensive that this installation might cause people to lose balance or trip over on the stairs. But as the hologram was small compared to the visual field, it did not override the visuo-spatial navigation of the stairs. However it was common to see viewers holding the wall or railing as they traversed the stairs while looking into the holographic image.

Viewer looking at a *Paternoster* in the stairwell
'Ex tempore', 2006

[144] '*Ex tempore*', The Stairwell Project, Melbourne, 20 November – 4 December 2006.

Installation of *Paternoster* (edition 2/6), 2006
(Right image also shows *Slide* in the foreground) at *'Explorations of the holographic gaze'*, 2010

In 2006, at the Center for the Holographic Arts, New York[145] and in 2010 at Gallery 175, Seoul[146], I installed *Paternoster* angled between the wall and the ceiling. Both galleries had fairly low ceilings, meaning the viewer was quite close to the hologram. Most viewers tended to stand or kneel underneath the hologram and then lean back to play the animation. In these cases the viewer's physical movement is amplified by the visually-suggested speed of the passing floors.

Leaning backwards is unsettling. As the body submits to gravity, a strong proprioceptive alarm is produced. The body wants to be in control, correcting balance so as not to fall. A flicking of the protagonist's gaze to check their surroundings prompts the viewer to check their own physicality, intensifying a vertiginous visceral feeling.

Viewers moving back and forth underneath the hologram *Paternoster*
'into the holographic landscape', Center for the Holographic Arts, New York, 2006

Paternoster was the first time that I explicitly explored vertical movement in a composition and found that slight movements, particularly where balance is involved, could evoke strong body awareness. In cross-referencing proprioception to visual(virtual) movement, an affective experience was evoked through an observation coupled with a felt intensity.

[145] '*into the holographic landscape',* 2006.
[146] *'Explorations of the holographic gaze'*, 2010.

A3 : Gravity as a directional reference and the sensitivity to this orientation

Viewing *Paternoster* induces an awareness of gravity. The force of gravity creates a vectorial structuring to space; it sets up a directionality. We feel this directionality. 'Pushing' up is radically different from 'falling' down. Balance, control and effort all play a role in our experience of the gravitational field. In situations where balance is critical there is an increased sensitivity – a heightened awareness of proprioception and the felt force of gravity. *Paternoster* made it clear that a sense of 'shaping' – from the spatial dynamics of the holographic scene – can be intensified by a cross-referencing with physical sensibility.

The importance of balance and gravity in the experience of *Paternoster* also played a defining role in the holograms *On the Roof* and *This morning on the balcony reminded me of a dream,* which I installed parallel to the ceiling above viewers for the exhibition '*Explorations of the holographic gaze'*. *On the Roof* was discussed in *Chapter 2* in terms of the exaggerated vertigo I experienced looking through the camera lens [Ch2.C1]. During the image capture I became intensely aware of my balance because of the distorted perspective of my view. I tried to activate the forces at work during the act of image capture in the viewer's experience of the holographic image installation.

Viewers leaning back to look at holograms
'*Explorations of the holographic gaze',* 2010

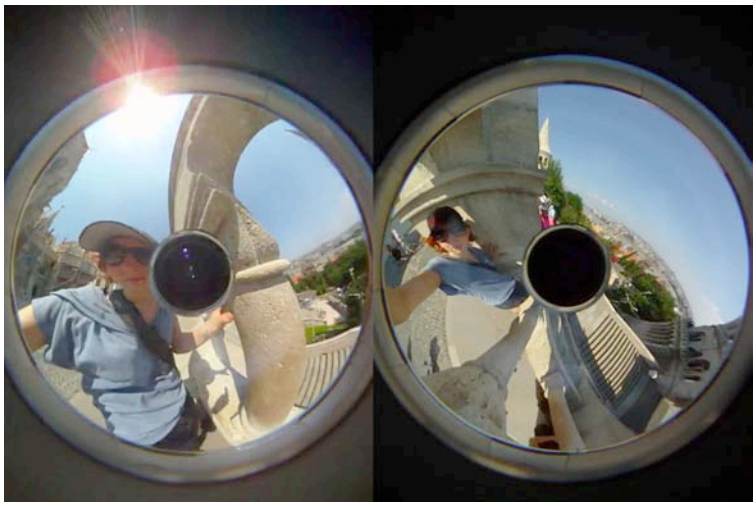
The viewer standing and looking up feels gravity pull in every direction as they move to see more of the image. As one viewer described, "you lean backwards and realise there is gravity".[147]

Exploring these scenes I noticed my sense of gravity was intensified in the head when leaning back, the shoulders when leaning to the side and the chest when leaning forward. The vertiginous sense made me brace for impact. I was hyper-aware of the body parts that were most at risk; the possibility of falling caused a localised sensitivity to the gravitational field.

[147] One on the KNUA holography students visiting the exhibition described her experience of looking at the hologram and associated the vertiginous sense of the work to the feeling of looking up at me – I was a good foot taller than her. Seoul, 16 November 2010, quoted as remembered.

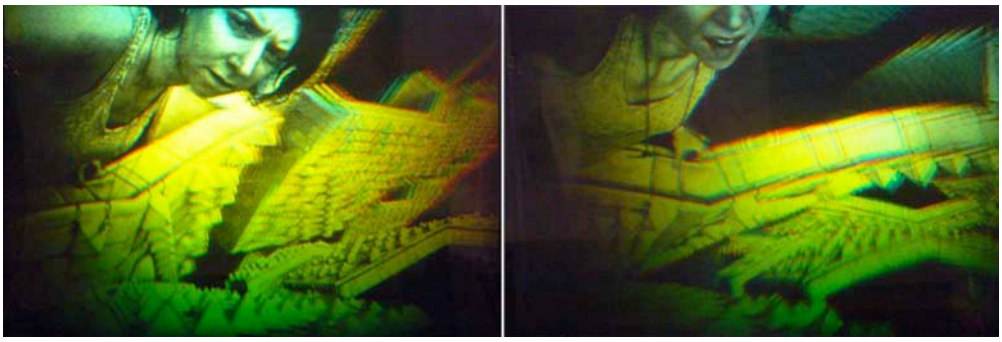
Left: Diagram of felt and visual forces. Centre: Viewer leaning back to look at *On the Roof*
Right: Two overlaid photographs of viewer looking at *On the Roof*
'Explorations of the holographic gaze', 2010

When capturing images I also experience a localisation of awareness – my attention is focused through both my movement and the camera view, which connects at certain points. An example of this is my hand on the rail of a staircase; this is both seen through the lens and felt, producing a cross-reference of location within the extended perception. These contact points, like the reflection and shadow of the photographer, establish a structure that implies a human presence within the formation of the visual scene.



Holding a column while moving around it with a camera at the Halászbástya, Budapest, 2010

The hologram *This morning on the balcony reminded me of a dream* comprises two video sequences with different lines of movement producing a cavernous depth I poetically describe as 'teeth attempting to swallow me'. The video was shot leaning out over a balcony. In holding this edge, I was physically connected to it while looking up into the camera so as to see into the depth below.



Two photographs of the hologram *This morning on the balcony reminded me of a dream,* 2010
Achromatic transmission 200-frame multiplex hologram, 30 x 40 cm

Across the hologram my expression of apprehension directed at the viewer, gives way to a look of questioning. While making *This morning on the balcony reminded me of a dream*[148] I became aware of how – like my imagination shaping the dream-landscape – looking through the camera could heighten a sense of the vertiginous.

Viewing *On the Roof* or *This morning on the balcony reminded me of a dream* produces a visceral sense of vertiginous motion while observing the protagonist experience a similar sensation.

In these two holographic compositions, there is also a sense of being suspended due to a mirroring of forces. In both of these images the protagonist is looking back at the viewer and holding their view. It is as if these 'lookings' are pulling on each other. In looking up at the hologram, the virtual force encoded in the image mirrors the proprioceptive intensity of balance. The viewer is aware of gravity pulling downward, while the visual-protagonist is concerned with falling 'up' away from the surface. The curiosity of looking, as well as desire for control, are pulled empathetically towards the protagonist.

This morning on the balcony reminded me of a dream installed on the ceiling
'Explorations of the holographic gaze', 2010

[148] In the dream I had climbed out a window and onto a ledge of a building with a cliff-like façade. As I shuffled along this ledge it became narrower as I became increasing aware that I could fall.

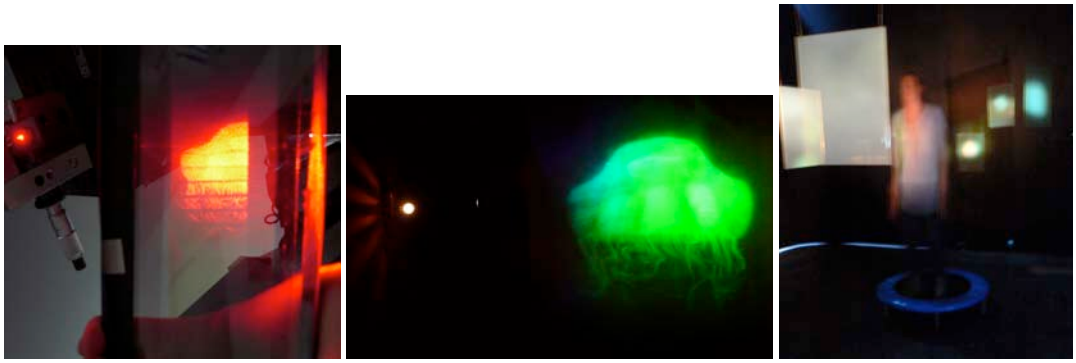
In *New Philosophy for New Media*, Mark Hansen suggests that vision emerges from physical experience: "those embodied capacities–proprioception and tactility–from which vision might be said to emerge".[149] My compositions also rely on the inverse process, in that a sense of physical experience is evoked by the visual holographic image. The suggestion of touch is achieved in a similar way to a protagonist's gaze. Through eye contact with the viewer a visible presence is established; and then extended to the virtual landscape by the depicted protagonist looking around the holographic scene. By looping sensation with the structured viewing there is a co-emergent establishment of vision and embodied perception.

By choreographing viewers to move in particular ways, installations of holograms can tap into an awareness of force and physicality. In this way, the movement encoded in multiplex holograms can act to cross-reference the visually implied and felt forces, such that they amplify one another. Vision taping into embodied perception and vice versa.

In the future I would like to install *This morning on the balcony reminded me of a dream* on a ledge or balcony so the viewer is next to a vertical drop and has a railing to hold while looking up[150]. The holding of the edge would create a physical mimetic reference to the scene. With my installation designs, I suggest that the spatial dependency of the multiplex holographic image not only allows for the reading of a dynamic scene, but that the physical viewing space becomes 'vectorised' by the image. The encounter of virtual forces pulls and pushes the viewer's sense of movement, reshaping their extended potential for action.

A4 : Jumping Jellyfish

In thinking about and discussing the difference between the sensations of being propelled upwards versus falling down, I noticed myself physically evoke a movement resembling that of a jellyfish. This inspired the design of *Jumping Jellyfish* (2008/9), a project which explored how proprioception (the sense of internal bodily shifts) could play a role in animating holographic images.



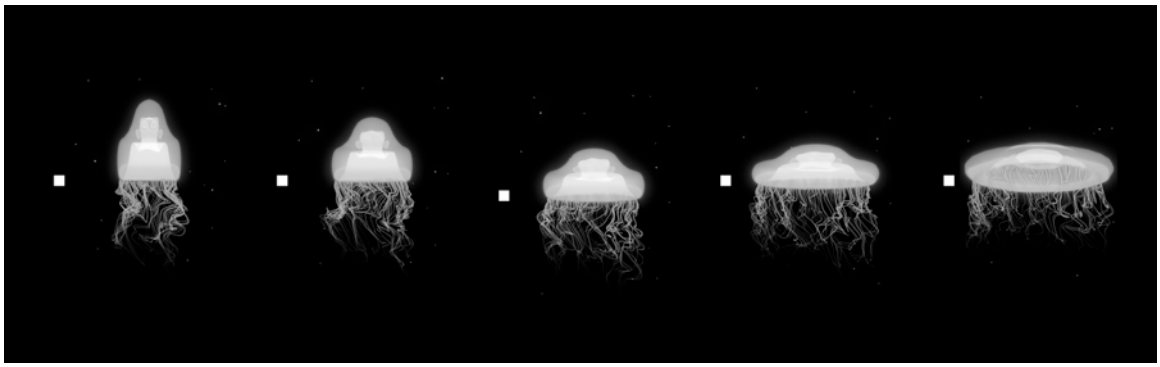
Jumping Jellyfish, holographic image installation, 2008/9
Left to right: Master multiplex hologram illuminated by a laser. Rainbow holographic print
Installation at '*Beyond Festival'*, ZKM | Centre for Art and Media Karlsruhe, 27–29 May 2011

The installation comprised five jellyfish holograms hung around a trampoline. The viewer jumps on the trampoline in order to see the movement in the *Jumping Jellyfish* holograms, such that the action of jumping is coupled with the vertically animated holograms of jellyfish. Into the master hologram I

[149] Hansen (2004), p100.

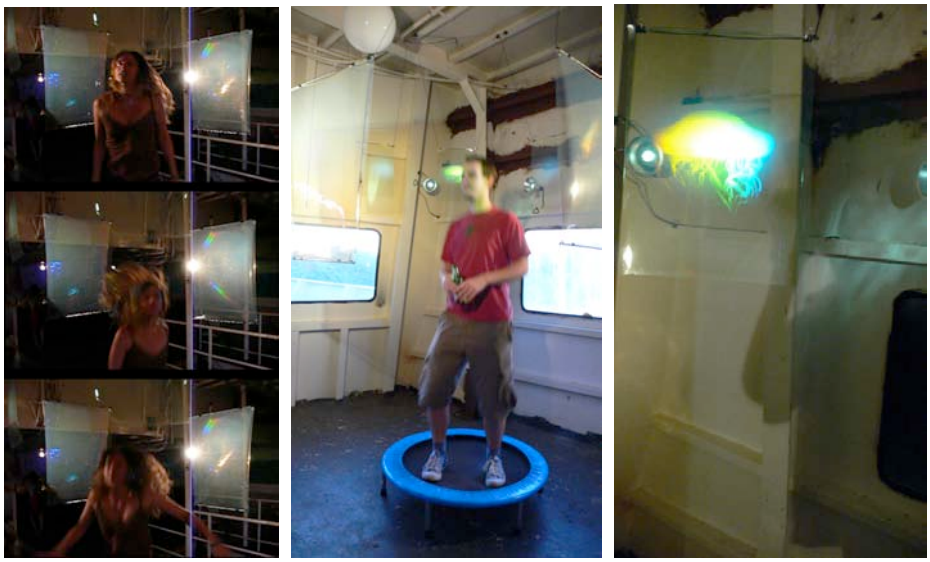
[150] For the exhibition *'The Emergent Holographic Scene'* I installed this work at the top of a stairwell, the viewer climbing up and then looking down into the scene. At *'The Art of Shaping Light'* the hologram was viewed by looking up with a stairwell leading up in front of the viewer (see images in *Appendix: Catalogue of Projects*).

recorded a vertical sequence of images of a computer-generated jellyfish[151] that 'blobbed'. The camera path had vertical parallax and was set to resemble the viewer's movement on the trampoline. The hologram's image-plane coincides with the centre of the jellyfish and a slight horizontal rotation over the sequence to suggests a voluminous form. I created bubbles surrounding the jellyfish but most were too small to see and do not contribute significantly to a sense of space, as had been anticipated. Several larger bubbles did however help accentuate the viewer's moving perspective.



Five frames of the digital image sequence used to make the *Jumping Jellyfish* master hologram
The white square is a registration mark to position each frame and is not transferred into the holographic print.

The coupling of movement helps give the holographic jellyfish a sense of animate 'blobbing' – as the viewer experiences a similar bodily sensation. Not only does one movement more-or-less correspond to the other, the jumping movement is an integral part of 'playing' the holographic animation. The viewer and jellyfish elongate to propel themselves upward and expand as they drop down. Participants feel their own 'squishy' parts as they watch a similar 'blobbing' in the jellyfish. While the spatial animation is recorded vertically, it is the animate horizontal expansion and contraction that creates a 'shared' sense of squishiness. The aim was for the visual to feed the physical (and vice versa) – to evoke an animated vitality[152] that is ascribed to the jellyfish, whose action is mimetically associated to the viewer's proprioception. Thus a physical-visual feedback loop is shaped by a sense of blobbing.



[151] To create the jellyfish I followed the Maya tutorial http://www.blackorb.com/3dtutorials/jellyfish.pdf adjusting parameters to get the effect I wanted.

[152] Vitality affects are described by Susan Langer in '*Feeling and Form'* (1953) and Daniel Stern in '*Forms of Vitality'* (2010). See also [Intro.4].

Photographs of the *Jumping Jellyfish* installation
'Brooklyn Pirate Art Show', Bushwick Boat, New York, 2009

In his essay *The Bleed* Massumi defines proprioception as the sensibility of muscles and ligaments that "folds tactility into the body".[153] He describes this folding as producing qualities to the relationship between the external 'exteroceptive' tactile sensibility and internal 'interoceptive' visceral sensibility. In *Jumping Jellyfish,* the proprioception of elongating and squishing with each jump is both visual and visceral. By sharing this action with the jellyfish, the folding of tactility into the body becomes conscious, somewhat amusing, or pleasurable. To some degree, this coupled movement encourages an extra awareness – a resonation – that amplifies the activity of the encounter.

Diagram from a discussion with my supervisor, Dr Pia Ednie-Brown, of what the installation 'does'. The arrows indicate the vertical animated sequence and viewer's movement that results in forces of expansion and compression, felt by the viewer and seen in the jellyfish. This causes a resonate sense of 'squishiness'.

On two occasions I observed viewers raise their arms above their head, as if they were plunging through water. I also noticed my own and other peoples' flopping arms, mimicking the 'blobbing' jellyfish in an attempt to propel each jump. The sense of 'blobbing' is projected onto the jellyfish by the viewer, while their felt sensations enable a sense of being a jellyfish to be adopted.

Photo sequence that one of my students took of me in the *Jumping Jellyfish* installation, *'Beyond Festival'*, 2011

The viewer and jellyfish enter into a partnered dance, a situation that Shaun Gallagher draws on to describe how neural mapping shows an extension of embodiment into visual surroundings, as visual elements are anchored to the moving body:

> "This extension of the body schema[154] into its surrounding environment is reflected in its neural representation. Not only do bimodal premotor, parietal, and putaminal neuronal areas that

[153] Massumi (2002), p58.

[154] Gallagher defines 'body schema' as distinct from 'body image' – "A *body image* consist of a system of perceptions, attitudes, and beliefs pertaining to one's own body. In contrast, a *body schema* is a system of sensory-motor capacities that function without awareness or the necessity of perceptual monitoring" [Gallagher (2005), p24]. In my work there is not such a strong distinction as I am attempting to produce an awareness of the body schema that draws on the body image, both playing a role in extended embodiment.

> represent a given limb or body area also respond to visual stimulation in the environmental space nearby, for some of these neurons the visual receptive field remains 'anchored' to the body part when it moves"[155].

Gallagher's observations suggest our visual referencing is not to a single located point in space, but that vision can be anchored to parts of the body. This implies bodily awareness has an active and fundamental role in visual experience. My flopping arms in the image sequence above are an observable gesture of adopting extended visual perception into the body and action.

The concept of an embodied visual consciousness is further supported by the physiologist/philosopher team O'Regan and Noë, who assert: "We propose that seeing is a way of acting"[156]. However simple this sounds, it is a radical shift from the accepted idea of visual perception being an internal representation of the external world. A number of empirical findings are used to develop their argument that visual consciousness is not a pictorial image within the brain, but vision is "a particular way of exploring the environment".[157] Following this, the hologram viewer is 'acting' when looking around the virtual holographic scene, while simultaneously negotiating physical space. The very movement of viewing a holographic scene entwines the exploration of the visual image into a bodily way of exploring the environment.

The trampoline for *Jumping Jellyfish* acts like an armature for the act of viewing; it positions the viewer and encourages a particular movement. In jumping on the trampoline while surrounded by the jellyfish holograms, the viewer becomes the focus of the installation. While the viewer jumps to animate these creatures, for all other spectators it is the hologram viewer who is animated. This sets up a performative aspect to how the installation works (and maybe a sense of self-consciousness on the part of the person being watched, jumping and feeling blobby). I have used the self-consciousness of unusual or awkward movement in a number of other installations to encourage an embodied awareness.

B : Enticing and structuring movement

B1 : The dance of holography

The concept that holograms encode a movement through space was compared to a projected diagram of dance steps by Bob de Marrais in 1981: "A hologram properly viewed is an excuse for TaiChi, requiring you to bob up and down, weave left and right, each artwork having its own implicit set (or sets) of 'Arthur Murray footprints'[158„159]. Through this research, I develop the implicit chorography of the viewer's movement into the composition of holographic scenes and design of their installation.

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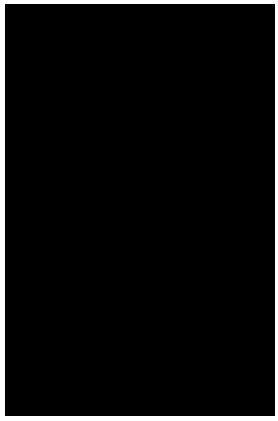
[155] Gallagher (2005), p27 – drawing on the work of Fogassi et al 1996, Grazino and Gross 1998 and Grazino et al 1994.

[156] O'Regan and Noë (2001), abstract.

[157] Ibid.

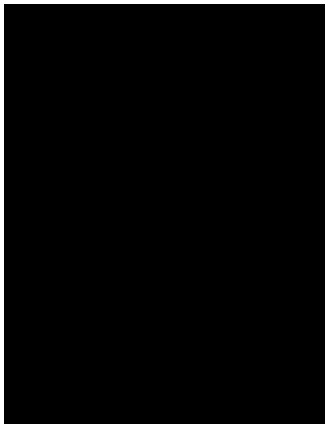
[158] The Arthur Murray School taught dance steps through mail-order diagrams of footprints.

[159] Bob de Marrais, p7, 1981. Quoted in the catalogue of the exhibition '*Flux* ' by Sam Moree, Museum of Holography, New York, 12 February – 9 May 1982.

Left: Sam Moree, drawing in the catalogue accompanied the exhibition '*Flux*', 1982, p8
Note: Sam Moree also described marking footprints on the ground in front of his hologram sculpture at the Centre Pompidou in 1985.[160]
Right: Arthur Murray, *How To Become A Good Dancer*, 1954
Image of two footprints, these would have been cut out an placed on the ground to guide dance moves
[source: http://www.quickerbuy.com/assets/photo/avatar/272966/how-to-become-a-good-dancer-arthur-murray-1954.jpg]

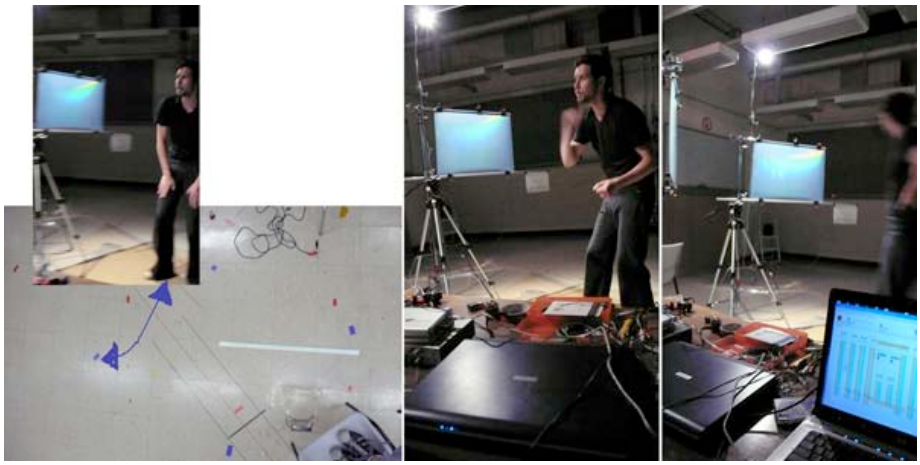
Getting viewers to actively move when engaging with a hologram is not always easy or simply given. An example where viewers did not move around was James Turrell's exhibition '*Large Holograms*'[161] in 2009. Turrell's holograms are mirror-backed[162] transmission images which are replayed by two different coloured light sources that produce two images of the recorded shape. They were framed and hung on the gallery wall like pictures. The beauty of these works is that as you move, the two coloured shapes merge and separate. Yet the installation did not provoke viewers to move. When I visited the exhibition, people just stood still in front of the works. I tried to create a gentle whirlpool of movement to stir the stagnant crowd – with limited success. The convention that artwork is viewed by standing motionless in front of it was ingrained in these viewers.

James Turrell*, 'Large Holograms',* 2009
Left: Stationary viewer with arms folded at opening. Photograph by Julius Schmiedel
Right: James Turrell, *Untitled (7ROA+B)*, 2007, "transmission light work", 186 x 100 cm
[source: www.thepacegallery.com]

[160] Private conversation with Sam Moree, Columbus, Ohio, 8 March 2012.
[161] James Turrell, '*Large Holograms*', PaceWildenstein gallery, New York City, 10 September – 17 October 2009.
[162] However, the holograms were processed so that they do not have a mirror-like quality.

In contemplating ways to 'move' viewers, I designed the installation *The Crossing* in collaboration with Philippe Pasquier, which comprised two large-format multiplexed holograms and a responsive soundscape. The concept was to use the responsive programming of the soundscape to encourage movement, engaging the viewer with the animated holographic images. Moving to view the holograms simultaneously reveals the spatial mapping of the programmed soundscape, establishing a feedback loop between the images, sound and viewer's action.



Designing the soundscape with Philippe Pasquier, Melbourne, 2007

The process of designing the soundscape required mapping out visual elements into the viewing space, and calibrating the sensor to detect the body at these distances. As the viewer moves they 'scratch'[163] the soundtrack and if they stop moving a small fragment of the sound repeats, which is unpleasant. Hence, responsive programming was designed to keep the viewer in motion. However, as the image below right shows, the ultra-sonic sound sensor was not hidden, and was sometimes played with separately to the images.

Martina Mrongovius and Philippe Pasquier*, The Crossing,* 2007/8
Installation of holograms with responsive soundscape using an ultra-sonic sensor with Pure Data programming
'Beyond the Window', Bus gallery, Melbourne, 2008

While the design process informed my practice the final results were problematic, particularly when more than one viewer was in the space, and also due to a lack of detail in the holographic images. One

[163] In the way that a DJ scratches a record.

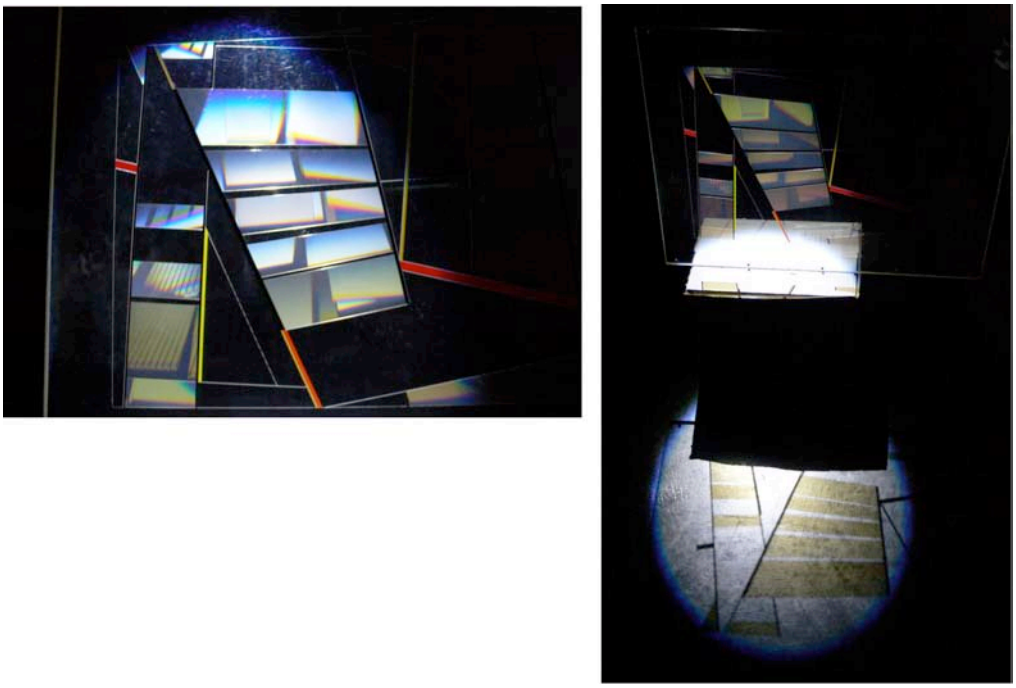
aspect that became very apparent with this work was the gestural interaction between viewers. The observation and mimicking of other viewers is something that occurs in many of my installations, and I half-jokingly described the holograms as only being devices for choreographing strange movements.

Video stills of viewers, moving together and communicating with each other while exploring *The Crossing 'Beyond the Window'*, 2008

B2 : Choreographing a dance with the hologram

Douglas Tyler, *Sector Vector: Study2,* 1977
Carbon Pencil on Paper, 52.8 x 76.2 cm. [source: Lipp and Zec (1985), p157]

The concept of encoding a movement diagram was the theme of Douglas Tyler's series that included *Urban Rhythm*: *Untitled No.1* (1984). These translucent acrylic panels have a constructivist-style tape diagram of lines with sections of holographic film that resemble footprints. At *'Mehr Licht',* Tyler presented a number of theses pieces with a diagram of the moon-walk; his work referenced the presence and movement implied by the footprints left during the first moon landing.



Douglas Tyler's *Urban Rhythm: Untitled No.1,* 1984

Acrylic panels with tape and white-light transmission hologram segments, 76 x 65 cm

Two photographs that I took at the ZKM | Media Library, Karlsruhe, 2011. The hologram is being replayed by an LED spotlight, which only illuminates part of the panel. The right image shows the projected diagram on the floor. When installed correctly the diagram would be larger and further from the hologram.

I was able to look at this work in the Media Library of the ZKM | Center for Art and Media Karlsruhe What struck me was the hologram sections infolded a geometry regarding where to position light, which in turn projects a shadow of the line diagram on the ground. The diagram of this stepping is then traced not only by the image, but projected where the viewer stands. The holographic footprints themselves were simply planes that receded from the surface, suggesting the tread of a moonboot but their encoded geometry ensured the projected diagram of steps.

Achim Lipp describes the experience of Tyler's installation in the *'Mehr Licht'* catalogue:

> "He reveals these traces as the visible remains of a choreographed movement. In this way he relieves the footprints in the moon's sand of their chance positioning. They are understood as dance-steps, as the single elements of a succession of movements that are defined by rhythm and energy and which rest within the framework of a whole. And if it is the moonboots that leave their impression behind in the sand, then it is the laserbeams of the holograms that leave their traces in the chemical emulsion of the film surface. This is what the observer has to pay attention to if wants [they want] to exhaust the full possibilities of holographic vision. With dance-steps he begins to follow the traces of light. And the parquet onto which the artist leads the observer starts to take on the dimensions of a dancefloor."[164]

Tyler's work explicitly proposes that holographic images can be used to choreograph movements of the viewer. I am using this property and combining it with a visual encoding of movement to produce a cross-referencing and drawing-out of bodily awareness. The emergent form of this cross-referencing enabling an affective encounter with the holographic scene.

[164] Lipp and Zec (1985), p153/154.

In comparison to the movement employed to capture a structure of perspectives, the installations require very little movement to see the scene. To fully realise the potential for the viewer to explore a holographic scene, I would want to produce multiple holograms and arrange these to create connections between the 'virtual windows'. The two panels of *The Crossing* were designed to create such a bridging, but due to the lack of detail, this did not work out as planned. The multiple tiles of *Are You Here*, *map of Here and There* and *Holoscape* (below) were another method of increasing the amount of movement required to animate the work.

Using three panels to extend the line of movement, *Holoscape*, 2009
A collaboration with Nick Normal. Three tiled three-colour transmission 200-frame multiplex holograms, 96 x 24 cm
Animated mapscape using upload photographs of the 2009 Conflux festival, installed at Conflux HQ, New York, 2010

For the most part, however, I developed single panel compositions. This was practical. It allowed me to experiment with a number of different composition techniques, and expand my design process. Single panel works – particularly in large installation spaces – raised the question of how to position the viewer to look through the virtual window of the hologram.

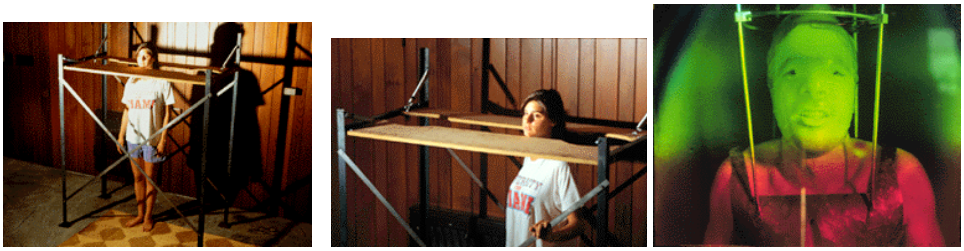
B3 : Positioning the viewer

To view a holographic print the viewer needs look through a virtual window determined by the size and position of the master hologram. The limited yet relational geometry of viewing white-light transmission holograms[165] was the basis of Stuart Rosenberg's experimentation leading to '*Viewing Apparatus'* (1991-3), in which relationships of viewer, light-source and hologram are materialised into a device.

[165] When a transmission hologram is illuminated by a white-light (broad spectrum) source, the colours (wavelengths) are diffracted through different angles depending on the wavelength, see also [*Appendix : Chapter 0 - Different kinds of holograms*]. White-light transmission holograms include rainbow holograms and holograms made with achromatic geometry.

Stuart Rosenberg, *'Viewing Apparatus'*, *View4*, *1993*
As Rosenberg produced this work at the Academy of Media Arts (KHM), Cologne
The geometry that spurred this series is the same for many of my pieces.
[source: http://www.holonet.khm.de/~s2/other/view4.html]

Rosenberg experimented with ways of restricting the viewer in the hologram's viewing field. The first iteration of the project *View1* looked something like a medieval torture device: the viewer inserted their head between two planks of scaffolding wood. The physically uncomfortable restriction was reflected in the hologram designed for the installation.

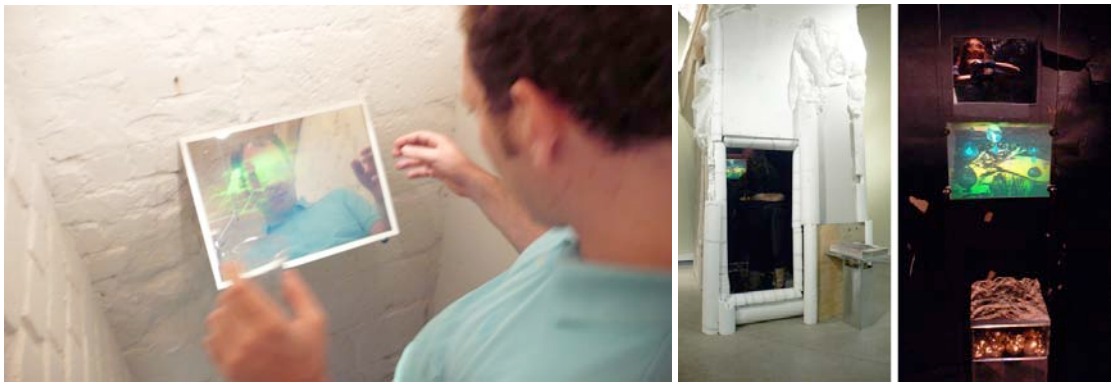


Stuart Rosenberg *'Viewing Apparatus'*, *View1* and hologram for installation, 1991
[source: http://www.holonet.khm.de/~s2/other/view1.html]

In *View4* and *View2,* the viewer is strapped into something resembling medical equipment or an early virtual-reality system. The device maintains the relational geometry of viewer, light-source and hologram. *View2* is a restrictive apparatus while presenting the geometric relationship between light, hologram and viewer as a system independent of the installation space.

Stuart Rosenberg's *'Viewing Apparatus'*, *View2*, 1992
[source: http://www.holonet.khm.de/~s2/other/view2.html]

In a number of my exhibitions I also confined the viewer by physically creating and seeking out narrow spaces to install the work. With these confinements I found that the viewer's sense of movement became exaggerated. There is a felt intensity to confined or restricted movement, as the spatial limitation evokes a bodily awareness.



Left: As well as being in a confined space the viewer was described feeling self-conscious by seeing himself move around as he viewed the mirror backed hologram.
Installation of mirror-backed transmission 200-frame multiplex hologram, *map to Heliosstrasse,* 2008
for the exhibition *'Postkarten aus der Tiefsee'* at the tiny gallery Funfzehnhabe, Cologne.

Centre and right: For the installation *Pasua Lama,* artist Ash Keating and I constructed an 'eski' to contain the hologram sculptural objects and control the lighting. The effect of being within this confined space amplified the sense of the left and right motion needed to play the hologram's animation.
Three-colour transmission 200-frame multiplex hologram, 30 x 40 cm in the installation *Pascua Lama*
Part of *'Trans Versa'*, Museo de Arte Contemporáneo, Santiago, Chile. 2006

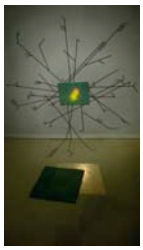
While spatial dependency of the holographic image allows for a structuring of view through space and therefore an animation linked to movement, it also poses a problem as viewers vary in height. One technique to maximize the vertical field of viewing can be achieved by angling the hologram so that viewers intersect the image at different heights depending on their distance from it. This also allows vertical animation to be activated as the viewer moves towards and away from the hologram.[166]

These achromatic recordings have a viewing field that angles up from the print; getting close to the hologram often provokes viewers to bend as they follow the image.
Left: *'Beyond the Window'*, 2008
Right: *'Explorations of the holographic gaze'*, 2010

[166] As described with the installation of *Exhibition Circle*, [Ch2.D2].

Annotated photographs from *'Explorations of the holographic gaze'*, 2010
Approximate viewing field shown in blue

While the spatial dependency of holograms can be creatively incorporated into the installation design, it does require the consideration of people's very different heights. At the exhibition '*into the holographic landscape',* a stepladder was available for children to view most of the works. One of the pieces in the exhibition, however, was at child height so they could freely explore this piece and discover how the animation worked (often then directing their parents to see the others).

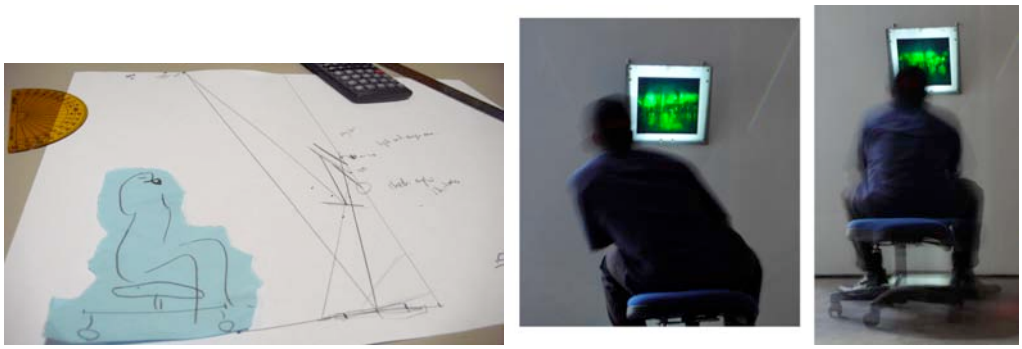


Installation *TrainWish* at child height
'*into the holographic landscape'*, 2006 →

A young girl using the stepladder with her mother to view holograms
'into the holographic landscape', 2006

Such an approach was also applied with the installation *Jumping Jellyfish* at ZKM | Centre for Art and Media Karlsruhe, 2011. One of the holograms was at child height and could also be seen by visitors (not on the trampoline) from across the room. I witnessed a girl jumping to animate this jellyfish – she gestured to her father to pick her up, and they jumped together to see the other jellyfish. This strategy shows one of my key aims: catching the viewer's attention and using the image to stretch their normal positioning and movement. In this way these holographic image installations serve as a tool to manipulate an engagement with physical space.

For the Bus gallery installation of '*we're all looking'* holograms [Ch2.D1-3] I wanted to encourage a slow, smooth movement as these works contained a dense compression of multiple perspectives. My solution was to use modified office 'wheelie' chairs. By being on wheels the people could move around, while being seated placed viewers at a similar viewing height.



'we're all looking' installation for '*Beyond the Window',* 2008

Left: Diagram used to calculate hologram and lighting placement. Centre and right: Viewer on a 'wheelie' chair

As my installation practice developed I sought places that had an inherent positioning and movement, such as stairwells and corridors.

C : Referencing to steps

Capture of traversing the staircase at TimeLab with the Bloggie video camera, Ghent, 2011

C1 : Unfolding holographic images through a staircase

> "The cognitive model assumes that visual cues are somehow used to calculate distances, as if our brains were computers preprogrammed in inches and feet. Isn't it more plausible instead that our bodies are habituated in steps? And that steps relate more directly to other steps than they do to conventional feet? The computational fiction is a natural outgrowth of the assumption that we effectively move through and live in a static, metric or quantitative, Euclidean space. I for one don't count my way around town."
>
> Brian Massumi (2002) '*Parables For The Virtual: Movement, Affect, Sensation*', p181.

Stairs involve more careful negotiation than flat surfaces, and as such, a more conscious activity of movement. Viewers in my stairwell installations often touch the walls, stabilising themselves physically while looking into the image. Stairs create a defined reference of physical space, each step a distinct position. The vertical movement and pauses between steps – creates a rhythm to viewing. The act of stepping is encoded in a staircase, an action that is drawn into the reading the holographic scene.

Viewers looking at a hologram in the *'Ex Tempore'* installation, 2006
To play the hologram's animation requires the viewer to negotiate the stairs and the image simultaneously

Navigating the image and physical space in my stairwell installations intertwines proprioception and visual perception into an experience that is both virtual and physical. While a switching of attention risks severing the accumulation of visual tracings of the scene, it also has the potential to create connections between virtual and physical aspects of experience.

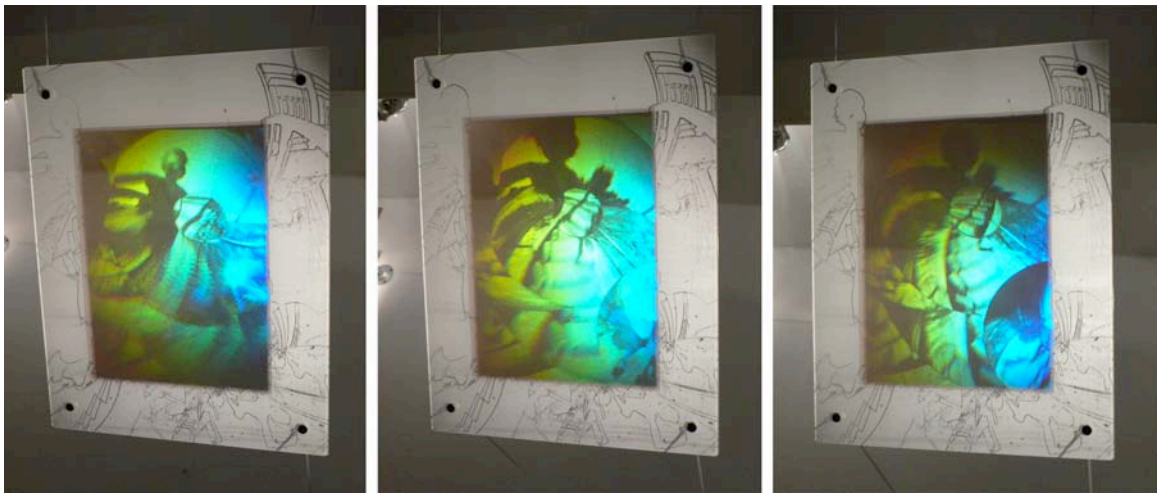
Postcard from Shantytown in the Stairwell of Flux Factory, New York, 2010
There are nine vertical channels in the hologram

After observing viewers in a stairwell installation[167], I decided to capture my negotiation of stairs, and produced the hologram series *'Up the Stairs'* in 2010. This project began with my recording of going up and down different staircases using a Bloggie HD video camera with 360-degree lens attachment. The regular pace of movement allowed footage to be layered into 200-frame animations and printed into holograms. Each situation was different but all were captured as a single piece of video footage, which was then cut and layered to show a composite scene of singular action. The layers fuse together through the shared rhythm of action[168] – a stepping – activated by the viewer's own stepping.

[167] This was re-sparked by my installation of the work *Postcard from Shantytown* - 1800-frame multiplex hologram with both horizontal and vertical animation. For the exhibition *'Housebroken'*, Flux Factory, New York, February 2010.

[168] In the first hologram the speeds of the various layers are quite different, but in the later works I kept the speed of each layer the same.

Video-still from the capture of *the first thing was to climb up the stairs*, Budapest,2010

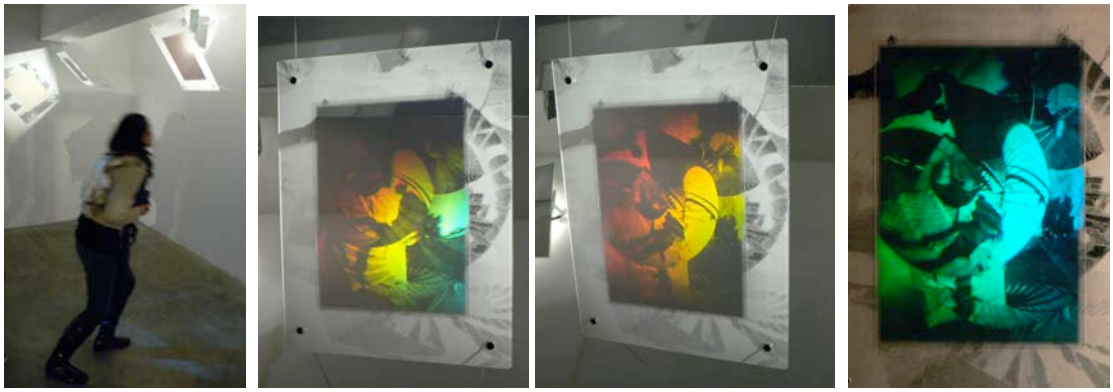


the first thing was to climb up the stairs, 2010
Achromatic transmission 200-frame multiplex hologram, laminated to laser etched plexiglass, 38 x 49 cm
'Explorations of the holographic gaze', 2010

to carry my bike up the stairs, 2010
Achromatic transmission 200-frame multiplex hologram, laminated to laser etched plexiglass, 38 x 49 cm
'Up the Stairs', Wuppertal, 2010

After looking at the first two holograms in the series, I created *up and down the spiral stairs*. The recording was made going down and then up an outdoor spiral staircase, my movement guided by both the physical staircase and my view through the lens. In one direction of movement, the footage was reversed so the virtual movement always matches the perspective of a moving viewer. Using the Bloggie camera to record the action of traversing the spiral staircase, there was both a physical

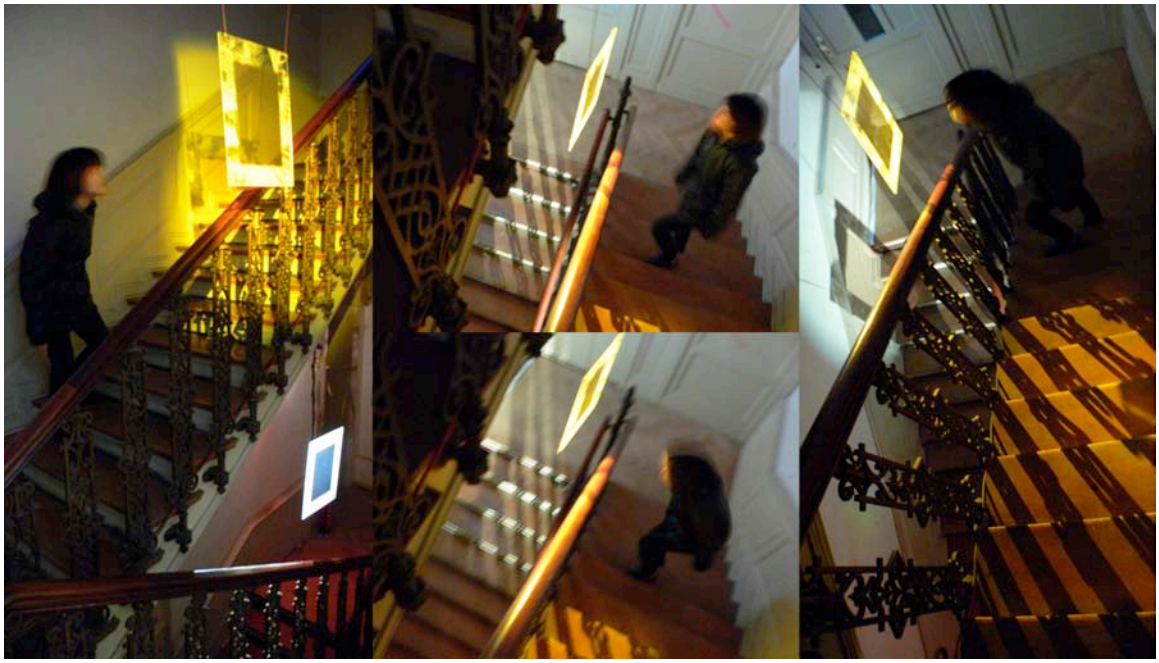
circulation and optical circling due to the lens distortion. In the holographic scene my shadow anchors the view so with each step the stairs seem to rotate underfoot. The shaping of space with this action is emphasised by the 'donut fish-eye' camera optics. While only a few steps are captured, there is a distinct sense of circulation from the combined moving perspective of multiple donut-shaped views. The image produces a diagrammatic awareness of spiral steps from the combination of the structure, shaping and movement. One viewer described the hologram as having an Escher-like infinity that the action seemed to fold in on itself.



up and down the spiral stairs, 2010

Achromatic transmission 200-frame multiplex hologram, laminated to laser etched plexiglass, 38 x 49 cm
Left: Viewer shifting her weight back and forth. Two centre images: Installation views. Right: Photograph of hologram

For the staircase installation in Wuppertal[169] – which happens to have the most public stairs of any German city – I installed the holograms parallel to the handrails of the stairwell. Viewers could then be very close to the hologram and tended to view it by placing each foot on a different step and shift their weight back and forth to animate the image. The animate action of the holographic scene unfolds into a suspended act of stepping. While the visual-protagonist climbs through the virtual stairs, the viewer is poised in the action of stepping. A potential act that becomes fulfilled through the image.



'Up the Stairs' installation, Wuppertal, 2010

[169] As part of the '*-1/MinusEins im Exil'* exhibition during the '*Sommerloch'* festival, Wuppertal, Germany, 25 August – 5 September 2010.

D : Unfolding the emergent dynamic form

"going up-side-down in our heads" – Alice Mrongovius (on right)
Carsten Höller, *Upside down Goggles*, 1994/2001
Haus der Kulturen der Welt *'The Art of Flying'*, Haus der Kulturen der Welt, Berlin, 2011

D1 : Emergent forces in the cross-referencing of perception

The 'virtual' aspects of holographic scenes arise from our ability to conceptualise motion and space; an ability based on our embodied sensibility and experience of space. This involves a continual looping between perceptual experience and conceptualisation. As virtual perceptions are adopted into our sense of motion and orientation, our embodied sensibility and spatial experience become augmented. While this adoption can shift the way we perceive, we can also separate ourselves from perception, conceptually ascribing it as a phantom sense.

An augmented experience is filled with contradictions that can lead to a phantom sense of a presence, force or motion. One situation in which my perceptual experience over took my physical reality was in Volker Kuchelmeister's panorama projection *Juxtapositions* at ZKM | Centre for Art and Media Karlsruhe, PanoramaLabor in 2011. The work is a long 3D[170] image that slowly moves across surrounding screens. As I was busy looking around the detailed 3D space, the image became my spatial grounding. Thin black lines between the screens seemed to move across the images and the whole room seemed to rotate. My mind glossed over the mechanics behind this, it simply was less effort for the dark room to move than to rotate the deep, detailed space of the image. I knew this was not the physical reality but continued to perceive it.

Volker Kuchelmeister*, Juxtapositions,* 2011
Stereoscopic 3D panorama montage and installation
ZKM | Centre for Art and Media Karlsruhe, PanoramaLabor, 27 May – 30 June 2011
[source: http://www.kuchelmeister.net/prj_juxtaposition.html]

[170] The projected image was stereographic, using polarized video projectors. Polarized glasses were worn to deliver offset left and right views that were perceived as 3D space.

An ‘everyday’ experience of phantom motion occurs when sitting in a stationary train looking at another train which starts to move and perceiving that it is your train which is moving. This is a physicalisation of virtual movement, bracing for action or internalising the situation. While we perceive virtual movement looking at moving images, a phantom sense requires an embodiment of the camera or adoption of a visual reference. In cinema viewing I do not often feel the movement of the camera but usually orientate with it and assume the camera is right-way up.

The 2009 film *Død Snø* [Dead Snow][171] depicts a scene in which one character is trapped in an avalanche. She lies on her back, distraught, and a droplet of mucus rises up from her nose. Earlier in the film we are told many people die in avalanches because they are disorientated and dig away from the surface. Both viewer and character process this knowledge together. The camera rotates. I am engaged to this orientation and feel a visceral re-alignment to my sense of the virtual landscape. It is similar to the re-alignment which occurs when the cognitive map is re-referenced to visual perception.[172] In viewing the film a cognitive map stems from the orientation within the virtual scene. My physical surroundings do not seem to revolve around me, but the virtual world I am engaged in detaches from my sense of orientation. A dynamic transformation occurs within my extended spatial perception.

I am interested in how extended understandings co-exist with navigation through physical space, allowing a complex awareness that encompasses different systems of orientation.

Experimenting with the perception of motion by coupling virtual dynamics to physical sensation is central to my holographic image compositions and installations. The movement required to view a holographic animation can be used to intensify a visceral sense of motion, and also be referenced to the visual scene. This coupling can take the form of a shadow that moves with the viewer, suggesting a physical connection to the animate scene that is also a clue to the scene’s composition. When looking into a visual image an external object or place is implied, here I am using devices and tactics of movement coupled together to draw the recorded activity into an experience of viewing.

My holographic image installations do not generally cause a complete reorientation to the virtual. They are not designed to be immersive. Instead I re-arrange perspectives to draw-out a perceptual shaping and diagramming of urban encounters. In physically negotiating a virtual movement, the body schema[173] that contributes to perceptual activity is brought forward into conscious awareness.

A potential of multiplex holography is to reveal a visuo-spatial experience that enfolds multiple motions, bearings, tendencies and forces. The immediate surroundings through which a viewer moves and the ‘through the window’ or media-augmented view via which they virtually move are combined into a complex sense of location, orientation and potential action. As the viewer moves around the animate scene, the implied visual dynamics are coupled to their proprioception. By becoming familiar with spatial animation, the image is explored like an extension of the body schema. Here the schema is a complex embodiment where the potential of extended motion is warped and hyperlinked by the structure of the image.

D2 : Conducting movement

The culture of viewing holograms is not well developed. Holograms require a different act of viewing from sculpture, screen and surface images. Physical holograms installed with specific lighting have an architectural presence. The hologram shares some visuo-spatial qualities of a window and of a mirror –

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[171] *Død Snø* [Dead Snow], Directed by Tommy Wirkola, written by Stig Frode Henriksen and Tommy Wirkola (2009).
[172] As described in [Ch1.A1].
[173] Gallagher (2005), p37. See also [Intro.6].

in that the optical image from a surface penetrates and augments space. Yet the hologram is not just a device for shaping light, it is impregnated with an image – a memory that can be unfolded through movement.

The illuminated holographic image, meanwhile, has an optical presence. Yet this presence depends on the viewer's position, the image is only visible to a viewer who looks at the scene through the projected virtual window of the hologram. This dependency on position in the viewer's experience I consider in terms of the movement of looking around through the fragmented virtual window of a multiplex hologram. And yet it is exactly a difference of position that I have brought together in the making scene, the various views being placed into the same image. The multiplexing of these different views, defining them into the positions that a viewer can then move through creates a conduit that shapes the perception of relationships and motion. Thus the actions of capture, along with the compositional mapping, are reconstructed into a new experience. As Ron Burnett describes in *'How Images Think'*, "…images are often assumed to be the *source* of a communication process when they are actually a middle ground for intervention and interpretation by spectators and creators".[174]

Using the multiplex holographic image as a means of expression I became concerned with how to establish and transform relationships between visual perspectives and motions to affect the sense/reading of the scene. Ideally, to produce such affects my holograms would be larger than the viewer's body – allowing them to 'look around' by moving their whole body. As the cost of producing this scale of work with holograms was outside my research budget, I explored ways to amplify and warp the viewer's movement by visually augmenting a sense of movement to create a perceptual shaping. This shaping is often a non-uniform compression of perspective. I have also experimented with directional relationships, such as virtual zooming from a physical sideways motion and inducing a proprioceptive shift by changing the directional relationship across the viewing field, such as with the hologram *Figure8 on Drummond Street*.

Maria Ludovica Tramontin points to a relevant architectural design question during a conversation with Lars Spuybroek:

> "When you think of this choreographing of forces through procedural techniques, the question is what kind of bodily experience is required to grasp their aesthetic quality."[175]

The installation *Paternoster* gave me one answer: if I wanted the viewer to grasp a dynamic form or perceptual shaping, I needed to use the hologram and installation to induce bodily awareness. I developed techniques for inducing this awareness by limiting some aspects of movement while provoking others. The installations involve a kind of choreography aimed at intensifying the virtual movement of the image. These choreographic techniques included:

- Confinement, as a technique for guiding the viewer into the viewing field of the holographic image and amplifying the sense of movement.
- A heightened awareness of gravity, used to intensify the sense of balance and proprioception to produce an affective reading in a number of works.
- The stairwell installations, drawing on the inherent movement of the architectural space.

These techniques informed the locations I chose to capture; my movement when recording and the structuring of the compositions.

My installations cross-reference virtual and physical movement to produce an emergent sensational reading. In *The Pleasure of Architecture* Bernard Tschumi writes about a similar emergent experience:

> "The ultimate pleasure of architecture is that impossible moment when an architectural act, brought

[174] Burnett (2004), p40.

[175] Maria Ludovica Tramontin in conversation with Lars Spuybroek [Spuybroek (2008), p214.

to excess, reveals both traces of reason and the immediate experience of space."[176]
Tschumi's description of 'that impossible moment… brought to excess' resonates with Deleuze's notion of intensity,[177] where perception and knowing are enveloped, referenced to each other, and unfolded as something else. In Tschumi's case, this is an aesthetic pleasure.

In the context of the projects discussed here, a structuring of view that is linked to bodily engagement is 'brought to excess' through a reflexive referencing. By reflexive referencing, I refer to the way physical and virtual movements are co-emergent and linked to each other. The virtual dynamics are read in relation to physical movement while also provoking a particular movement. This feedback loop can amplify correlations and disjunctions in the extended activity of embodied cognition. The composition also reveals these relations by employing an external 'reference' such as the visual-protagonist who allows for an extended perspective outside the body to be incorporated. The installation encounter extends awareness allowing the viewer to reveal and engage with the implicate dynamic form of the holographic scene by drawing it into their heightened perceptual experience.

[176] Tschumi (1996), p89.
[177] Deleuze (1968) 1994ed, p236/7.

In Conclusion

Contemporary experience involves negotiating many different kinds of images and information. Locating ourselves in a way that we can deal with these layers of information becomes a complex process involving both physical and virtual 'heres,' and 'theres'. Through this research, I have experimented with multiplex holograms as a medium for exploring the embodied nature of this process.

While all images can extend our perspective beyond the immediate surroundings, the viewing of a multiplex hologram – by requiring bodily movement – can also establish and transform the dynamic qualities of such a perceptual extension. One of the techniques developed was to couple the viewer's movement to a virtual body and action of recording through the visual suggestion of an embodied protagonist and their camera. The installations were designed to entice the viewer to move in particular ways to activate the dynamic holographic scenes with bodily awareness. Through this project-based research I addressed how an awareness of the body, location and movement can be shaped by images. The holographic scenes were used to diagram and conduct these shapings.

The experience of being lost informing a complex sense of location

With a static, undistorted, laser-viewable holographic image a virtual space can appear 'concrete'[178] by the continuation of perceived spatiality through the holograms surface. By contrast I employ visual references and transform the sense of movement with a spatial montage of views to activate a navigation of the scene. The assembled continuity of these views into a holographic scene emphasised a dynamic topology to perceptual process and concept of location.

What I developed through analysing the 'experience of being lost' in *Chapter 1* was an understanding of how multiple spatial references are brought into a located-embodied experience. A multiplicity of locative awareness becomes apparent when it is disjointed, such as in the experience of being lost when knowledge – a mental or mapped concept of place – conflicts with intuitive orientation and a sense of placement. In this state a perception of location does not cohere but remains in an unsettled feedback loop. In my own and others documented experiences of being lost the incoherence between different systems of knowing caused a visceral giddiness, feelings of disembodiment, the sense that the terrain was shifting and/or a mental blurring. These sensations were used as an extreme case to understand the shifts and shapings that could be brought forth through holographic compositions.

The value of trying to elicit something akin to a 'lost' experience through the holographic composition lies in prolonging and bringing awareness to the perceptual/conceptual process of locating oneself. Like the photographic technique of *ostranenie* [making strange, Ch1.B1], by keeping the activity of reading the image open, the viewer is offered time and a structure with which to explore their own perceptual tendencies and assumptions. Having to 'navigate' the scene actively allows for an engagement with a perceptual process of visual construction.

Tracing an encounter with a place into photographs slices up the moving perspective, allowing it to be compressed, re-arranged and/or transformed. The process of fragmentation sets up a visual rhythm that the viewer then fuses into a scene. The limited resolution and number of frames of the multiplex

[178] A term Paula Dawson used to describe her laser-viewable holograms. Interview with Paula Dawson in 1992 [Coyle and Hayward (1995), p68].

recording systems that I used for this work required me to reduce the action and intention of a scene into a simple structuring of perspectives, such as moving along a path and recording an image at regular intervals or the action of climbing stairs. A holographic image structure is established with distinct dynamic and spatial relationships by using patterns and movements to reference the images.

By montaging perspectives and mapping them back into space – in relationship to a viewer's movement – a sense of co-existing forces and/or volumes can be established. As a visual space can be established from a few clues, such as parallax or vanishing perspective, an impression of more than one volume or spatial system can be created within the holographic scene. For instance, *Are You Here* has two distinct superimposed layers each showing an array of views into the scene but with different spatiality. A different approach to such a multiplicity was used in *I followed a box of matches to the Halászbástya but it was under construction*, where a number of image sequences with different rhythms of animation and directions of movement are brought together into a single scene. Different again is the dense spatial montage of different views in *Exhibition Circle* [Ch2.D2]. In each of these cases there is a multiplicity of perspective that can be perceptually separated while being fused into a dynamic scene.

The holographic view – the assembled perspective through a holographic image – allows a separation of perspective and perceived movement from direct physical experience, while occurring through a physical experience and drawing on our propensity to fold perception back into a unified located and embodied understanding. The inclusion of the camera and 'visual-protagonist' in many of the compositions is an attempt to reveal a similar (although limited) process of separation and folding in the act of visual recording. By spreading out the activity of visuo-spatial perception the viewer can explore the structural shaping of perspective sense the virtual movement and spatiality.

Coupling extended vision to the body

In *Chapter 2 – Linking the holographic view to the body,* I explored how the hologram can link the experience of capturing images and the experience of viewing the hologram through various hinges. Anchoring the captured 'photographic'-perspective views to a visual-protagonist in the scene, enables the viewer to navigate and activate a folded/hyperlinked, shaped and/or dynamic structure in relation to a perspective outside of their own body. The suggestion of a bodily presence within the holographic image is an attempt to connect the viewer empathically into the scene, allowing the viewer to engage with the recorded structure and movement while observing how this shapes the scene.

This double act – of feeling an activity, and viewing how this sensation results from the action – led me to think about my holographic installations in terms of affect. I considered this in terms of Spinoza's notion of affect: a modification of bodily action accompanied by a simultaneous idea of that modification[179]. Developing and applying a philosophical understanding of 'affect' to the situations I create with the holograms required me to consider not only the production of bodily sensations in the viewer but also giving the viewer a sense of agency and an awareness of the composed extension and augmentation of perspective. I consciously began to capture and compose the holograms as a choreography of felt, imagined and enacted movements that would be then be unfolded by the viewer. This choreography was based on a diagram of woven perspectives to trigger a particular sense of virtual movement or spatial dynamic. The mimetic visual-protagonist acted as a guide to this complex virtual landscape while enabling an empathic feeling of perceptual shaping.

[179] Spinoza (1677), quoted [Intro.6].

In other works,[180] the body of the photographer – elicited by visual clues such as a shadow or refection – establishes a protagonistic-presence that mediates the virtual movement and provides a reference to the virtual space. The holographic images installed in *'Explorations of the holographic gaze'* trace the suggested body through different actions. In *up and down the spiral stairs* [Ch3.C1] there is sense of spiral shaping – a twisting background, that the tethered shadow steps around. In inhabiting a protagonist's shadow the viewer's body is active but not present in the scene. The relationship established with the extended activity of viewing is a spatially dynamic structure of dislocation and mirroring – similar to the structuring that can be produced with the camera-screen feedback of visual media. A shaping/diagramming is created by the process of capture and composition, which becomes animated by the viewer. The dynamics embedded in the holographic scene can then be adopted into the viewer's extended embodied sensibility.

Adopting cameras into our visual experience is an act of perceptual extension, we look and think through the camera's perspective. Attaching a composition of captured-views into the activity of viewing also fosters an adoption of external cognitive abilities. As defined by 'extended mind' theory[181] this adoption is based on 'coupling' to external and augmented abilities.

With the holograms *Paternoster* and *Emotions for the seaside* the camera ⇔ holographic image relationship acts as a mirror-reflection feedback operation, setting up a comparison of spatial inhabitation and movement between the viewer and the protagonist. In contrast, when the camera is visually recorded through the shadow, reflection or a multiplication[182] of the protagonist, a folding operation occurs which is external to the viewer. The camera operation has a mimetic double within the holographic scene. The viewer ⇔ subject/space relationship of images in which the camera or perspective stands in for the eye is then expanded to viewer ⇔ hinging operation ⇔ subject/space allowing for the imaging process to have a comparable relationship to the perceptual process.

The transformations elicited through the imaging process sketch a nature and form of perceptual shaping. Hinged through anchors and with a dynamic that is coupled to movement, comparative and complex relationships of visuo-spatial conception can be established. These hinged structures of views are played out into the viewing space and activated by the viewer's movement. In engaging with the image, an abstract dynamic form can then attach into the viewer's sense of physical movement.

The projects have been used to explore how movement is a key aspect of spatial perception and therefore allows an engagement with the holographic scene. The physical and virtual movements discussed cross through a number of territories:

- physical; the viewer's body and the environment of viewing that effect bodily movements,
- compositional; the animated structure of the holographic image, often a result of the changing perspective in the capture of the constitutive images.
- and conceptual/narrativistic; the associations, 'story' or events occurring as part of the holographic image content.

These territories are connected diagrammatically – or through the matching and transformation of vitality forms (forces, actions and shapings). This coupling can be either a matching of forms or a linking of relationships that are perceived as connections or transformations. The dynamics of moving through different perspectives are adopted into a virtually/imaginatively extended sense of experienced potential.

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[180] Including: *Shadow-waves at Safety Beach* [Ch2.B1], *Museum Reflection* [Ch2.B2] and *Down from the Peak* [Ch2.B6].

[181] Clark and Chalmers (1998).

[182] Such as in *we're all looking* [Ch2.D].

The recorded movements along paths and through patterns become entangled with the physical sense of moving around the hologram. This extends embodied cognition to produce an awareness that stretches beyond physical potential but is firmly rooted within it. The dynamics of the holographic scene fold back into the viewer's sense of a located body.

Unfolding the enfolded

In *Chapter 3 – In and through the Paternoster* I describe a number of installation designs that use the viewer's sense of movement, proprioception and balance to trigger a resonant connection to the holographic scene. With these installations I explore how holographic images can be unfolded into physical spaces with a consideration of the viewer's awareness and tendencies of movement through that space.

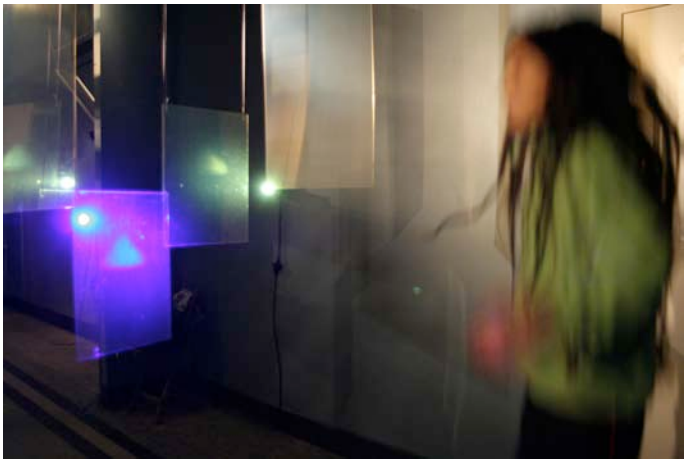
Due to practicalities and logistics, many of my hologram prints are limited to the 30 x 40 cm multiplexed master that I could produce at the Academy of Media Arts (KHM), Cologne. All the viewing perspectives of these images can be reached from a single standing position, with a little swaying and bending, so devices and techniques for inducing a bodily awareness became more important. Using confined spaces and stairwells was a way to accentuate small movements within the physical space. My experiments to accentuate and amplify bodily awareness led me to realise that provoking vertical movement produces a more acute proprioception than horizontal motion due to the vectorisation of gravity. For example, when holograms are hung parallel to a ceiling, the viewer becomes intensely aware of gravity and balance in looking up and leaning around to animate the holographic image.

The action of stepping was encoded into the physical space and through the visual image of my *'Up the Stairs'* series of holograms [Ch3.C1]. Installation of these works in a staircase induced the captured act both visually and physically. This enacted and visually suggested experience allows the viewer to explore a dynamic form of stepping through different linked modalities of perception.

Staircase installation *'The Emergent Holographic Scene'*, 2011

The assembled knowing of a physical body and the physics of moving are complex by nature. The conscious sensitivity to our body schema fluctuates from unconscious actions to acute awareness. My own projects engage with proprioception in order to produce an awareness of different bodily sensations that are part of the scene's composition. With the *Jumping Jellies* [Ch3.A4] installation there is an internal sense of organs shifting, and the jellyness of what is under the skin. This is quite different from the sense of balance and vertigo that is an important part of *Paternoster* [Ch3.A2] and *On the Roof*

[Ch3.A3, Ch2.C1], and different again from the directional inversion of the relationship between physical and virtual movement in *Figure8 on Drummond Street* [Ch2.D3].



A physical experience of the holographic images
'The Emergent Holographic Scene', 2011. Photograph by Anna Baróthy

I want the viewer to look up and to move around my installations. By doing this I suggest that the image does not have to be a picture on a wall or take the form of a classic architectural 'window', but that images can surround us. Our experiences incorporate and flow through images.

The installations were somewhat limited in scale, and are far from the 'immersive' experience in which orientation and perception can be primarily drawn from the augmentation. However, through engagement with the composed scene a relational folding extends the implicated sense of a located body. This engagement with the act of viewing enables an awareness of how extended perceptions fold and feed into a complex sense of movement, location and embodiment.

Different activities of looking
'The Emergent Holographic Scene', 2011. Photographs by Anna Baróthy

The emergent holographic scene

The physical negotiation of the installation space by amplifying, mirroring or contrasting the virtual movements and forces of the image becomes part of how the scene is experienced. The viewer navigates both physical space and the holographic scene to unfold the virtual structure with their own perceptual tendencies. I use the viewer's activation of the spatial montage to bring awareness to a relational structure of physical and virtual movements. The optical qualities of the holographic image allow for a spatial yet ephemeral form, emphasising the shape and the dynamic shaping between and through the structured sequence of perspectives. The recorded structure of views, while revealing an animate scene, also suggests a choreography of movement. In moving around the hologram the viewer animates a dynamic form, engaging with its shaping through their motion. The encoded movement between the visual perspectives amplifies and transforms the viewer's action, and establishes virtual forces that are drawn from and affect the bodily sensibility. The sense of dynamic shaping and virtual forces are emergent aspects that arise out of this feedback loop.

Working with the processes of folding movement and images into and out from the hologram, I came to treat the multiplex holographic image-structure as a kind of diagram – a map of relationships. By using the spatial montage to hinge the tracing of lines of movement and patterns in the urban environment, the composed diagram of recorded perspectives shapes the activity of unfolding and perceived scene. The composition process occurs through these various activities, considering the conduction of relational dynamics as the diagramming through a multiplexed holographic window. The emergent dynamic arises from the similarities and the differences in the rhythm and spatial perspective of these processes. Taking a diagrammatic approach enabled me to design compositions and installations around dynamics, conceptual structures and/or perceptual affects, aiming to elicit rather than represent the emergent 'shaping'.

Developing my concept of the emergent form of the holographic scene, as a 'shape' that exists only due to the intersection of various patterns, including the rhythm of perception and visual dimensions, became the aim of my creative research. This approach moves beyond the conventional understanding of the holographic image, where a scene is thought of as a determined virtual space. Instead, the 'scene' is emergent, arising through the related processes of making and viewing.

The fold

Key to my process of creating a diagram through spatial montage is the concept of 'the fold' which is understood as the related actions flowing into and out from a hinge, an intersection and/or reference point.

The implication of the compositional approaches I have developed – toward revealing the activity of image construction within the holographic encounter – is well described in Massumi's characterisation of how an image can allow access to the virtual:

> "Since the virtual is in the ins and outs, the only way an image can approach it alone, with its own content and structure, is to twist and fold on itself, to multiply itself internally, knotting at a certain point."[183]

[183] Massumi (1998b), p306.

The anchored elements of the holographic scene hinge the movements, forces and spaces of the recorded scene into the viewer's own experience. What I am exploring with the compositions are different shapes to the folding of referenced perception. Defined by connections that act like points of intensity within the perceptual process, a composition of hinged elements between perspectives is a diagram of folds that can be multiplied into 'knots'.

One question that arose with the projects was how to identify experientially and induce the 'twist and fold on itself' that Massumi refers to above. One way I found to induce this internal multiplication was as an inversion of forces, or change of motion, such as a turning point. For example, the experience of a momentary 'weightlessness' at the peak of a jump when we are suspended between the propulsion that got us here and the gravity which is about to take over. This meeting point of effort and potential integrates into our extended knowing of location.

I explore such a suspended state in *Chapter 1* through the experience of being lost, in particular when systems of orientation conflict producing a sense of spatial instability before orientation is resolved. In *Chapter 2,* I come across the situation again with *Figure8 on Drummond street* when the viewer moves one way past the hologram while the direction of the virtual movement appears to switch. With the *Jumping Jellyfish* installation described in *Chapter 3,* I physically evoke this experience by placing a trampoline in amongst the holograms. At the top of the jump the viewer is between movements – up is about to become down, an elongation of the body and image is about to turn into an expansion. In these moments, actions turn and we feel forces invert within us. Each of these situations has an aspect of ungrounding; they dislodge, they augment to produce a heightened sense of the impinging forces on our embodied assumptions.

The disappearance of our gaze from ourselves in the moment of looking as described by Foucault[184] can be considered as an inhabitation of 'the fold' where we connect to many places/understanding at once yet as such are no longer singularly situated. This situation is becoming more normal as we flick our attention to engage with the virtual, disappearing in some senses from our immediate surroundings. What I have been able to explore with my holographic image installations is a reflexive sensibility within a suspended composition of folding. As Massumi suggests:

> "Where we go to find ourselves when we are lost is where the senses fold into and out of each [other]. *We always find ourselves in this fold of experience.*"[185]

Within a folding we can gain or glimpse an awareness of ourselves, of our own drive and perceptual activity. Being able to enter and emerge from 'the fold' allows for the incorporation of different systems of knowledge into a complex yet unified sense of located experience.

Revealing the process

While experimenting with the process of multiplexing I came to think of the pattern of captured perspectives as a kind of 'reference' that enabled an encoding of spatial dynamics.

My holographic scenes are inspired by the activity of moving through and the conceptualisation of urban spaces. These compositions aim to show a conscious, embodied activity of image construction, such as how a scene can encode and generate physical and psychological 'shapings'. The holograms *On the Roof* and *This morning on the balcony reminded me of a dream* are about the sense of this shaping in the act of capturing. The installation of these holograms on the ceiling[186] was aimed at evoking a

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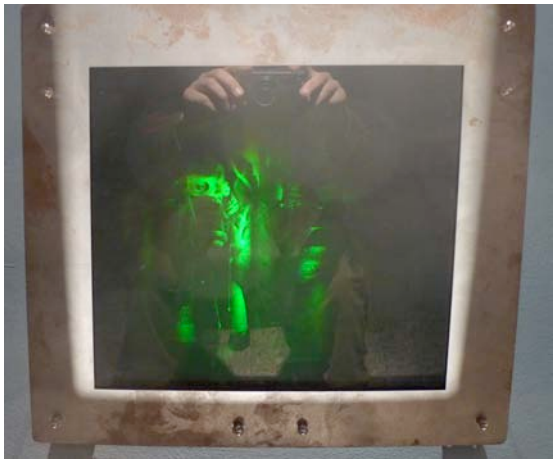
[184] Foucault (1966), p9 as described in [Ch2.B7].

[185] Massumi (2002), p182.

[186] Including at *'Explorations of the holographic gaze'*, 2010.

similar vertigo in the viewer to that experienced during the image capture. These and many of my other installations are designed to enhance the body's role in the dynamic structuring of a visual impression – an experiential mapping of the scene.

In the series '*we're all looking'* the holographic view is composed of the combined photographic act of a group of photographers. The action of capture through which the image has been constructed is reinforced by the appearance of the photographers in the hologram. These holographic scenes are structured around the act of recording, and this diagrammatic form becomes re-activated through the act of viewing. The aim here is to provoke an awareness of the process of constructing an impression through offering access to the process through which the hologram itself was constructed.



Photograph of *Figure8 on Drummond Street* by Wouter Cox
'The Emergent Holographic Scene', 2011

Even a direct reflection does not represent space but creates a virtual space, perpetuating bodily and spatial awareness into the visually suggested scene. Like in a hall of mirrors it is not the reflective surface itself that fascinates us but the way in which, through transformations our own image, we can feel ourselves to be transformed by and propagated into our surroundings. The way that our movement and vision trace space also allows visual space and its dynamics to be folded back into our located awareness,[187] along with the emergent outcomes of the perceptual experience.

Like a reflection in a mirror allowing us to see ourselves, a reflexive perspective produces an awareness of our perceptual activity. In the assimilation of multiple references into a complex sense of location, we flick our senses momentarily inwards, allowing our own dynamic shaping to establish new bearings within implicated and entangled layers of experience.

[187] For example in Jacques Lacan's theory of the 'mirror stage' infants assemble a range on sensory inputs into a unified concept of self when they recognise their own form in the mirror. Lacan (1966), with English translations in 1977 and 2002.

Looking beyond

A holographic approach

My practice shifts the focus of holographic imaging from the volume of the optical image-space to the relationships between the embodied acts of image capture and viewing. Through this approach, I suggest a new trajectory for holography that not only offers a way of conceptualising and recording scenes, but also allows for the design and embedding of referenced visuo-spatial images into our physical experience of space. The hologram then can be considered not only as a 'window with memory', but also an enfolded diagram of spatial dependencies and dynamic forms.

Looking beyond the immediate implications of my research, the concept of resonant dynamic structures and engagement through movement are areas of particular relevance to a wide range of contemporary practices. With the personal and collective amassing of images, questions of structuring and engagement are becoming more critical. The composition approach that I developed aims to engage viewers with a complex visual scene through linked rhythms and 'landmarks', as well as by suggesting a perceptual activity that shapes the scene. By employing coupled external references, the viewer can sense forces and shapings between them and a virtual scene, as well as conceptualising these in relation to the scene's structure. The linked exploration and conceptualisation allows for intuitive comparisons between systems and an engagement with diverse information.

We search for patterns to make sense of the huge amounts of information that we encounter each day. We also make patterns with our neural firing, heartbeats, breaths and steps. These body rhythms, as well as our conceptual structures, are used to cross-reference visual perception. Like the underlying principles of interference and reconstruction that allow for the holographic image, one pattern encodes another. When these patterns have 'resonance' or 'coherence' there is an intensity that leaps out to another quality – a feeling, a concept, an impression.

Two areas of enquiry that consider such processes of resonant or matching forms are theories around how the mind stores information – 'the holonomic brain'[188] – and an aspect of interpersonal communication described as 'affect attunement' – the resonating of a expressive pattern. Daniel Stern, who has found matching patterns in parent-infant communication, gives this definition: "'Affect attunement' is the matching of dynamic forms of vitality, but across different modalities".[189] In addition to moving across modalities (such as communication shifting between hand gestures and vocal sounds) affect attunements are not perfect pattern matches and, as Stern has shown through his work, can be actively used to amplify or dampen what is expressed, while showing an understanding of it. My work also attempts amplifications and transformations of dynamic forms.

In one holographic mind theory that draws on Bergson's model of perception[190] and James Jerome Gibson's work with the invariant properties of patterns,[191] Stephen Robbins proposes that the 'invariance structure of an event', is key to the working memory of the mind. He defines this 'invariance structure' as "a specification of the transformations and structural invariants defining an event and rendering it a virtual action".[192] An invariance form created in the cross-referencing of patterns,

[188] Pribram (1987).
[189] Stern (2010), p42.
[190] Bergson (1908).
[191] Gibson (1966) and (1950), p153.
[192] Robbins (2006), p371.

diagrams and dynamic forms can be holographically stored and then activated with variation. The structured content sets-up a reference pattern, allowing for an associative encoding. Using movement as a reference to the scene allows an activation by the viewer that, like the recollection of a memory, draws on the rich aliveness of the present moment. Vitality is breathed into the image by the viewer.

These examples show the massive potential that resonant dynamic forms have in cognitive and information processes. George Lakoff, one of the proponents of 'the embodied mind' understanding, considers language and communication in terms of topological and orientational relations to the body: "Humans think in terms of what are called 'image schemas' — these are schematic spatial relations"[193]. The holographic scene, when composed around relationships to a viewing body, allows for such image schema to be recorded and shared. This research lead to a development of how such relations could be shaped to express a dynamic conceptualisation of place.

Resonance – which in holography occurs as a relationship of coherence and interference – provides in a broader context a framework for communicating relational structures that are shaped by virtual extensions and embodiment. In developing my practice, this principle has become implicit to the way I compose a holographic scene, both technically and in terms of my creative expression. Through this research, my aim has been to contribute a methodology for the creative expression of 'image schema' that encourages a conscious engagement with their composition and enactment.

Changing perceptions with mobility and media

With the increase in mobility through transportation and media, concepts of distance and therefore space are shrunk by accelerated perspectives and folded through hyper-connections. Our engagement with place is shaped by abilities and access. Inhabiting a place is not just being at a physical location, but also having a potential for action and a connection to virtual information. Media and visual technologies have increased the overlaying of visual information into the urban environment. Access to Global Position System (GPS) co-ordinates, locative media content, as well as smart codes and other hyperlinks weave the virtual knowledge of maps and information into the experience of place. These technologies add to the complexity of experience, layering and folding information into a superimposed, meta-structural encounter.

Holography is one of the fundamental ways to understand and produce spatially-dependent visual perspectives. The holographic image is based on optical-material interference rather than sensors and programs; the information is enfolded within the surface rather than being applied onto it. We sense the difference by moving around and returning to find the image again. The holographic image has its own presence, which we move through, playing the image with our own perception and agency.

The spatially dependant holographic view allows for situations and understandings of a constructed environment embedded with experiential potentials. Programmed environments, such as relational architecture and responsive systems also enable an extended locality and augmented perception – however the sense of these systems is quite different. My hope is that the use of spatial imagery in the architectural environment will not just allow for the delivery of dynamic images, but that by negotiating these images we develop the relationship of body to environment – locating our complex selves with a greater understanding through a sense of agency. Through experiences of extended agency and virtual movement, we can grasp and navigate through new virtual territories and conceptual systems.

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[193] Lakoff interview by Ian A. Boal, *'Body, Brain and Communication'*, Brook & Boal (1995), p121.

Holographic image processes

An aspect of holography that I have not discussed is the use of holograms as sensors[194] or their role in optical computing, mainly because these technologies are not yet available on the scale of physical interactions with which I work. Holographic principles are however the basis of laser scanning, a technology that has been adopted into a range of imaging practices. If and when active holographic sensors are used for visuo-spatial recording, processing and displays, these technologies have the potential to open up new aspects of media engagement.

Holographic video is one technology currently being developed[195] that incorporates visual motion with holographic information. However, if these displays are designed only for a stationary viewer in front of a holographic screen, then we have lost a huge potential of the medium.

An understanding of holography becomes more important with the development of a whole range of technologies. While it is widely known that a hologram broken into pieces still contains the whole image, the implications of this encoding in relation to located perspective and dynamic forms has been largely ignored. Bringing a holographic understanding that includes movement and emergent cross-referencing into the design of visual media, I see as crucial for maintaining the primacy of the body in experience. What I consider most important is that access to virtual layers of experience occurs not only through devices, but requires a physical presence and agency that engages us socially and as embodied individuals. Wearable computers and gestural interfaces are already breaking the convention that virtual interactions occur seated in front of a computer. The hologram takes this a step further, directly addressing how information can be physically encoded and accessed.

In *Chapter 2,* I briefly described how the directing and nature of 'the gaze' has been part of political and social shifts, particularly from that of an observer in early 20th century to the co-creator of the 21st century. There are similar discussions arising with visual technologies (both holographic and programmatic) that allow for the choreography of movement. A critical issue of gestrual computer interfaces was explemplified by the experience of a colleague who was beaten by a 10-year old girl in a Nintendo Wii dance competition. After watching a video of the 'dance-off', my colleague was dismayed; "she was not dancing but just poking the controller around in the air".[196] Rather than the interface recognising an aesthetic quality of dancing, the 10-year old girl had learnt to move for the computer.

We should question the intentions and affects of 'movement', as we do 'the gaze', as both have the ability to change the way we consider ourselves and engage with each other through visual media. In communicating through gestural interfaces we engage with an embodied mind, developing conceptual understandings that acknowledge a physiological and intrinsic link between the body and its environment. By working with movement in its enfolded form, the encounter can convey a richness that belongs to both the activity of recording and the act of unfolding.

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[194] Such as, http://www.smartholograms.com

[195] HolographicTV is one of the research projects being developed by the Object-Based Media group of the MIT Media Lab – http://obm.media.mit.edu/ and active holographic displays are being developed at The University of Arizona, College of Optical Sciences – http://www.optics.arizona.edu/

[196] Daniela Kinateder, quoted as remembered, Cologne, 2010.

Towards holography

"Let's get to the real deal, let's place a video call to Obi One Kobi. We're headed towards holography and until we get there the hypercubists[197] will point the way to the future."

Gabriel Shalom, 2010 *hypercubist manifesto* 5:57 – 6:08 min

Star Wars, 1977

Slide shown by Shalom when presenting his *hypercubist manifesto 'Pecha Kucha',* Berlin, 31 August 2010. [source: http://vimeo.com/14604303]

Implicit in the quote above from Gabriel Shalom's *Hypercubist Manifesto*, is the suggestion that we have not reached the envisioned role that holography could play as a medium. Holography is still in its infancy – it is not yet a vernacular practice, and as such could be compared to early photography or film making, particularly because of the need for elaborately constructed devices and dedicated facilities to produce an image. At one end of the spectrum the Do-It-Yourself practice of 'Shoebox holography'[198] can be compared to home-made pinhole cameras, while large corporations[199] are researching and developing consumer holography products along with calculating how they could be commercially successful.

How wide spread accessibility to current technology (such as digital printing, miniature pulse lasers and photopolymer films that do not need chemical processing) will shape holographic imaging practices has yet to be determined. What aspects of holography will be adopted into future devices and displays is still being defined, yet the current cultural trajectory seems to be narrowly focused on 'Princess Leia' – a holographic illusion in midair.

In considering the commercial value of holography, Ralph Schneider proposed[200] that the hologram should not be considered as an object or thing but as a virtual volume. Through this research, I have drawn movement into this potential of the virtual 'real-estate' that the hologram offers. The main purpose of my holographic installations is to engage the viewer dynamically through a holographic structuring. A dynamic that is established by working the image into the feedback loop of active perceptual experience. Encountering the holographic image then activates a similar process to when

[197] Hypercubism is a practice of cubism expanded onto multiple surfaces or through time-based images.

[198] A term used by Frank DeFreitas in his dissemination of low cost production methods online [http://www.holoworld.com/holo/diode11.html].

[199] Including SONY, HP and Samsung.

[200] Schneider (2010) conveyed in English through a private conversation, Cologne, May 2011.

we are in motion and navigating a new territory. Underlying this experience is our ability to move, and how this movement shapes our conceptualisation of space.

In 1982 Victor Burgin considered the essays he brought together for *'Thinking Photography'* as "contributions towards photography theory" – emphasising his choice of the word 'towards' – "as the theory does not yet exist".[201] Similarly, there is a long way to go before the potential of holography is developed into media theory.

One approach towards holography is to consider how multiple perspectives can be spatially arranged. Holographic and lenticular video screens[202] allow for the overlaying of imagery with both spatial and temporal montage possibilities. Active holographic materials are also being developed to enable 'real-time' holographic images[203]. The compositional possibilities of combining spatial dependency with temporal dimensions could open up new potential structures of engagement. Just as I found a need for anchoring the multiple perspectives of the multiplex holographic scene, I suspect a scene with intertwined spatial and temporal dynamics will utilise a structure and/or rhythm of hinges.

Compositional questions will remain whichever way image practices co-emerge with holography, including: with what pattern or structure to map; where to situate and lead the gaze as well as movement; and how to engage embodied cognition. Each new medium and approach allows us to look outwards and recognise ourselves through a reflexive engagement. Our own perceptual processes enable the emergence of virtual experiences that, in turn, inform our sense of embodiment and location.

[201] Burgin (1982), p1.

[202] These displays direct a number of different images across the viewing space. For example placing a lenticular in front of a screen [www.alioscopy.com] or when a holographic screen directs the images from multiple video projectors Sang et al. (2009).

[203] Such as photorefractive polymers, Volodin et al (1995).

Appendix: Chapter 0 – Inside the practice of holography

This section offers an overview of some of the technical aspects of holographic imaging. I have focused on the specific principles that inform my work, such as the parameters of the physical processes of making holograms and the aesthetic characteristics of different types of holograms.

The role of this section is also to introduce readers who are not familiar with holography to the technical and conceptual background of the field. While this section is an appendix, it has been titled 'Chapter 0' – both to place it as a prequel to my work and also as an ode to Stephen Benton (1941–2003), a brilliant and influential character in the small holography community. Benton would begin with a Chapter 0 to establish why a particular inquiry was relevant. By developing a basic understanding of how holography is a distinct visual medium and way of encoding information, I aim to help the reader see why holography is a unique tool for visuo-spatial practices.

What is a hologram?

A hologram is a physical structure that diffracts light into an image. The term 'hologram' refers to both this material encoding and the resulting image. A hologram is an image and a shaping of light.

The hologram captures light as it interests the whole area of the film, hence being described as a 'window with memory'. By contrast a photograph captures a single small area 'aperture' of perspective, the photographic image being created by focusing this light onto film or a digital sensor.

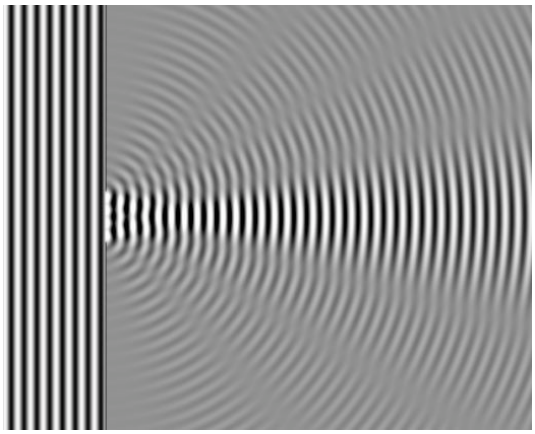
The physical medium of holographic film is photo-sensitive with a fine grain structure[204]. The physical structure of a hologram is recorded by the interference pattern of two or more optical-wavefronts. With display holography, this is usually an 'object' beam that emanates from an illuminated scene or the projected image on a screen, and a 'reference' beam that is shone directly onto the holographic recording medium. These wavefronts combine at the recording medium as an interference pattern of constructive (intensity peaks) and destructive (elimination) of the superimposed electro-magnetic field. By using a coherent laser light-source and a stable geometry (or short 'pulse' duration), the interference pattern is stationary and can be recorded into the hologram's photosensitive emulsion. The hologram is then chemically processed[205] so that the emulsion has a modulated density, freezing the interference pattern into 'fringes'.

[204] Resolution of holographic film is often described in lines per millimeter (ln/mm), which is the finest diffraction grating spacing that can be recorded. Common films range fro 1000 – 5000 ln/mm.

[205] For the silver halide materials that I use, this is photographic developer and then bleach.

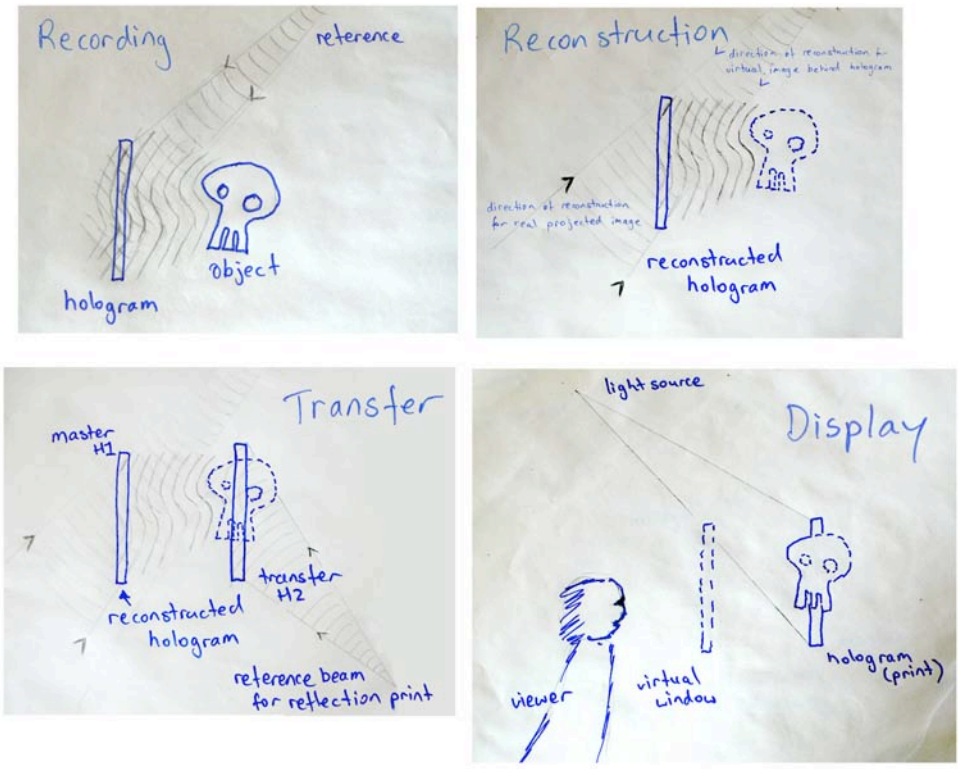
A Moiré pattern results from the interference of two similar undulating patterns, such as stripes
The Moiré pattern shown above is from the superposition of a shifted wave-pattern
[Kafri and Glatt 1990, p31]

When looking at the modulated ‘fringe’ structure of a hologram under a microscope it does not look like the image encoded within. When the hologram is re-illuminated light ‘bends’ around the microscopic fringe structure. This bending is called diffraction and occurs because optical waves propagate spherically. Uninterrupted this propagation adds up to a beam of light traveling in a straight line. However, when a wavefront however hits a barrier with an edge the light that passes through the barrier then spreads out.



A plane wave passing through a barrier (traveling left to right), resulting in diffraction and interference
[source: http://bsmooth.hubpages.com/hub/Laser-Light]

If the direction and shape (curvature) of the light is similar to the reference beam, then the hologram diffracts the light into the shape of the other wavefront, reconstructing the recorded image.

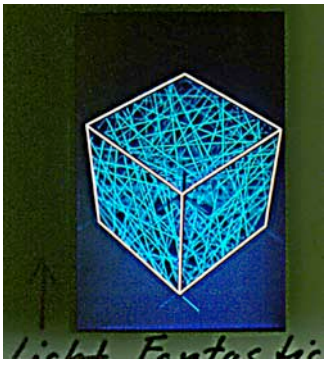


Sketch of process: Recording, Reconstruction, Transfer and Display

The optical field scattered from the original object or by the screen is encoded across the perspective of the hologram 'window'. Looking through this window the holographic image appears to occupy space – the viewer can move around to see different parts of the recorded scene. But the holographic scene is now a virtual rendering optically reconstructed by the diffraction of light through the hologram's structure.

When light travels through the modulated density of a hologram the wavefronts diffract – they are shaped into a spatial image. This is the holographic image we see in (and of its own) space, existing around the hologram's surface.

Line Addition by Andrew Pepper combines a surface drawn point-perspective diagram of a cube with a holographic image of lines within this cube. The work allows for both a contrast between the different ways of tracing a virtual volume, while reinforcing the perceived spatiality by mutual suggestion.



Andrew Pepper, *Line Addition*, 1984
Reflection hologram, 20 x 25 cm
[source: The Jonathan Ross Hologram Collection, http://www.jrholocollection.com/collection/pepper.html]

Upon encountering a hologram, what is most surprising is that a surface seems to hold a space. The difference of scale between the optical shaping by the hologram structure and our material sense of it as a surface produces a perception of a virtual form, as if the light holds its own shape.

A well articulated hologram that illustrates and plays on the nature of the optical medium is Rick Silberman's *The Meeting*. The object, its shadow, and its holographic image are brought together in a composition that reveals their interdependency and different types of presence.

Rick Silberman, *The Meeting,* 1979
Reflection hologram, 25 x 20 cm
[source: The Jonathan Ross Hologram Collection, http://www.jrholocollection.com/collection/silberman.html]

The holographic image of the glass sits in the place of the broken off part of the object. The holographic image is a virtual extension of the missing part of the object. Looking at a photograph of this work, it can also appear as if the glass is whole and partly filled with water. Even in the photograph, however, the physical presence of the broken stem is differentiated from the immaterial holographic image by the shadow.

Most holograms have a perceptually intriguing ephemeral presence. The holographic image is a physicalisation of light – it holds form but not material. The optical quality of the holographic image often has a visual softness or limited colour palette that gives sense of a recollection, where dimensions and details are skewed by the reconstruction. This quality is quite different from the crisp uber-realism of high-resolution 3D cinema.

I have focused my discussion on display holography, that is, holograms of images for the human viewer. The holograms discussed are recorded using silver halide emulsions, there are other mediums such as dichromate gelatins and photopolymers that have their own characteristics but a similar appearance, and require different processing. Embossed holograms are surface structures that are stamped into a foil. The micro-structure of grooves diffracts the reflected light into an image. Embossed holograms are an optical variable device (OVD) with applications including security identification, such as on passports, credit cards, tickets and packaging. Embossed holograms are difficult to copy without the master hologram, thus are used to demonstrate the authenticity of products or documents. Holography also plays a role in photonics, optical tweezing and a number of other optics applications. These applications of holography, however, are not part of this research.

Different kinds of holograms

There are a number of distinct types of display holograms that can be defined by their optical-geometry and the recording medium. What is common to all holograms is they can diffract light to reconstruct an image. The two basic geometries for holograms are 'transmission'– where the image is replayed by shining light through the hologram, and 'reflection – where the hologram is illuminated from the same side as the viewer and 'reflects' (by Bragg diffraction) particular wavelengths into the image. These techniques were developed from two different fields of enquiry and have distinct optical aesthetics.

The reflection hologram developed by Yuri Denisyuk[206] (1927–2006) followed the colour and spatial photographic recording practices of Lippmann photography and Daguerreotypes, which were created on polished metal surfaces. Gabriel Lippmann (1845–1921) claimed to have invented a method of colour photographic recording and provided a scientific explanation of how the emulsion structure recorded and then could reconstruct optical standing waves patterns, the particular wavelengths of which comprise a colour image. While Lippmann was the first to explain this process, later analysis has shown that his method of recording was similar to the Daguerreotype[207]. In a Daguerreotype/Lippmann recording and the reflection hologram, the colour of the image is selective, only being formed by the wavelengths that can resonate (form a standing wave) through the spacing of the fringes.

Lippmann's colour technique
[Syms (1990), p15]

The process of transmission holography developed from a series of scientific experiments and a developing understanding of the wave-nature of electro-magnetic radiation. The process of diffraction was demonstrated in 1912 by Max von Laue who diffracted x-rays through a crystal lattice of copper sulphate. Experimental results were then formulated in 1913 by father and son, William Henry Bragg and William Lawrence Bragg, into Bragg's law of diffraction ($2d\sin\theta = n\lambda$), which equates the fringe spacing (d) to the angle of deflection (θ) for any given wavelength (λ)[208]. Using this relationship diffraction gratings can be made to control the angle of deflected light and separate different wavelengths of light.

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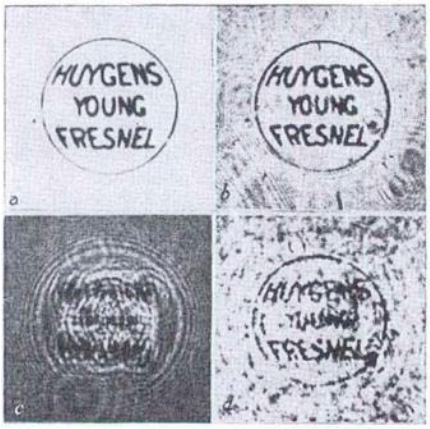
[206] Working in Russia, Denisyuk developed reflection holography separately from the transmission work that was occurring in the USA and UK.

[207] Barger and White (1999) p103 - 112.

[208] n = an integer representing the 'order' of diffraction, the zero order is the un-diffracted beam while the 1st order is the holographic image, further orders are suppressed by volume holograms but can be seen with the diffraction through a crystal lattice, thin diffraction grating or a distant light through a mesh.

The key step in the development of holographic imaging was the use of a reference beam to encode one wave by superimposing it with another (to record the interference pattern). This 'double diffraction' process was proposed by Denis Gabor in 1948 in an attempt to improve the design of the x-ray (electron) microscope. However, Gabor's experiments were limited to optical-waves travelling close to the optical axis (paraxial rays) and hence when used for optical holography the reconstruction beam was co-incident with the image, and thus would shine directly into the viewer's eyes.



Left: Denis Gabor's hologram recording technique. [source Gabor, 1948]
a) Original micrograph with 1.4 mm diameter b) Micrograph directly photographed
c) Interference pattern obtained by projecting the micrograph onto a photographic plate with a diverging beam d) Holographic reconstruction from interference pattern
Right: Emmett Leith and Juris Upatnieks, *Train and Bird*, 1964
Laser-viewable transmission hologram [source: www.holophile.com/history.htm]

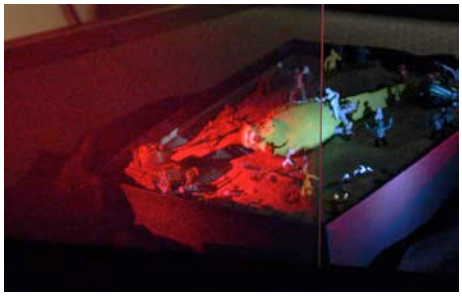
Emmett Leith and Juris Upatnieks while working with side-reading radar developed the technique of off-axis optical holography in 1962. Their theory proved practicable when they gained access to a laser in 1964 and produced a number of holograms. The potential of holography was recognised the moment these holograms were published, causing a flurry of research and Gabor's awarding of the Noble Prize for Physics.

As transmission holograms diffract all of the illumination into the image, 'mono-chromatic' light (such as from a laser) is needed to reconstruct a sharp image. Stephen Benton developed transfer geometries that allowed transmission holographic prints to be viewed with a white light source; including the rainbow hologram in 1969 and using an achromatic geometry in 1977 to recombine the spectrum.

Left: Stephen Benton looking at a rainbow hologram. [source: http://www.media.mit.edu/events/past/2003]
Centre: Polaroid Patent Rainbow Hologram, 1975
Rainbow hologram on film in card mount, 4.5 x 7" [11.4 x 17.8 cm]. [source: The Jonathan Ross Hologram Collection, http://www.jrholocollection.com/collection/benton.html provenance: Abe Rezny Collection]
Right: Stephen Benton, Herbert Mingace, Jr. and William Houde-Walter, *The Bartlett Head (Aphrodite),* 1978
Achromatic white-light transmission hologram on glass, 13.5 x 12.5" [34.3 x 31.8 cm] at MIT Museum

The laser-viewable hologram

The laser-viewable transmission hologram allows for a near perfect reconstruction of the optical field. I sometimes play a trick on students when making this sort of hologram. After processing, I place the hologram back in the position where it was recorded and sigh as if exposure was unsuccessful. I get the students to look through the hologram at the object on the table and explain how if there is too much vibration the interference pattern blurs and no fringes are recorded into the emulsion. While the students are still looking I remove the object and to their astonishment the image of the object remains, exactly where the object had been. In observing this, there is a strange sense of peeling, a displacing of the material from its optical skin as the object is separated from its image.



Academy of Media Arts (KHM) holography class*, The battle for the sandbox,* 2011
Laser-viewable master holograms shown with original object, 8 x 10" [20.3 x 25.4 cm]

The laser-viewable transmission holographic image is the colour of the light used to replay the hologram. With normal reconstruction the recorded scene appears behind the film, and when replayed by a laser this scene can be very deep and sharp. Artist Paula Dawson who has worked extensively with laser-viewable transmission holograms describes these recordings as 'concrete' holographic images because they create a sense of physical presence[209].

The holographic print

The laser-viewable transmission hologram can also be used as a master to project the optical holographic image so that it can be transferred into a second hologram – a holographic print. In transferring the hologram it is possible to manipulate the image-field, including: the image's placement in relation to the film, magnification, distortion, colour control, and also to record multiple masters into one print.

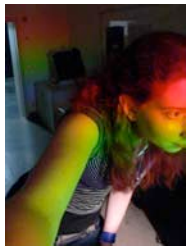
A holographic print can be recorded with either a transmission geometry – created when the reference and reconstructed image come together from the same side of the holographic film; or using reflection geometry – with the reference and reconstructed image coming from opposite sides.

Rainbow and achromatic transmission holograms

Transmission holograms have a visual quality of a diffraction grating, as found naturally in opals, that appears as a spectrum of colour. When illuminated with a white (broad spectrum) light source the transmission hologram will diffract all the wavelengths of light into the image. However as red-wavelengths are longer, they are deflected more than blue-wavelengths and so the image will have some colour smear – the multi-spectrum light spreads into a rainbow image. This principle is ultilised for the rainbow hologram developed by Benton in which only a narrow slit of the master is transferred. The

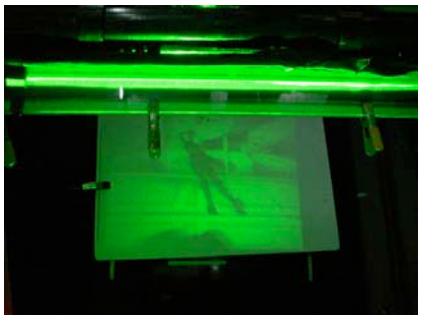
[209] See [Ch2.A1].

rainbow print has image parallax in only in one direction, while in the orthogonal direction the image is formed by the diffracted spread of the spectrum.



Looking into a rainbow hologram, Cologne, 2006

A rainbow hologram, recorded from a horizontal master strip and replayed with a light from above, will have horizontal parallax – enabling the spatial qualities when looking with two eyes or moving side-to-side. But moving up-and-down produces no change in spatial perspective and viewer only sees a change of colour.



Left: Photograph of the projected image reconstructed from a master strip that can then be transferred into a rainbow hologram

Note: The image has been rotated 90-degrees from its orientation on the optical table to show the way it would be viewed.

Right: Photograph of a rainbow hologram *Unfurl*, partial, 2004/5

This spectral smearing gives a 'rainbow' appearance – a saturated colour palette. By recording a number of masters on an achromatic angle the spectral colours can be combined to produce whitish or colour-mixed images

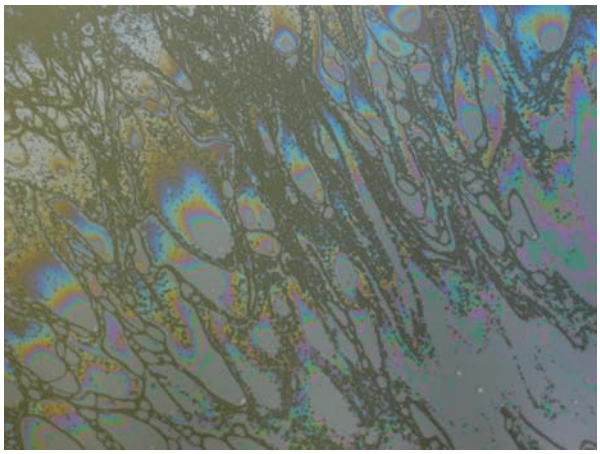
Left: Three master channels recorded on a single piece of film

Right: Three-colour (red, green and blue) multiplex holographic print *Pascua Lama*, 2006

One advantage of using achromatic geometry is that the image can be replayed with different colour intensities. For example, red, green and blue channels reconstructed together create a range of colours. As the ideal viewing area of three channel-colour transmission holograms are where diffracted red, green and blue light from each corresponding master-strip coincide, this limits the correct colour viewing to a narrow area projected into space (a 'letterbox' viewing window).

Reflection holograms

The reflection holographic image is formed by only the particular wavelengths of light that constructively interfere through Bragg diffraction from the physical structure of fringes.

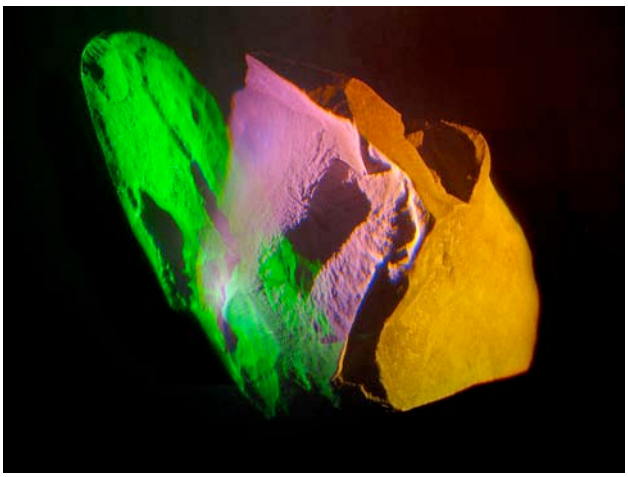


Photograph of thin film interference, Newtown Creek, New York, 2011

The Bragg diffraction by the refection hologram is analogous to the coloured bands seen from thin film interference, such as when a layer of oil sits on water, the different thickness of the oil layer determines which colours constructively interfere and are reflected.

By manipulating the chemical processing, the holographic fringe structure can be expanded or shrunk changing the colour of the reconstructed image. A Denisyuk reflection hologram uses a single beam that is shone through the hologram plate to illuminate the object as well as being the reference. The depth of this type of hologram is limited and the image appears to be behind the film plane.

Pseudo-colour reflection holograms can be created through multiple exposures between which the emulsion is swollen or shrunk to shift the recorded fringe spacing and therefore colour, a technique that has been used extensively by John Kaufman and Iñaki Beguiristain.



Left: John Kaufman, Canted Fragment, 1994

Reflection Hologram, 30 x 40 cm [image courtesy of the artist]

Right: Iñaki Beguiristain, *Telephone - Theydon Bois 2286,* 2001

Three-colour reflection hologram, 30 x 40 cm

[source: http://www.displayhologram.co.uk/archiveobjects.html courtesy of the artist]

By using multiple colour lasers a full colour Denisyuk reflection hologram can be recorded and is almost indistinguishable from the original object. The tendency on encountering such an image is to check its authenticity – to look behind the plate for the object.

Reflection holograms have been used for the recording, display and dissemination of precious and fragile artifacts such as the hologram of the *Lindow Man* in the British Museum.

Left: Hans Bjelkhagen, *BejeweledFish*
True colour (panchromatic) reflection hologram
Han Bjelkhagen is a scientist who has worked extensively to improve the colour reproduction characteristics of holograms
Centre: Richmond Holographic Studios, *Lindow Man,* 1987
[source: The Jonathan Ross Hologram Collection, http://www.jrholocollection.com/collection/rhs.html]
Right: Hans Bjelkhagen, *Decorated horse jaw*, 2010
'The Virtual Artefacts Exhibition – Bringing the Artefacts Back to the People' across Wales, 2010
[source: http://www.llangollenmuseum.org.uk/english/VirtualArtefacts/Exhibition.htm]

Reflection hologram prints have a visual softness, the light forms a membrane that can project out from the film. An example of this glowing texture is the skin in Ana Maria Nicholson's portraits. Holograms such as *At the Gate* and *Cocoon* were made using a pulse laser master and two colour transfer, mixing the reconstructed colours. Nicholson describes her fascination with holography: "Objects and people shed their dense materiality and became shells of light"[210]

Ana Maria Nicholson's holograms
Left to right: *At the Gate,* 60 x 50 cm. *Cocoon,* 50 x 60 cm
Two-colour (colour mix) reflections hologram from pulse laser masters
[images courtesy of the artist]

[210] In the video *Portraits in Laser Light,* 0:40 min [source: www.anamarianicholson.com].

Kate's Faces, a hologram made by Robyn Beeche at Richmond Holographic Studios[211] is an example of a multi-channel technique using multiple masters to create a reflection holographic print. The placement of each master determines the viewing position through which each hologram 'frame' can be seen. In *Kate's Faces* these different angles of view correlate to different expressions.

Four photographs of *Kate's Faces* by Robyn Beeche, 1986
Multi-channel reflection hologram, 43 x 33 cm.
'*Fashion Face: Fashion Photography by Robyn Beeche 1979 to 1989'*
RMIT Gallery, 2007. Photographs taken with the artist's permission

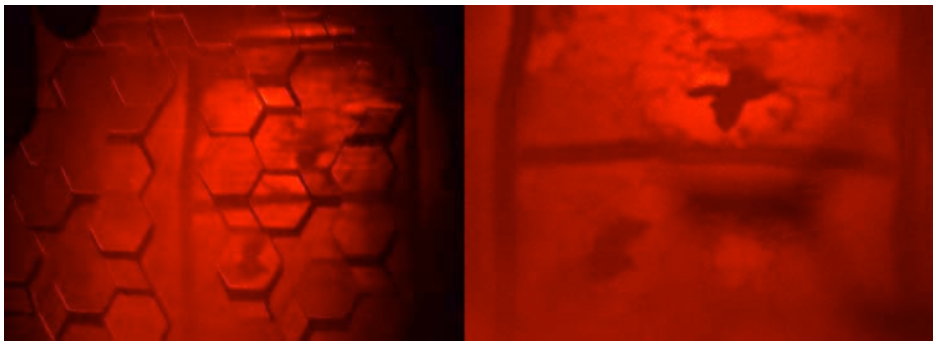
Multi-channel and multiplex holograms

Another one of Lippmann's experiments was intergral photography, proposed in 1908. This technique uses a sheet of fisheye lenses to record an array of perspectives. The recorded pattern can then be reconstructed back through a lens sheet recreating the scene with full parallax over the recorded area. This is the basis of lenticular images, and the array of lenses act in a similar way to the array of perspectives recorded into a multiplex hologram.

Principle of integral photography: (a) recording (b) reconstruction with broken line figure showing secondary integral (akin to the master hologram) that is then transferred
[Ōkoshi (1976), p22]

Multiplexing is a technique of recording multiple holographic exposures across the surface of the master hologram. Each exposure region captures a small aperture of perspective, recording the interference pattern of the incident wavefronts. By transferring a multiplexed master, a final print can be produced where the 'virtual windows' onto the scene are fragmented. This breaking up of the viewing perspective allows for spatial animation, stereopsis and depth perception by parallax as the viewer moves around.

[211] Founded by Edwina Orr Richmond Holographic Studios was located in Richmond, UK.



Broken Window Birds, 2006

One of my stencilled laser-viewable transmission holograms (master hologram), 4 x 5" [10.2 x 12.7 cm]
Replayed with a red laser and photographed at varying distances

The incident field from a 3-d scene can be pixilated into multiple 2-d images. Optically by reducing the aperture an image can be resolved from the incident field. The pinhole camera shows this principle. The reference beam used to record a hologram encodes not only the intensity of this field but also the direction of travel allowing for the directed projection of the image. By moving through multiplexed perspectives a 3D scene can be synthesized from multiple 2-d views.

In a pinhole camera the optical field through a small aperture produces a sharp image

The fence project, 2004/5

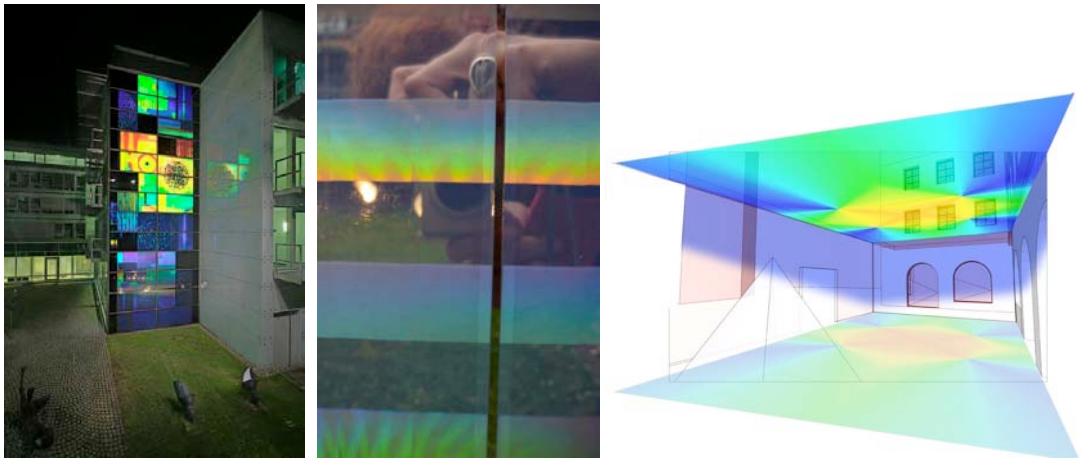
Left to right: Visual model of pinhole camera. A pinhole camera I made and used to record arrays of views through chain-link 'cyclone' fencing that informed my thinking about the multiplex process. One of the pinhole photographs placed back in a fence for *'into the holographic landscape'*, 2006

Lloyd Cross developed a one step process of recording multiplex holograms in 1972, using a sequence of film frames to make a cylindrical hologram where the image appears in the centre. The process combines cinematographic and holographic techniques to display a short animated image loop. By either rotating the cylinder, or if the viewer walks around, the animated image is seen. Peter Claudius, who worked with Lloyd Cross, used the cylindrical format to titillate viewers with images such as *The Flasher* 1978, an image in which the subject opens her trench coat, enticing the viewer to walk around the cylinder, and yet teasingly from the other side she has closed her coat again.

Multiplex hologram by Lloyd Cross and Pam Brazier, *The Kiss*
Left three images: *The Kiss II* c 1976, Multiplex hologram on film 12 x 23 cm
[source: The Jonathan Ross Hologram Collection, http://www.jrholocollection.com/collection/cross.html]
Right: *The Kiss*, 1973. On exhibition at MIT Museum
[source: http://www.flickr.com/photos/nsicchia/3045426820/]

Dot-matrix holograms

Dot-matrix hologram printing is a technique of building up an image of diffractive 'pixels'. Each area is recorded with a particular fringe geometry that diffracts light by a corresponding angle. The illuminating light is deflected into varying colours (with a reflection hologram) or varying angles of divergent colour-spectrums (with a transmission hologram). The image is a tiling of colours which means the images are very bright but do not have 3-d depth information. Dot-matrix holograms have been used as a means of decorative 'light architecture'. Michael Bleyenberg defines 'light architecture': "This term indicates a vision: to 'plan and construct' environments beyond everyday perception and experience, barely tangible, not using solid material, but the ephemeral medium light."[212]



Michael Bleyenberg's 'light architecture'
Left: *EyeFire/AugenFeuer*, 2000. German Research Association(DFG) building in Bonn, 13 x 5 m
[source: http://www.holonet.khm.de/eyefire/Augenf_eyefire.html]
Centre: Close up photograph that I took of *EyeFire/AugenFeuer*, 2008
Right: Design for a light façade roof in collaboration with blauhaus Architekten, Nürnberg, Germany 2010
[source: http://www.holonet.khm.de/eyefire/]

[212] Artist statement from http://www.holonet.khm.de/eyefire/, the word 'once' was removed after the colon for better grammatical sense.

Computer generated 'digital' holograms

With computer generated 'digital' holograms, the fringe pattern of each pixel is calculated and recorded into the hologram. There are a number of ways of making digital holograms in which small regions of the film, termed 'Voxels' or 'Hogels', are exposed to the pre-calculated fringe pattern, such as by using a Spatial Light Modulator (SLM) or electron beam lithography. In early systems these Hogels were noticeable,[213] causing the surface of the hologram to look pixilated. This surface pattern disrupts the optical ephemerality of these holograms; it is obvious that the information is on the surface.

Most of the commercially-produced digital holograms are reflection images allowing for full[214] colour images. These holograms have an uber-digital aesthetic that is closer to computer graphics (CG) than traditional holography.

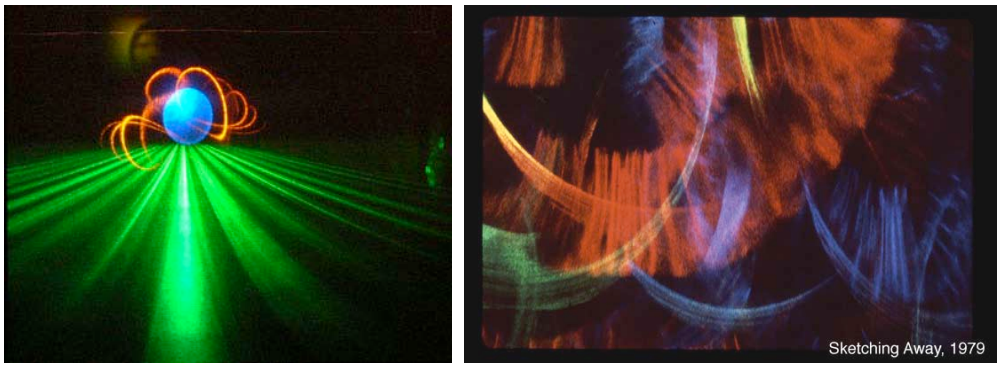
Left: Geola Technologies Ltd *Motorbike*, 2006
Full colour digital computer generated multiplex hologram, 45 x 59 cm
[source: The Jonathan Ross Hologram Collection, http://www.jrholocollection.com/collection/geola.html]
Right: Zebra Imaging *Downtown Seattle Holographic Print*
Computer generated digital hologram
[source: www.zebraimaging.com/gallery Copyright © Zebra Imaging. All Rights Reserved. Copied with permission]

While the quality of digital holograms continues to develop, very few artists have accessed these facilities. As the nuanced aesthetics of holographic images change with the technology, artists tend to comment on the medium, as well as use it to communicate concepts and impressions. Art holography will change as this sort of fidelity becomes the norm. Bill Viola, amoung others: has described the jump from video to high defintion (HD) video as requiring a different way of thinking – "It's a whole new medium".[215] Lev Manovich compares 4K digital video to the textural depiction of 17th-century Dutch paintings, including the excessively detailed Veduta style: "It achieves the poetic effect not by hiding the details in shadows or fog but rather by presenting them all – and letting our eyes delight in comparing different patterns and textures."[216] How digital holography is utilised artistically will continue to evolve with the technology.

[213] In 2006, I was able to produce an image with 8 mm wide Hogels, while current printing systems can print Hogels that are a fraction of a millimeter.
[214] Achieving 'true' colour with holograms is difficult, as it requires exact chemistry and environmental stability. This has often a problem with commercial applications, such as advertising where colour matching is critical.
[215] Bill Viola quoted in Wolff (2002).
[216] Manovich (2005).

Holographic optical elements

Holograms can also be used to direct light, which has commercial application in lighting design as well as being used for video projection screens. This property has been incorporated into the process of making holograms, notably by the artist Rudie Berkhout. Before the stenciling and digital printing techniques became widely practiced, Rudie Berkhout was creating spatially dynamic holograms, using multiple holographic optical elements (HOEs) to shape light into dynamic, abstract holographic image. Berkhout's work explores the optical landscape in relation to a cosmic nature of the perceptual field: "I like the work to oscillate between landscape and abstract painting, challenging viewers and jolting their usual perception of the world."[217]



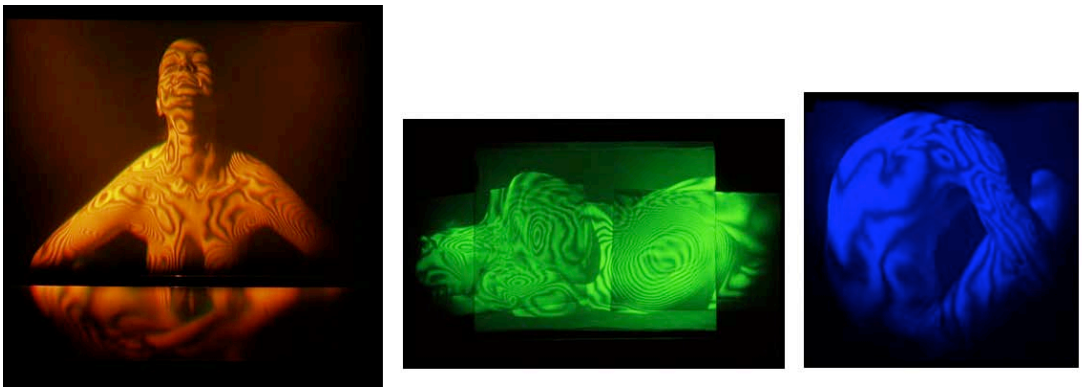
Rudie Berkhout's holograms

Left: *Event Horizon*, 1980. 8 x 10" [20.3 x 25.4 cm] White-light transmission hologram laminated in 30 x 40 cm
Photograph I took at the exhibition *'Light Magic',* Center for the Holographic Arts, 2009
Right: *Sketching Away*, 1979. 8 x 10" [20.3 x 25.4 cm] White-light transmission hologram laminated in 30 x 40 cm
[Courtesy of the Rudie Berkhout holography collection]

Holographic interferometry

As the holographic recording process is dependant on the interference pattern between waveforms, the holographic image is based on a comparison between waveforms. Holographic interferometry utilises this property to detected small variations in form[218], with application in industrial non-destructive testing.

As part of her *'Strata Series',* Sally Weber used a holographic interferometry technique – a double laser pulse – to show the movements of breath and blood under the skin.



Sally Weber, *'Descent'* a six part series of holograms for the *'Strata Series'*, 2006
Open-aperture (laser-viewable), transmission holograms
Left to right: *Laccolith,* 26 x 27" [66 x 69 cm]. *Terrain* 18 x 36" [46 x 91 cm]. *Fossil* 26 x 26" [66 x 66 cm]
The pulse masters were recorded in 2001 at the Center for the Holographic Arts, New York
[source: http://www.sallyweber.com/descent.htm]

[217] Berkhout (1989).

[218] As shown with Margaret Benyon's holograms in [Intro.2].

The relationships that can be set up with the holographic image suggest a particular way of considering optical information. While there are a number of ways of making holograms, each having their own aesthetic qualities they all share the same underlying principle. Holography is a way of encoding by recording an interference pattern. The reconstruction of this image is an optical 'shaping' that appears distinct from the material surface. We perceive the light that flows through the hologram as holding space. This perceived space is dependent on the perspective from where it is viewed, allowing for a holographic scene with spatial dynamics.

Appendix: Catalogue of projects

A version of this catalogue accompanied the exhibition component of the thesis
presented as:
'*The Emergent Holographic Scene*'
at PostX, Ghent, Belgium, November 2011

Exhibition installations

Hover…

Asti & Gold Gallery, Melbourne, 25–29 May 2004
As part of the 2004 Next Wave Festival

Images of the holographic laser projections for the exhibition '*Hover...',* 2004

Holographic images of a dragonfly were projected around the gallery space. The holograms were hand animated using stop-motion and stencils. Mechanical contraptions scanned beams of laser light through the holograms to project animated images. The exhibition space had the feeling of a workshop and throughout the show I tinkered with the mechanical contraptions. The installation was designed to reveal poetically the process of holographic multiplexing and was accompanied by an art booklet.

Page 13 and 14 from the booklet that accompanied the exhibition '*Hover...'*, 2004

into the holographic landscape

Center for the Holographic Arts, Long Island City, New York, 21–24 September 2006



This body of work explored spatial dynamics within the urban environment using both holographic and photographic images. The installations were designed to help unfold the content of the holographic scenes and the image construction process.

In 2006 I was developing images based on how the urban environment could be captured in holographic scenes. The images were printed into multiplex holograms at the Academy of Media Arts (KHM), Cologne and then exhibited at the Center for the Holographic Arts in New York. Each hologram combined photographic sequences with computer-generated environments that explored the movement-dynamics of urbanism.

The virtual camera in the 3D computer-generated environment was a bodyless perspective with a metric view of space from a programmed line of movement. This view is completely different from that of the photographer in the city, using their body and lens to navigate and capture the image. A perspective through a hologram is different again. My aim with this series of projects was to create images somewhere between these ways of seeing that would give the viewer a sense of urban dynamics.

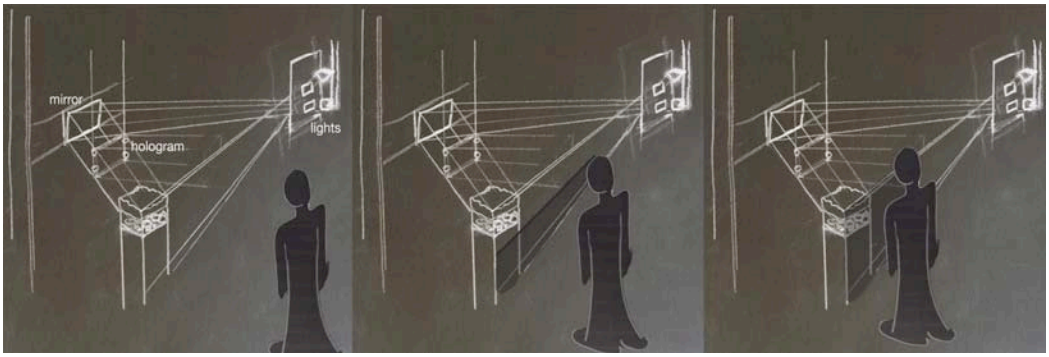
My first concerns were technical – such as how to create the gritty detail of the city with the limited resolution of the hologram and the glance perfection of the digital image. In working with computer generated environments I often found myself adding in analogue phenomena to produce a more tactile visual space – to give a sense of body to the perspective. In the stenciled analogue holograms I implemented a fragmentation (a process inherent to the digital) to dislodge the ‘concrete’ presence of the holographic image to create a sense of movement. The scenes bring together various understandings of perspective and are used as experimental thinking about image structure in terms of the relationships between them.

Pascua Lama

An installation within *'Trans Versa'*, Museo de Arte Contemporáneo, Santiago, Chile, 4 October – 5 November 2006

Working in collaboration with Ash Keating an Eski[219] was constructed to house my hologram and Keating's models that were part of a project to protest and bring awareness to the Pascua Lama gold mine. The viewer was confined by the Eski and this emphasised the animate and spatial qualities of hologram. The lighting also produced an affect of disappearance as the viewer's shadow disappeared as they approached the work.

Three-colour transmission 200-frame multiplex hologram, 30 x 40 cm in the installation *Pascua Lama,* 2006



Lighting diagram showing how the viewer's shadow disappeared as they approach the hologram

[219] An Australian brand name that became the generic term for a cooler/ice-box

Ex Tempore

Part of The Stairwell Project, Melbourne, 20 November – 4 December 2006

The exhibition *Ex Tempore* curated by Danielle Evans used a stairwell as an exhibition space. The hologram *Paternoster* was designed for this exhibition to resonate the vertical motion inherent to stairs.

Viewers looking at a hologram in the *'Ex Tempore'* installation, 2006
To play the hologram's animation requires the viewer to negotiate the stairs and the image simultaneously

Viewer looking at the holograms *AlongCityBridge* (left) and *Paternoster* (right)

Postkarten aus der Tiefsee

Galerie fünfzehneinhalb, Cologne, 20 July 2008

Two of the postcard-map series of holograms were exhibited along with *Slide* (placed opposite the stairs), two of the *Jumping Jellyfish* (in the window above the front door), and a laser scanning animation by Nachtmann/Silies (on the upper level).

The exhibition *'Postkarten aus der Tiefsee'* in the tiny gallery *Galerie fünfzehneinhalb, 2008*

Playing on the absurdly tiny space of *Galerie fünfzehneinhalb* I presented a series of holograms with mirrors behind them so that the viewer not only had a physical intimacy with the holograms but was also visibly aware of themselves viewing the holographic images.

'Postkarten aus der Tiefsee', 2008

Beyond the Window

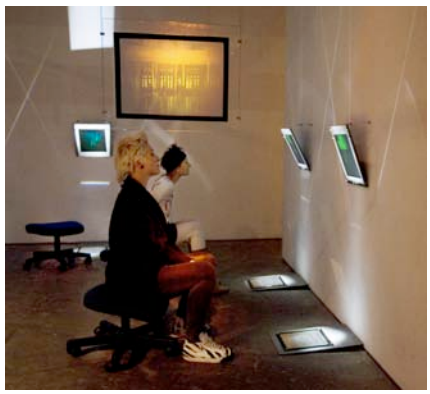
Bus gallery, Melbourne, 18 March – 5 April 2008

Artists: Lise Couchet, Clare Hassett, Martina Mrongovius, Erin O'Callaghan, Philippe Pasquier, Yandell Walton and the *'we're all looking'* photographers:

Shabana Ahmed, Briony Barr, Sarah Beetson, Sally Blenheim, Rebecca Cannon, Yiu Bun Chan, Lise Couchet, Lindsay Cox, Daniel Docherty, Misha Dumnov, Alexi Freeman, M. Hank Haeusler, Ceri Hann, Aniko Hazi, Chad Lane, Romaine Logere, Martina Mrongovius, Juliette Peers, Lynda Roberts, Ivan Sarkin, Danica Sladic, James Smith, Salote Tawale, Naomi Tettmann, Adele Varcoe and Yandell Walton

I was invited to curate an exhibition of works to accompany my holographic installations *'The Crossing'* and *'we're all looking'*. This group show explored layered imagery and suggestions of space, taking the concept of the picture plane as something more that an architectural window. The exhibition was accompanied by a catalogue, and text within the gallery:

> *Dreaming out the window thoughts unfold into the scene, anchoring and shifting the emotive landscape.*
>
> *This exhibition explores relationships in optical and sonic imagery through the connections, resonance and disjunctions of perception. Oscillating between the physical and virtual, the artists' imagery reveals relational dimensions within experience.*
>
> *The restricted encounter of each installation manipulates but also emphasises the agency of experience. Whilst not designed to be immersive, these works play on the individual's embodied palette of sense to express something beyond the image.*



Viewers in the main gallery space looking at the installations '*The Crossing'* and '*we're all looking'*

'Beyond the Window', 2008

Explorations of the holographic gaze

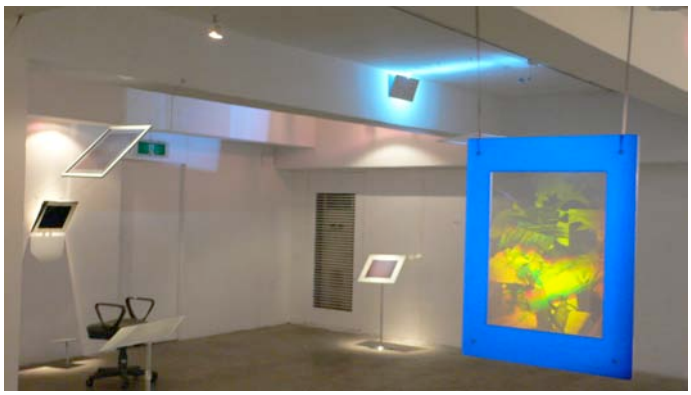
Gallery 175, Insadong, Seoul, Korea, 12–22 November 2010

'*Explorations of the holographic gaze'* brought together 16 holograms.

This exhibition of animated holograms explored the structuring of movement and gaze. Multiple perspective photographic and video recordings were constructed into spatially dynamic holographic images, which required the body movement of the viewer to explore the scene.

I appear as a protagonist in the images, my body is a visual anchor connecting the viewer into the holographic scene. This presence creates a sensual and visual resonance in the works, a familiar connection into these strange environments, while the dynamics induce a physical intensity and imaginative shaping.

The holographic works draw on the practice of psychogeography and urban exploring, where place is considered as a combination of the psychological, programmed and physical aspects of the urban environment. The captured experiences are driven by chance, rhythms and personal narrative.



Gallery view and viewers looking at holograms. '*Explorations of the holographic gaze',* 2010

The installation was designed to entice viewers to be aware of the activity of moving and looking in the exploration of these holographic scenes.

The Emergent Holographic Scene

PostX, Ghent, Belgium 18–20 November 2011

Working with the medium of holography my doctoral research focuses on the affect of a cross-referencing of movement in viewing multiplex holographic images. Since the multiplex hologram allows for the recording of virtual movement, such as a perspective that moves through a scene or an animation of the scene, and the viewer must move to activate this virtual motion there is a cross-referencing of the physical proprioception of motion and expected change in view with the virtual movement in the scene. My compositions use this affect to produce not only a visual sense of spatiality but also transformations in the perception of motion. An example is when the viewer's physical movement sideways produces a visual zooming into and out of the scene resulting in a dynamic sense of form or perception (such as with *UnderCityLink* and *Figure8 on Drummond Street*). A spatially dynamic structure of perspectives arises from the coupled cross-referencing of perceived motion and is ascribed to the scene as an animate quality, adopted by the viewer as an extension of perception or in most cases is an oscillating and complex combination of both.

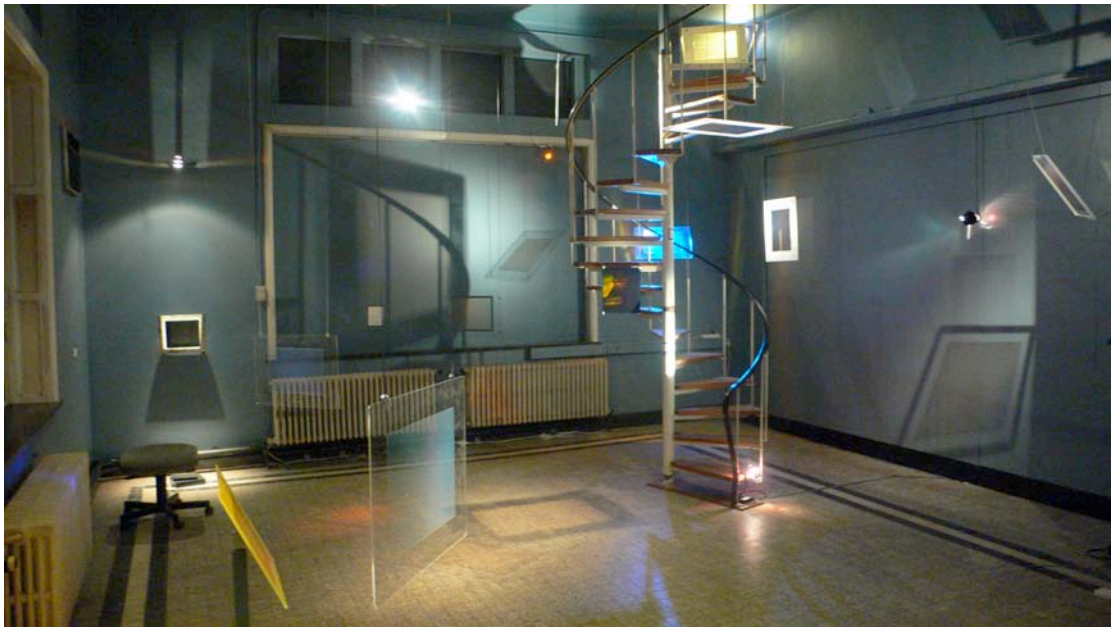
My investigation was developed around the experience of creating and viewing holographic images. The medium providing a framework through which a spatial and conceptual arrangement of images could be produced. The process of enfolding and unfolding connected perspectives in the capturing and viewing the holographic image became central to my acts of capture, compositions and installation designs. A relationship between the movement of the photographer and movement of the viewer, anchored around a visual pattern or physical path was used to produce a sense of dynamic shaping. I considered my holographic image mappings as a hyperlinked terrain, a scene emanating from anchored visual elements or paths of movement. The dynamic and spatial qualities of the holographic scene emerging through the process of capture/composition/installation by drawing on the viewer's perceptual experience.

The holographic image compositions allowed me to open up and explore the intersection of multiple perspective scenes and the sense of being located. My worked developed an understanding of perceptual shapings to the experience of motion by incorporating a sense of potential action and conceptual connection into a complex understanding of what it means to be located. The experience of being lost and feeling located being used to explore the alignment and misalignment sensory perception. This understanding drew on the activity of mapping – the conceptual sense of place that map could provide and record as well as how this sense was connected to an understanding of being 'here' physically and 'here' on the map or within a visual scene. This extended yet connected sense of location I considered analogous to how virtual motion could be incorporated into the experience of moving around to view a holographic image.

A key aspect of my work is to link the viewer's sense of moving around and exploring the image to the photographer's activity of capture. While there is an implicit perspective positioning to all image recordings from a camera, I wanted to show the activity of capture as an act of looking that is not only a spatial positioning but can reveal the photographer's bodily sense and conceptualisation of place. To enable the viewer to share this sense of perceptual activity I began visually including the photographer as the protagonist of my holographic scenes. The visual suggestion of an active bodily presence is an attempt to mimetically and empathically connect the viewer to the holographic scene. The viewer engaging with the holographic scene through both a sense of agency to animate the image and an awareness of the act of looking being an active part of shaping the visual structure.

The installations presented here are designed to enhance a physical awareness of viewing by enticing the viewer to move in particular ways that amplify or contrast the virtual motion of the composition.

My dissertation, *The Emergent Holographic Scene: Compositions of movement and affect using multiplexed holographic images*, developed through many projects. Some of the holographic image installations directly addressed the question of my research while others explored tangential themes. Each investigation contributing to a way of understanding the complexity that images weave through experience.



Photographs of the exhibition '*The Emergent Holographic Scene', 2011*

The mapping projects

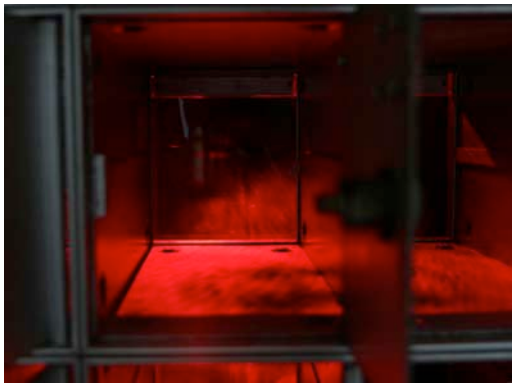
Establishing a sense of location through a process of mapping.

Are You Here

Multiple exposure pulse laser masters with open aperture transfers
Made at The Holographic Image Studio with Dr Martin Richardson, London, 2002
[Ch1.A2 : A mapping]

After moving from Melbourne to London I sought a sense of connection to my new neighborhood. So I explored the streets on my tiny bicycle, building my knowledge of place to establish my sense of location within in it. *Are You Here* is about the process of building a sense of location through developing a map of place.

35 mm film photographs looking into one of the four 30 x 30 cm laser-illuminated panels of *Are You Here*, 2002
Open aperture transmission hologram from two stenciled pulsed masters, one transferred into the print to produce an orthoscopic (normal) view the other is transferred to produce a pseudoscopic (inside-out) view.

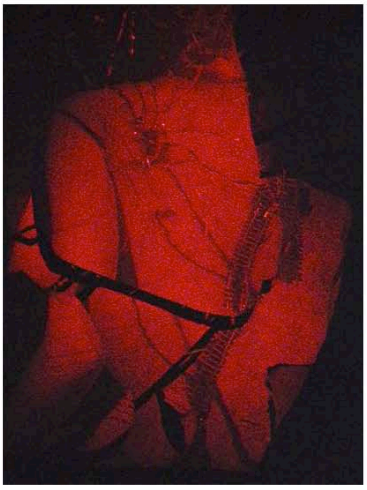


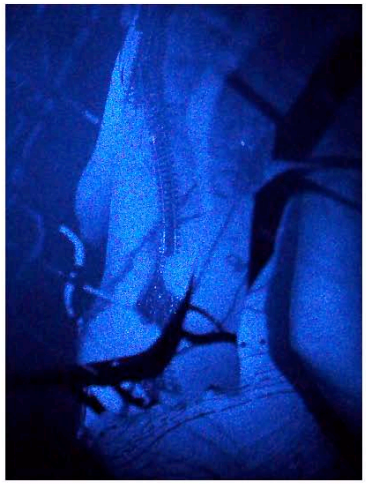
Four panels were installed in post-boxes to emphasise the need to look through multiple windows in order to view the scene. Other post boxes were installed with mirrors.
Photographs by Anna Baróthy. *'The Emergent Holographic Scene'*, 2011

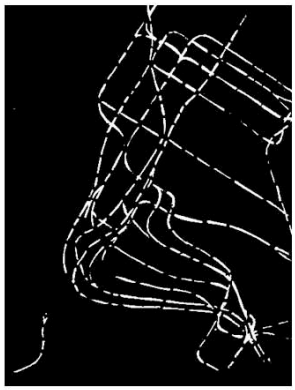
Map Dress

Stenciled pulse laser master with reflection print
Made at the Center for the Holographic Arts with Sam Moree, New York, 2005

Both the skin and surface of the hologram are considered as maps. The pulse laser exposure was made with three different stencils that formed a map of New York City. The dress I am wearing in the image was embroidered with a kind of map from Melbourne to New York by Naomi Tettmann including elements created by Rebecca Andrews, Danica Sladic and me.







Map Dress, 2004
Top: The laser-viewable master from two positions, 60 x 50 cm
Right: One of the three stencils used to produce the master, 60 x 50 cm
Below: Three views of the reflection transfer, 60 x 50 cm
Exhibited at Ente Gallery, Melbourne, 2004–2006 and SIAL Project Gallery, Melbourne, 2007

The fence project

Capturing sites with a pinhole camera, New York and Melbourne 2004/5
[Appendix : Ch0. Multi-channel and multiplex holograms]

I constructed a pinhole camera that could slot into chain-link fencing to photograph inaccessible – fenced-off – places with an array of multiple perspectives. The photographs were shown in a number of ways including being digitally layered into different virtual depths in the 200-frame multiplex hologram *looking through a pinhole fence*, 2006.

The fence project, 2004/5
Left: Images of the pinhole camera and photographs along with digital and analogue arrangements.
The project was shown as an installation for *'into the holographic landscape'*, 2006
Right: The photographs being arranged by the teaching assistants at The Korean National University of Arts, 2009

Approach

Sequence of photographs, 36 exposures on 35mm slide film, London, 2002
[Intro.1 : Research background and methodology]

This photo sequence was inspired by the visual symmetry of a balcony/breezeway/veranda that I would walk along on my way home. With habituated strides I would traverse this corridor along a border of contained and open space. Steps punctuated by lights above doors, and yet a single impression of a place through which I repeatedly crossed. *Approach* was an exploration of how an impression emerges from a sequence of photographs taken along a path with visual symmetry.

Approach, 2002
Five of 36 images from a 35 mm film photo-sequence

Building Time

Three-colour transmission 200-frame multiplex hologram
Printed at Academy of Media Arts (KHM), Cologne, with Peter Schuster, 2006

The hologram *Building Time* is composed to imply dimensions of space and time within the scene, including a time-lapse sequence of lights being turned on and off in a building. The scene was computer compiled with *Maya*. A number of stencils was used to create a layered ground, so that even though there is no vertical parallax it appears as if there is a vertical depth to the scene.

Left to right: Difference between last and first photograph of the time-lapse, the white outlined windows have been switched on or off in the duration of capture. One of the 200 images rendered from the compiled scene. Photograph of the hologram. Installation view *'into the holographic landscape'*, 2006

AlongCityBridge

Three-colour transmission 200-frame multiplex hologram
Photographed in Melbourne 2006
Printed at Academy of Media Arts (KHM), Cologne with Peter Schuster, 2006

A multiplex hologram that is also digitally stenciled to reveal parts of superimposed photographs that were captured along a path walking towards the city. The images were rescaled to maintain the skyline, layered and stenciled within each frame. The multiplexing then produces a shimmering effect.

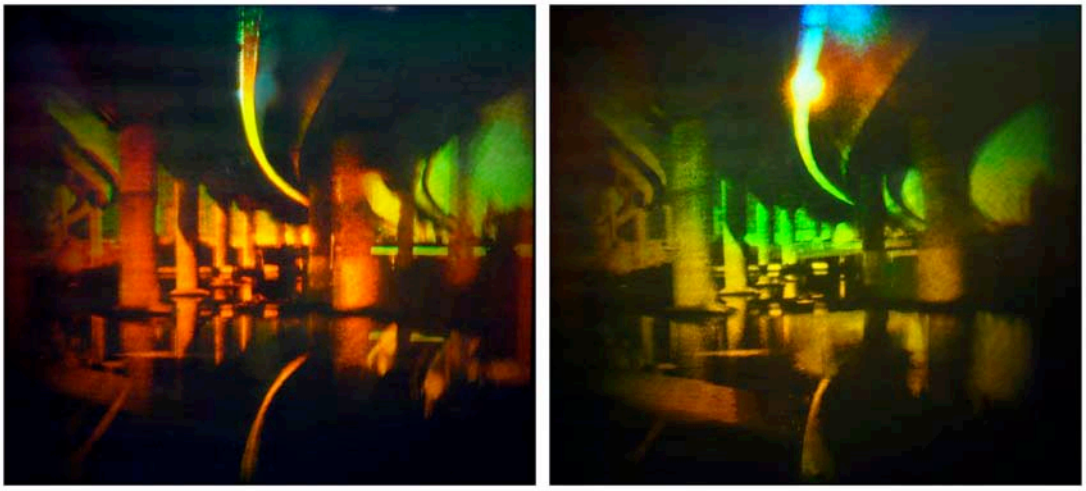
Five of the digitally stenciled images from the 200-image sequence used to print the hologram

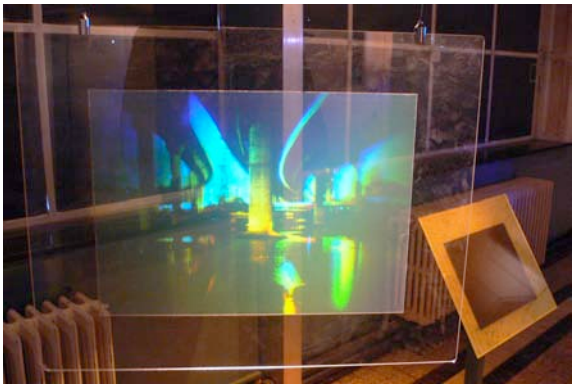
AlongCityBridge, 2006
Three-colour (RGB) transmission 200-frame multiplex hologram 30 x 40 cm
Exhibited: *'into the holographic landscape'*, 2006
'Ex Tempore', 2006
Opening exhibition of the Korean HOLOcenter, Seoul, 2007

UnderCityLink

Three-colour transmission 200-frame multiplex hologram
Photographed in Melbourne 2007
Printed at Academy of Media Arts (KHM), Cologne, 2007

Mapping a curved path of capture and long exposures into a holographic scene.





UnderCityLink, 2007
Three-colour transmission 200-frame multiplex hologram 30 x 40 cm
Top: Two photographs of the hologram
Bottom: Photograph of hologram installed at *'The Emergent Holographic Scene'*, 2011
Also exhibited at the opening of the Korean HOLOcenter, 2007

map to Heliosstrasse

Achromatic transmission 200-frame multiplex hologram
Printed at Academy of Media Arts (KHM), Cologne, 2008

The hand drawn map in the hologram is the way in which I gave directions from Ehrenfeld train station to 'Postkarten aus der Tiefsee' when inviting people to the exhibition.

Three of the digital images that composed the 200-frame animation, *map to Heliosstrasse*, 2008

Photographs of *map to Heliosstrasse*, 2008
Achromatic transmission 200-frame multiplex hologram, on mirror, 30 x 40 cm
'Postkarten aus der Tiefsee', 2008

I followed a box of matches to the Halászbástya but it was under construction

Achromatic transmission 200-frame multiplex hologram
Printed at Academy of Media Arts (KHM), Cologne, 2008
Reflection prints made at Center for the Holographic Arts, New York, 2008
[Ch1.B3 : A composition of movement]

Composition of a holographic scene from multiple paths of movement.

The far left and right frames of the sequence along with the vectors of virtual movement (centre)

I followed a box of matches to the Halászbástya but it was under construction, 2008
Achromatic transmission 200-frame multiplex hologram, 28 x 38 cm
An edition of this hologram was laminated to a mirror and exhibited in the style of a placard for the exhibitions '*Postkarten aus der Tiefsee'*, 2008 and *'The Emergent Holographic Scene'*, 2011 (right)

Also exhibited at Center for the Holographic Arts, New York, 2008
and the International Symposium on Display Holography, Shenzhen, 2009

Postcard from Shantytown

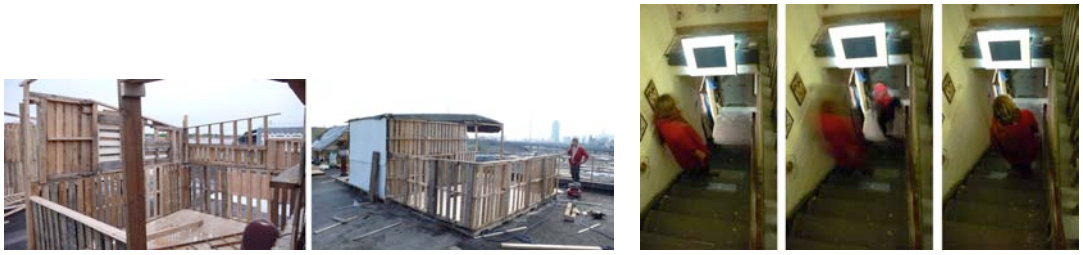
1800-frame multiplex hologram with open aperture transmission and reflection prints
Printed at Academy of Media Arts (KHM), Cologne, 2008
Reflection prints made at Center for the Holographic Arts, New York, 2008

Ian Montgomery began constructing a shantytown on the roof of the building on 43rd street in Long Island City in response to Flux Factory's looming eviction. The idea was to make functional shelters from collected materials, and explore the aesthetics of survival in New York City. When the Fire Department ordered its dismantling Shantytown consisted of two and a half shanties, a saloon and many dreams.

The holographic image *Postcard from Shantytown* was composed from the photographs I had of the short-lived collaborative art project *Shantytown*. Within the holographic scene there are nine chapters – seen as you move vertically – each documenting the people, structures and their relationships. The dynamics of the hologram postcard allow the viewer to explore this place that only exists in memories and splinters.

The holographic scene contains nine vertical channels each with a spatial quality and some animation. Both the open aperture transmission and reflection prints of this image have been exhibited.

Three views of the hologram *Postcard from Shantytown*, 2008
1800-frame multiplex hologram, framed in palette wood, 46 x 56 cm



Photographs from *Shantytown* construction and installation in the stairwell of Flux Factory (23rd street)
Exhibited: Shantydown Bar, Flux Factory (43rd Street), New York, 2008
'Housebroken' – the opening exhibition of the new Flux Factory (23rd Street), New York, February, 2010 – ongoing
In the group show '*Holography – the art of shaping light*', Beacon, NY, 2011

map of Here and There

20 squares, each a transmission 200-frame multiplex hologram, taped together so as to be foldable
Printed at Academy of Media Arts (KHM), Cologne, 2009
[Ch1.A3 : map of Here and There]

This hologram combines hand-drawn animation with video and photographs to map a cyclical sense of being ‘here’ and going ‘there’.

Frames from the compiled sequence used to print *map of Here and There*

map of Here and There, 2009
Transmission multiplex hologram with 20 squares of holographic film and tape, foldable, 48 x 60 cm

map of Here and There was produced as part of the iMotion seminar collaboration with Paese Museo, Sansperate, Italy where it was exhibited in July 2009 (shown on left)

Holoscape

A participatory photo-mapping project captured during Conflux Festival, 2009
The hologram was printed at Academy of Media Arts (KHM), Cologne, 2009

Nick Normal and I collated all the images uploaded and tagged of the 2009 Conflux Festival over its duration. These images were printed on cardboard and constructed into a diorama that could be animated by participants. The diorama photo-map-scape was then photographed along a physical 'time-line' and printed into a holographic scene.

Left: Participant animating the photo-map-scape in the Flux Factory gallery during the Conflux Festival, 2009
Centre and Right: Viewers looking at the hologram, Conflux HQ, New York, 2010

Three tiled photographs of the hologram *Holoscape*, 2009
Three-panel three-colour (RGB) multiplex hologram, total of 600 frames of animation, 24 x 90 cm

Unfolding the holographic scene

Meeting in the Sandbox

Sculpture and installation made from found objects
Hologram recorded at RMIT University, Melbourne, 2006

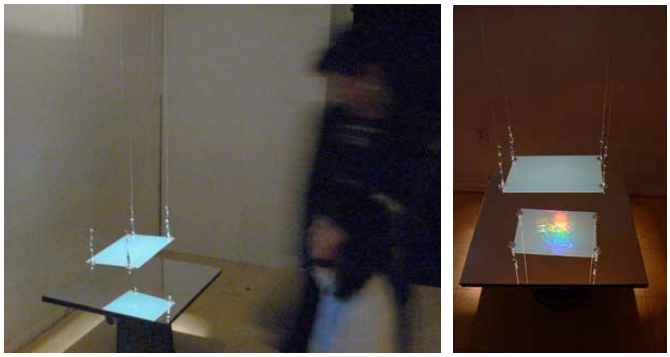
The installation of *Meeting in the Sandbox* had a poetic similarity to the recorded holographic image.

Meeting in the Sandbox, 2006
Open-aperture transmission hologram, animated by 6-stencilled exposures, 4 x 5" [10.2 x 12.7 cm]
Installed with either amber or white LED light and mirror in a box of sand
Left to right: Designing the stencil pattern. Photograph of the hologram
Installation at SIAL Project Gallery, 2006. Viewer looking at hologram

Lichthaus boat

Photography of found-objects sculpture on a rotating mirror, Cologne, 2006
Hologram recorded at Academy of Media Arts (KHM), Cologne, with Peter Schuster, 2006

The '*into the holographic landscape'* installation of *Lichthaus boat*[220] was viewed by looking into a large mirror below the hologram. This act creates a mimetic clue to the construction of the image, in which a model boat was photographed 'sailing past' the reflection of a lighthouse.



Installation of *Lichthaus boat* at *'into the holographic landscape',* 2006
Transmission 200-frame multiplex hologram, 30 x 40 cm, hung above mirror

[220] Titled when I had little knowledge of German, the correct translation of lighthouse is *Leuchtturm*.

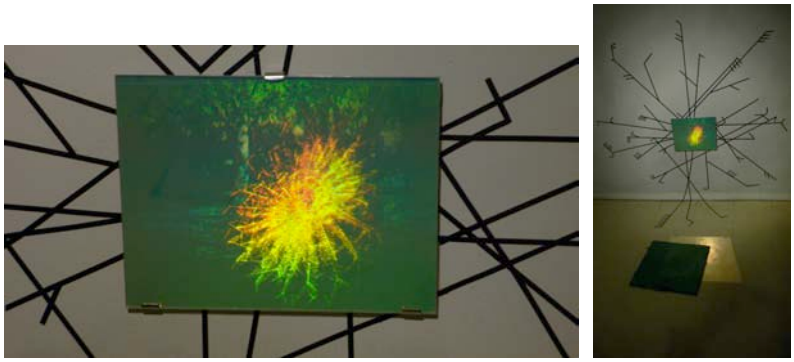
Lichthaus boat, *2006*

Left: Photograph of recording set-up, the mirror is on a turntable and was rotated while the camera position was fixed
Right: View of holographic image in mirror at *'into the holographic landscape'*, 2006

TrainWish

Composition of photographs and a map using 3D software
Three-colour (RGB) transmission 200-frame multiplex hologram
Printed at the Academy of Media Arts (KHM), Cologne, with Peter Schuster, 2006
[Ch3.B3 : Positioning the viewer]

The holographic image of *TrainWish* was pulled-out through a tape-diagram[221] that resembled the 'wish' in the foreground of the scene. A 'wish' was the name I called tree-seeds as a child, this one was created in a 3D computer graphics program (Maya) from a train map of Melbourne. The hologram was installed at child height with a grass-carpet placed in front of the hologram: indicating a place for the viewer to sit and extending the grass of the park in the scene.



TrainWish, 2006
Three-colour (RGB) transmission 200-frame multiplex hologram laminated to mirror, 28 x 38 cm
Photographs of installation at *'into the holographic landscape',* 2006

[221] Briony Barr, with whom I was collaborating on a generative fence-weaving project, assisted with the tape-diagram.

The Crossing

Photographs and video from traveling across Japan, 2006/7
Rainbow transmission 180-frame multiplex holograms printed at the Korean HOLOcenter, 2007
[Ch3.B1 : The dance of holography]

The Crossing was an installation designed in collaboration with Philippe Pasquier to explore how visual and sound elements could encourage movement. This installation uses responsive image and sound elements to enclose the space of a journey – a kind of remembered experience of glimpses mapped into a structure. The imagery was collected on a road-trip across Japan, between discussions of Shinto and the nature of the road. A digitally constructed collage/montage was transferred into two holograms, leaving scenes that inhabit an ephemeral landscape punctuated by the familiar markings of the road.

One frame from the digital montage used to create the two holograms for *The Crossing*

The motif of the zebra crossing is both a structural element of the 4-dimensional digitally compiled scene as well as appearing in two of the photo-sequences. The columns of the freeway [autobahn/motorway/interstate] on the right also visually extend the zebra crossing motif. The zebra crossing marks out a path that suggests the act of stepping. This striped delineation is also similar to the structure of the holographic master slits, the virtual viewing windows that combine to produce a multiplex scene.

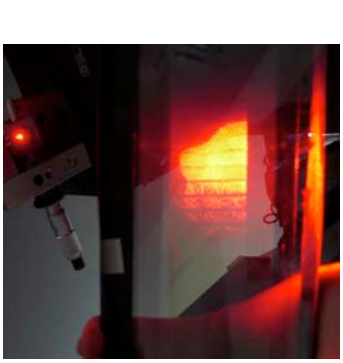
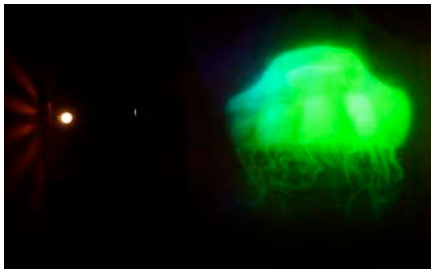
The soundscape layers a background recording with distorted voices, as the viewer moves they scratch the soundtrack, stopping causes the sound to fragment in unpleasant 'seeds'. The idea of this installation is that each encounter is different and the combination of holographic images and responsive sound is designed to keep the viewer moving.

Martina Mrongovius and Philippe Pasquier, *The Crossing*, 2007/8
Installation of two rainbow transmission 180-frame multiplex holograms, 60 x 80 cm
with ultrasonic sensor, PureData programming and 4-channel audio
'Beyond the Window', 2008

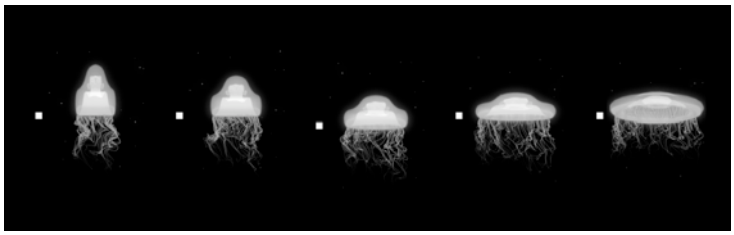
Jumping Jellyfish

Computer generated content
Vertically animated transmission multiplex holograms and trampoline
Printed at the Korean HOLOcenter, 2007 and Academy of Media Arts (KHM), Cologne, 2008
[Ch3.A4 : Jumping Jellyfish]

In this installation vertically animated holographic jellyfish are viewed by jumping on a trampoline. The viewer and jellyfish elongate to propel themselves upward and then expand as they drop down. Participants feel their own 'squishy' parts as they watch a similar expansion and contraction in the jellyfish. The visual feeds the sensual (and vice versa) to evoke an animate vitality.


Jumping Jellyfish, holographic image installation, 2008/9
Left to right: Master multiplex hologram illuminated by a laser. Rainbow holographic print, 80 x 60 cm
Installation at '*Beyond Festival*', ZKM | Centre for Art and Media Karlsruhe, 2011



Five frames of the digital image sequence used to make the *Jumping Jellyfish* master hologram
The white square is a registration mark used to position each frame of the film
To create the jellyfish I followed the Maya tutorial http://www.blackorb.com/3dtutorials/jellyfish.pdf adjusting parameters to get the effects I wanted for the holograms



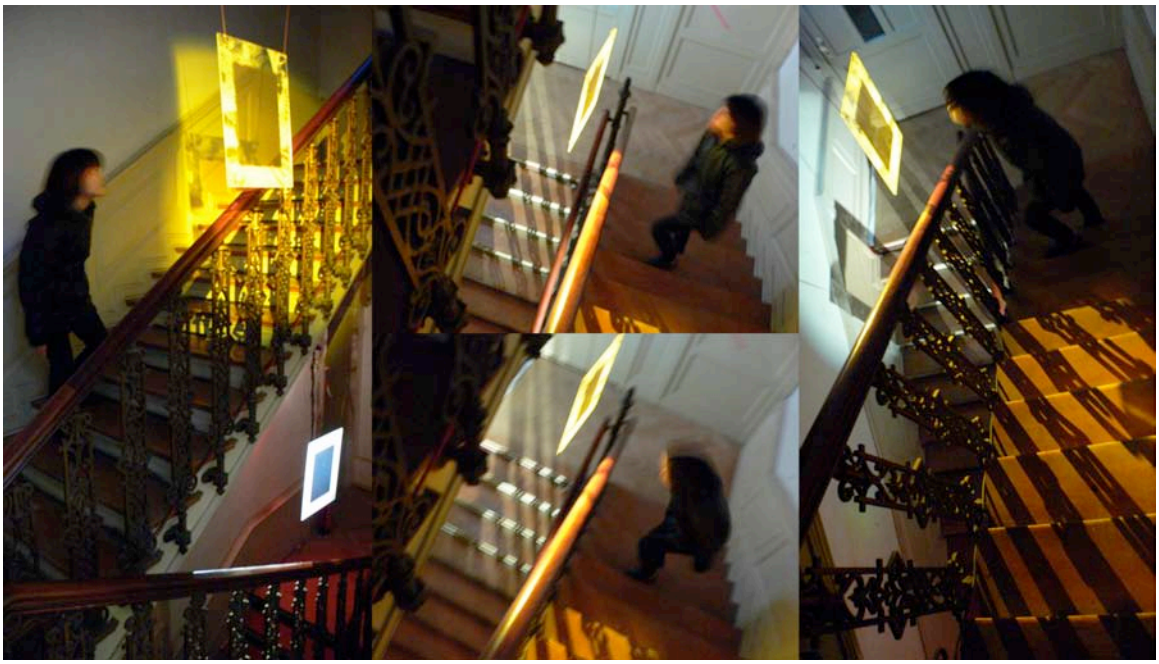
Viewer jumping at *'The Emergent Holographic Scene'*, 2011. Photographs by Anna Baróthy

Up the Stairs

Video recordings with 360-degree lens, 2010
Vertically animated 200-frame multiplex transmission holograms
Printed at Academy of Media Arts (KHM), Cologne, 2010
[Ch3.C : Referencing to steps]

The project *Up the Stairs* developed from thinking about movement through architectural spaces in relation to the structuring of images in a holographic scene. A staircase divides physical space into distinct vertical positions and creates a rhythm of motion. The act of stepping is encoded in a staircase, and can lend this action to a reading of the holographic scene.

After observing viewers in my stairwell installations, I decided to capture my negotiation of stairs. I recorded going up and down different staircases using a Bloggie HD video camera with a 360-degree lens. Each situation was different but all were captured as a single piece of video footage, that was then cut and layered to show a composite scene. The layers fuse together through a shared rhythm of stepping which is activated by the viewer's own motion of stepping.

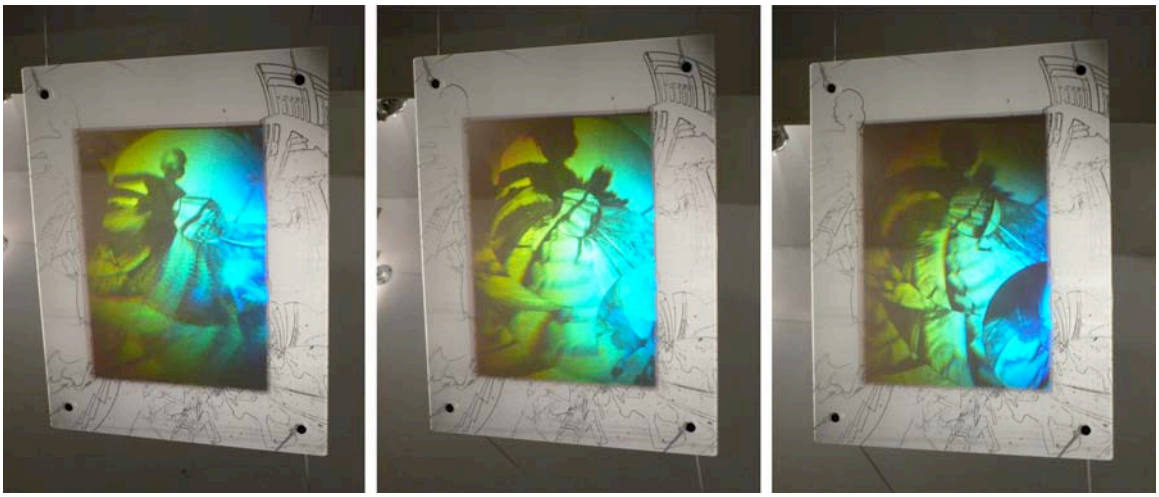


'Up the Stairs' installation, Wuppertal, 2010

to carry my bike up the stairs

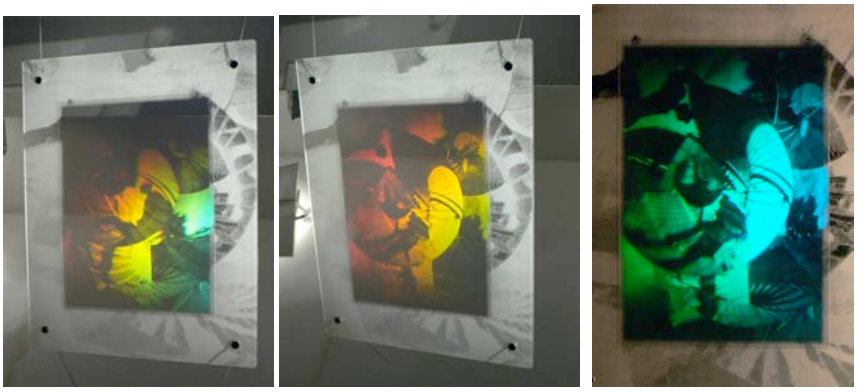
to carry my bike up the stairs, 2010
Achromatic transmission 200-frame multiplex hologram, laminated to laser etched plexiglass, 49 x 38 cm
Exhibited: *'Up the Stairs',* Wuppertal, 2010; *'Explorations of the holographic gaze'*, 2010
'Dark Disco', Santos Party House, New York, 2011

the first thing was to climb up the stairs



the first thing was to climb up the stairs, 2010
Achromatic transmission 200-frame multiplex hologram, laminated to laser etched plexiglass, 49 x 38 cm
Exhibited: *'Up the Stairs'*, 2010; *'Dark Disco'*, Santos Party House, New York, 2011
'The Emergent Holographic Scene', 2011 (below)

up and down the spiral stairs



up and down the spiral stairs, 2010

Achromatic transmission 200-frame multiplex hologram, laminated to laser etched plexiglass, 49 x 38 cm

Exhibited: *'Explorations of the holographic gaze'*, 2010; *'An Urban Pirate's Life'*, New York, 2010 *'The Emergent Holographic Scene'*, 2011 (below)

Viewer looking into the hologram *up and down the spiral stairs* photograph by Wouter Cox

For the exhibition *'The Emergent Holographic Scene'*, I installed a spiral staircase in the PostX gallery.

The visual protagonist

Unfurl

Two large-format transmission 180-frame multiplex holograms from photographs and computer generated content
printed with Dr John Perry at Holographics North, Burlington, Vermont, USA, 2004
[Ch2.B5 : The reflective gaze]

A collaboration with garment designer Sruli Recht resulting in two subtly animated holograms of figures that beckon the viewer yet remain elusive.

Left and Centre: Photographs of the two holograms
Right: Installation at the Warehouse gallery, Melbourne, 2007

Mark Ruff's 50-camera array used to capture the figures, Melbourne, 2004

Unfurl, 2004/5
Two rainbow transmission holograms with 180-frame horizontal animation, in steel frames, 130 x 90 cm
Exhibited: Experimenta *'Vanishing Point'*, Melbourne, 2005; Diretribe Gallery, Melbourne, 2006
Warehouse gallery, Melbourne, 2006; In the street-front windows of Don't Look Gallery and M.A.D, Sydney, 2007/8

Unfurl was commissioned by Experimenta for the 2005 *'Vanishing Point'* exhibition
and produced with the assistance of Mark Ruff and Ged Wright

Emotions for the Seaside

Video recording, Rockaways, New York, 2004
Achromatic transmission 200-frame multiplex hologram
Printed at the Academy of Media Arts (KHM) with the assistance of Peter Schuster, Cologne, 2005
[Ch2.A2 : Orientating through the image]

Four photographs of the hologram *Emotions for the Seaside,* 2004/5
Achromatic transmission 200-frame multiplex hologram, 27 x 37 cm

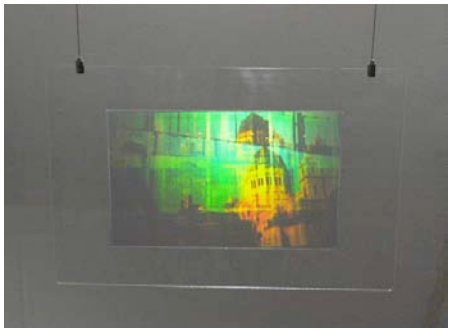
Emotions for the Seaside was one of the first multiplex hologram that I made from digital images. The images were captured by spinning around with a video camera directed back at me. There are some technical peculiarities to the image, such as the morphing of the buildings caused by retiming the video to create enough frames for the hologram. But the handheld view, morphing buildings and dramatic lighting create a sweeping vitality to the piece. *Emotions for the Seaside* is structured around an extended and reflexive 'looking'. The photographer/avatar/protagonist is both the director of the viewer's gaze and its subject. This work is exhibited with the suggestion that the viewer hold the hologram at arm's length and move around to find the correct angle of illumination and to play the animation. The act of viewing the hologram then mimics and strengthens the empathic reading of the act of holding the camera to make the recording.

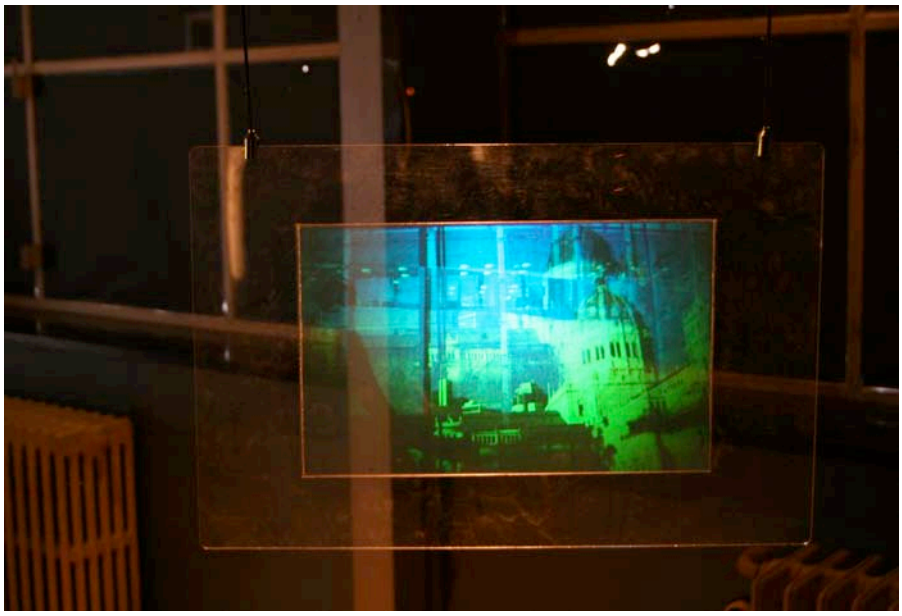
Viewers with the hologram *Emotions for the Seaside*
Viewers tended to match their reflection to the protagonist's image as well as playing the animation
Shown: SIAL Project Gallery, Melbourne, 2006; -1/MinusEins Experimental Labor, Cologne, 2011 (images above)

Museum Reflection

Photographic sequence, Melbourne, 2006
Three-colour (RGB) transmission 200-frame multiplex hologram
Printed at the Academy of Media Arts (KHM), Cologne, 2009
[Ch2.B2 : Museum Reflection]

There are two references within the scene of the hologram *Museum Reflection*: the animated act of photographing as shown by my shadow on the glass surface, and the spatial depth captured through parallax. Each spatial viewpoint of the holographic image shows a single photographic perspective that optically combines reflections and a silhouette with the view through the glass. Different readings of space and dynamics emerge as the viewer moves past the hologram. This entangled spatial structuring is an emergent quality of the capture and multiplex process.



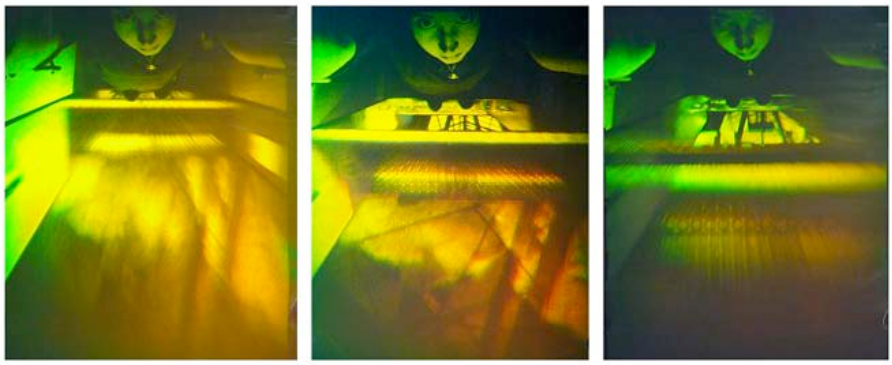


Museum Reflection, 2006/9
Three-colour (RGB) transmission 200-frame multiplex hologram on plexiglass, 48 x 32 cm
Exhibited: *'Explorations of the holographic gaze'*, 2010 (top left)
'The Emergent Holographic Scene', 2011 (bottom, photograph by Anna Baróthy)

Paternoster

Montage of photographic sequences, Cologne, 2006
Reflection 200-frame multiplex hologram, with vertical animation
Master printed at the Academy of Media Arts (KHM), Cologne, 2006
Reflection transfer printed at Center for the Holographic Arts, New York, 2006
[Ch3.A2 : In the Paternoster]

A paternoster is an open-faced elevator that continuously moves while passengers step on and off at different floors. My experience of riding in a paternoster resonated with my thoughts about the experience of viewing a hologram installation: a feeling of being on a precipice between two systems of space. As a passenger in the paternoster, moving past floor after floor, my sense of confinement was heightened. This feeling, in turn, amplified my sense of peering through a boundary into what seemed like another world.



Photographs of the hologram *Paternoster*, 2006
Reflection hologram with 200 frame vertical animation, 40 x 30 cm

As the hologram *Paternoster* is vertically animated, my installations of this work are designed to encourage the viewer to move through the animation, such as rocking back-and-forth while looking up, descending stairs or leaning back. The movement of viewing *Paternoster* is exaggerated by the virtual motion through the elevator shaft. A feeling of rising or falling emerges as the perception of visual movement amplifies the viewer's own sense of movement, gravity and balance.

Installations of *Paternoster*
Exhibited: *'into the holographic landscape',* 2006 (right);*'Ex Tempore',* 2006;
'Explorations of the holographic gaze', 2010 (left and centre); *'The Emergent Holographic Scene'*, 2011

Up a Tree on the edge of the East China Sea

Photographic sequence, Ishigaki, 2007
Achromatic transmission 200-frame multiplex hologram with vertical animation
Printed at the Academy of Media Arts (KHM), Cologne, 2010
[Ch1.B3 : Here in the fold]

After a few days at sea I intensified my sense of location by photographing myself up a tree. The montage of images that became the hologram *Up a Tree on the edge of the East China Sea*, combines two arrangements of these photographs. The background sequence is based on the direction of view – a looking out from the tree. On top of this is a sequence that traces out a bodily awareness.

Five images from the animated sequence of overlaid photographs

Photographs of the hologram and installation at *'Explorations of the holographic gaze'*, 2010 (Right)

Up a Tree, 2007/2010
Transmission 200-frame multiplex hologram vertically animated, 40 x 30 cm
Also exhibited in *'An Urban Pirate's Life'*, New York, 2010

we're all looking

Choreographed group photography for multiplex holographic images, Melbourne, 2007
Masters and transmission prints made at the Academy of Media Arts (KHM), Cologne, 2007
With reflection prints produced at the Center for the Holographic Arts, New York, 2007
[Ch2.D : we're all looking]

In May 2007 I organised the event *'we're all looking'*, convincing 26 participants (via a Facebook event) to meet and take photographs in choreographed formations around Melbourne for a series of holograms. Together we photographed a number of sites, using the architecture and urban landscape to position our bodies and direct the camera view. I wanted to see how my techniques of capturing extended to a group of people, shifting the role of the photographer from a single mobile protagonist to being an agent for the simultaneous gathering of multiple perspectives. The project was designed as a way of creating an architecture of visual perspective, a spatial diagram that enfolds a structure of different views.

Museum Reflections

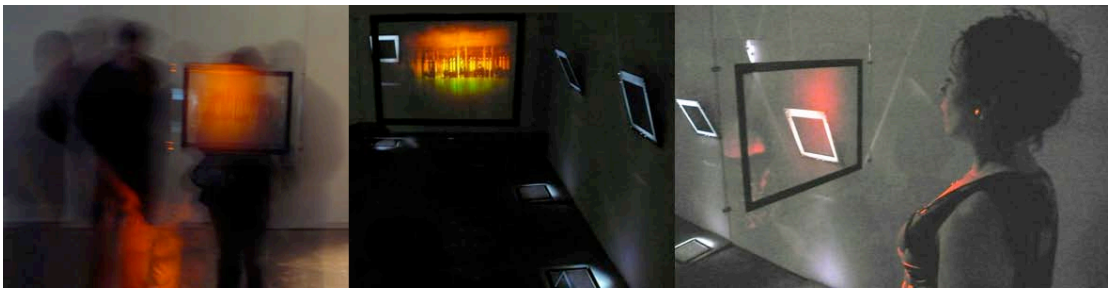
Revisiting the site where *Museum Reflection* was captured. This time, rather than a sequence of positions the photographers stood further back and simultaneously recorded the scene.

Museum Reflections, 2007
Reflection 200-frame multiplex hologram, 30 x 30 cm
Left to Right: Giving instructions for shooting. One of the source photographs. The hologram in steel frame
Exhibited: Center for the Holographic Arts, New York, 2007
'Beyond the Window', 2008

Exhibition Circle

[Ch2.D2 : Exhibition Circle]
Exhibition Circle captured the interior space of the Royal Exhibition Building, in Melbourne, by the photographers forming a circle under the central dome. We took a photograph simultaneously in nine different positions. These positions marked out a movement from crouching with the camera on the ground to stretching the camera up above the head and a corresponding directing of the camera from the opposite photographers feet to up-stretched hands. Moving side-to-side the viewer of the hologram sees through 360-degrees around the circle, while moving up and down they see the perspective from nine different positions, their view changes with a visual mirroring of this movement. The blended photographers look back at the viewer from a position that will subsequently be looked through.

Four photographs of the hologram *Exhibition Circle*, 2007
Open aperture transmission 1800-frame multiplex hologram, illuminated by amber LED, 30 x 40 cm



Installations of *Exhibition Circle*
Exhibited: *'Beyond the Window'*, 2008 (above)
'PIXILERATIONS [V.5]: Fragments & (W)Holes', Providence, 2008
International Symposium on Display Holography, Shenzhen, 2009
'The Emergent Holographic Scene', 2011 (below)

Figure8 on Drummond Street

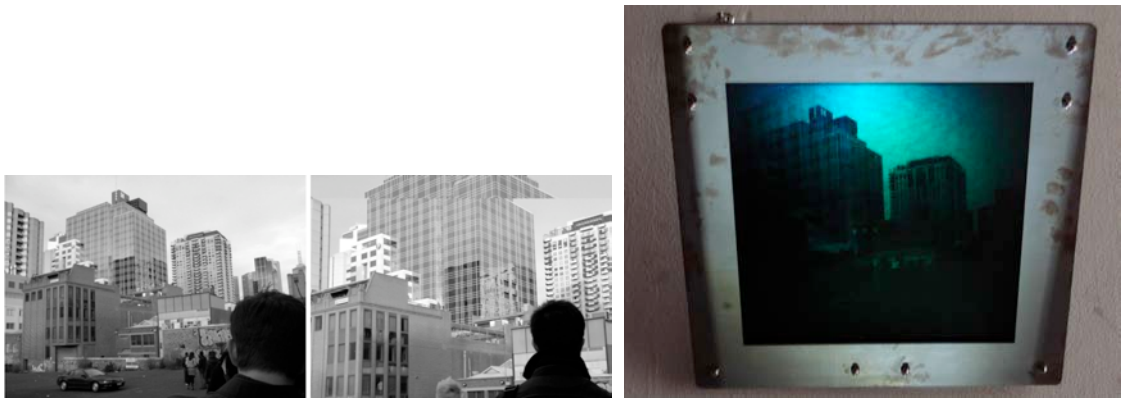
[Ch2.D3 : The act of the image – Figure8 on Drummond Street]

Figure8 on Drummond Street captures a transformation between different types of movement. For this holographic image the photographers were positioned in a figure *'∞'* around two trees on a street of Melbourne terrace houses. The first shot was taken simultaneously of the back of the person in front, then starting at the centre, each photographer turned around taking a photograph of the face and camera of the person behind them, creating a dominos-action of capturing. The holographic image seems to comprise 'snapshots' – a virtual blinking that compresses the scene through the action of capturing, while the movement through the perspectives feels continuous. As the viewer of the hologram moves past the image their perspective hops through each of the photographers, seeing them ⇔ seeing what their camera saw. The visual perspective moves through the twisted figure *'∞'* loop, yet the viewer is moving from side to side, while the effect of seeing into/through the sequence of perspectives is that of zooming into and out of the image. At the centre of the image, the visual movement changes direction while the viewer continues to move – a momentary flip of the virtual movement, transforming the relationship between physical and visual space.

Photographs of the hologram *Figure8 on Drummond Street*, 2007
Reflection, 200-frame multiplex hologram, 30 x 30 cm
Exhibited: *'Beyond the Window'*, 2008; Center for the Holographic Arts, New York, 2008
'Explorations of the holographic gaze', 2010; *'The Emergent Holographic Scene',* 2011

Post Position

The positioning of the photographers for this composition was determined by the camera view. Each photographer aimed their camera at a 'P' on the Australia Post building and then directed the person in front of them to stand so that their head and shoulders filled the corner of the frame. This resulted in a long snaking line through a car park. The sequentially captured images were then aligned to the 'P' and the head of the photographer in front, by adjusting the scale between the images. The resulting hologram has a strong dynamic as the grid pattern of the buildings shift over the viewing field.



Post Position, 2007
Reflection 200-frame multiplex hologram, 30 x 30 cm,
Left: Two images from the sequence. Right: In steel frame at '*Beyond the Window*', 2008

Installation

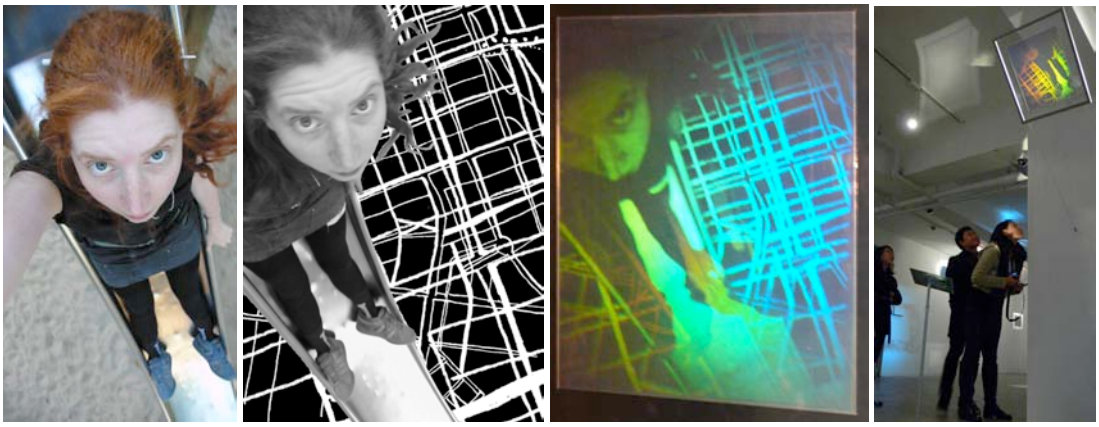
[Ch3.B3 : Positioning the viewer]

Modified office 'wheelie' chairs were used to both position the viewer and encourage a particular type of movement in the installations for *'Beyond the Window'* (left, centre and below); *'Explorations of the holographic gaze'*, (right) and *'The Emergent Holographic Scene'*

Slide

Photographic sequence, Cologne, 2008
Achromatic transmission 200-frame multiplex hologram with vertical animation
Printed at the Academy of Media Arts (KHM), Cologne, 2008
[Ch12.B5 : The reflective gaze]

This composition combines a sequence of 15 photographs with hand drawn maps. The clunky animation of the photographs is contrasted by the smooth parallax of graphics, which are layered to suggest a considerable depth. The main sequence of photographs for the hologram was recorded while descending a slippery-dip. It was difficult to keep looking at the camera. The captured expression is a compelling mixture of apprehension and determination.



Left to right: One of the photographs taken on a slide. One of the digital images used in the hologram. Photograph of hologram. Installation view '*Explorations of the holographic gaze'*, 2010

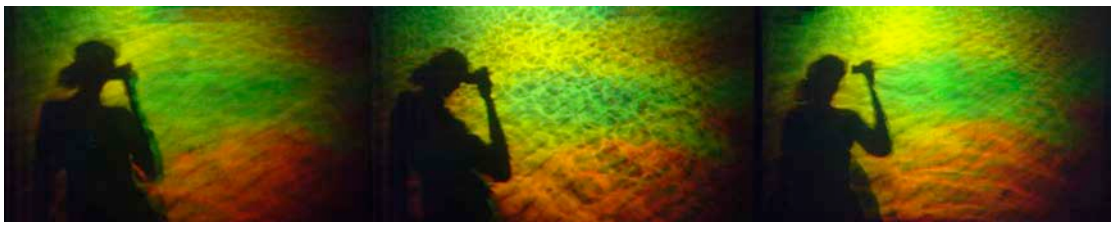
Slide, 2007
Transmission hologram with 200-frame vertical animation on plexiglass with aluminum frame, 46 x 38 cm

An edition of this hologram was laminated to mirror and exhibited opposite the stairs for '*Postkarten aus der Tiefsee'*, 2008 (above)

Shadow-waves at Safety Beach

Photographic sequence, Safety Beach, Melbourne, 2008
Achromatic transmission 200-frame multiplex hologram
Printed at the Academy of Media Arts (KHM), Cologne, 2009
[Ch2.B1 : Suggesting the activity of capture]

The sequence of photographs used to create *Shadow-waves at Safety Beach* is anchored around the shadow of the camera. This anchoring connects the point of recording to its reflexive projection, linking the movements of view and the shadow.



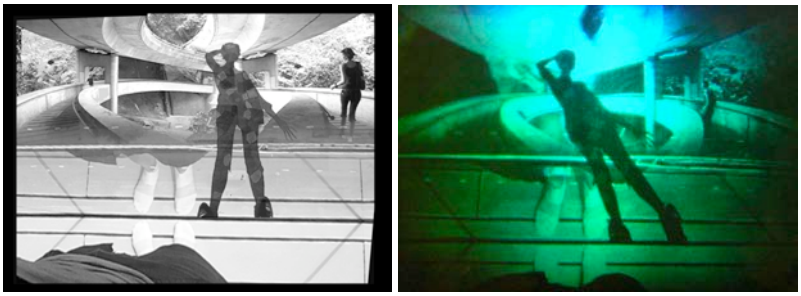
Three photographs of the hologram

Shadow-waves at Safety Beach, 2008/9
Achromatic transmission 200-frame multiplex hologram laminated to laser etched mirror, 40 x 50 cm
Exhibited: *'Explorations of the holographic gaze'*, 2010 (left)
'Illusions' Korean National University of Arts, Seoul, 2010/11
'The Emergent Holographic Scene', 2011 (right) – a gold tinted halogen light was used to illuminate the hologram

Down from the Peak

Photographic sequences, Hong Kong, 2009
Achromatic transmission 200-frame multiplex hologram
Printed at the Academy of Media Arts (KHM), Cologne, 2009
[Ch2.B7 : Multiple embodiments]

Down from the Peak is a composition of various reflections of me captured while exploring the city of Hong Kong. I was attracted to the architecture of Hong Kong; with its woven walkways and reflective surfaces, the densely populated city sets up a complex structure of interwoven gazes of inhabitation. The hologram however is quite a simple structure of views. The sequences capture reflective moments away from the bustle of the city in which I found myself alone or with friends.



Down from the Peak, 2009
Achromatic transmission 200-frame multiplex hologram, laminated to plexiglass, 38 x 49 cm
Digital source image (top left). Photograph of the hologram (top right)
Installation at *'Explorations of the holographic gaze'*, 2010 (bottom left and centre)
Installation at *'The Emergent Holographic Scene'*, 2011 (bottom right)

Exploring Cologne through a 360-degree lens

Video recordings, Cologne (and Hungary), 2010
Achromatic transmission 200-frame multiplex holograms
Printed at the Academy of Media Arts (KHM), Cologne, 2010

Walking and recording along a wharf, Cologne, July 2010

Riding under the Fernsehturm

[Ch2.C1 : Looking through the lens; effects of the device of capture]

The hologram *Riding under the Fernsehturm* was made from recording a bicycle ride through the green belt of Cologne. The layers are anchored to the tower while the stacking order of the layers changes across the sequence, creating a flickering between similar movements. The hologram is a homage to the TV tower in Cologne, a landmark that has a strong perceptual presence in my knowing of this city. I look at the tower from my apartment (both directly out of the bedroom window and in the reflections of the windows across the street from the living room). I also use the Fernsehturm to find my way home. Riding under the Fernsehturm, it looms over me, with a tingle of intensity I feel connected to all of the places from which I've seen the tower, giving a sense of structure to my experiences within an adopted city.

Photographs of hologram and three compiled frames from the sequence
Riding under the Fernsehturm, 2010
Achromatic transmission hologram with 200-frame horizontal animation
laminated to laser etched plexiglass, 38 x 49 cm
Exhibited: *'Explorations of the holographic gaze'*, 2010

A bridge crossing on bike

This holographic composition shows a protagonist riding along a path while holding the camera. The optical distortion from the 360-degree lens and the action of riding along the path create a virtual dynamic. The cyclist's position in the frame remains constant while the surroundings wrap around them.

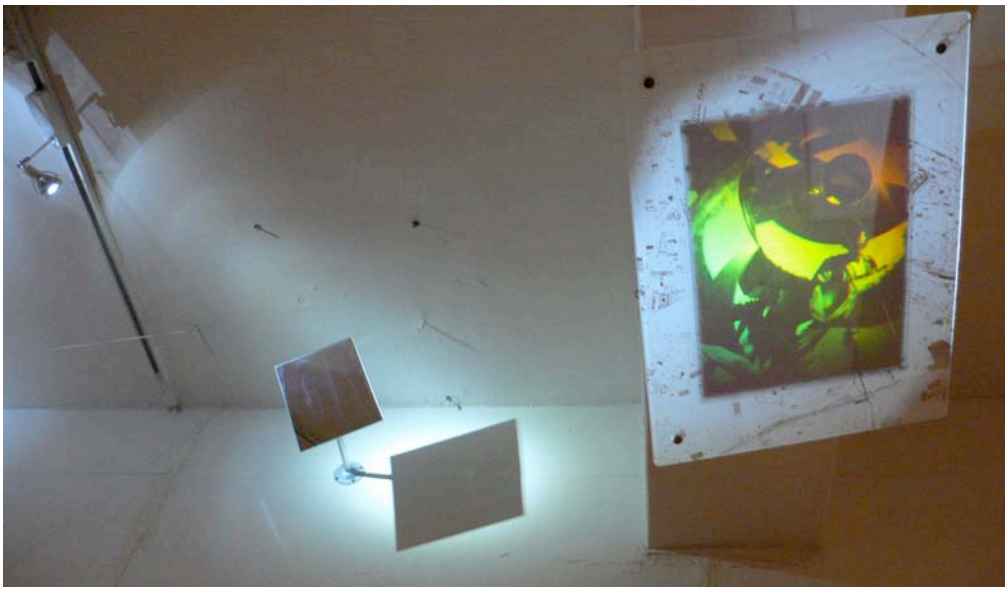
Photographs of hologram and installation *A bridge crossing on bike*, 2010
Achromatic transmission hologram with 200-frame horizontal animation
laminated to laser etched plexiglass, 38 x 49 cm
Exhibited: *'Explorations of the holographic gaze'*, 2010

Exploring under the autobahn

[Ch2.B7 : Multiple embodiments]

This hologram was captured from an area I had seen while driving past on the autobahn. Using a map and my memory of where the place was I went back there to explore the place from a different perspective. Walking around, tracing this often seen but not often entered place with my body and camera. The hologram *Exploring under the autobahn* was created from one of the video recordings that was cut and layered to give a sense of my exploration.

Three source frames for *Exploring under the autobahn,* 2010



Exploring under the autobahn, 2010
Transmission 200-frame vertically animated multiplex hologram
laminated to laser etched plexiglass, 49 x 38 cm
Installed diagonal to ceiling *'Explorations of the holographic gaze'*, 2010
Also exhibited: '*Dark Disco'*, Santos Party House, New York, 2011

Wharf Walking

[Ch2.B1 : Suggesting the activity of capture]

In this recording I was trying to capture both my face and arm holding the camera and the path anlong the wharf. With the Bloggie's 360-degree lens it is difficult to record both the feet and face – focal points of the activity of recording while walking. The legs in the image actually belong to Michael Bleyenberg who I was following down the wharf (and had to keep pace with). Another relational flattening is created by the maintained visual symmetry along wharf even though I walked around a corner.

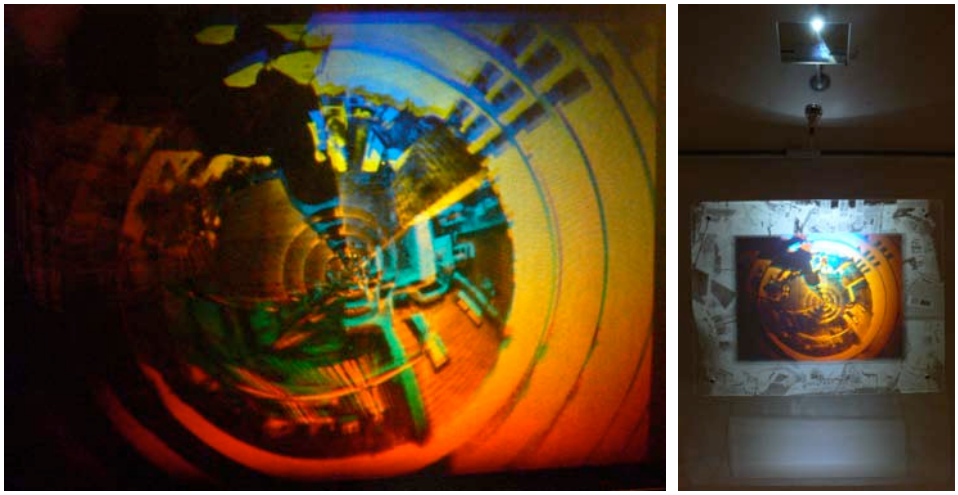
Three source frames for *Wharf Walking,* near Lake Balaton, 2010

Wharf Walking, 2010
Transmission 200-frame vertically animated multiplex hologram
laminated to laser etched plexiglass, 49 x 38 cm
Left: Photograph of hologram
Right: Installed diagonal to ceiling *'Explorations of the holographic gaze'*, 2010

On the Roof

[Ch2.C1 : Looking through the lens; effects of the device of capture
& Ch3.A3 : Gravity as a directional reference and the sensitivity to this orientation]

On the Roof is an exploration of the affect of visual distortion on a sense of space. Looking through the 360-degree lens while walking across my roof produced a vertiginous exaggeration of my movement and shaping of space.

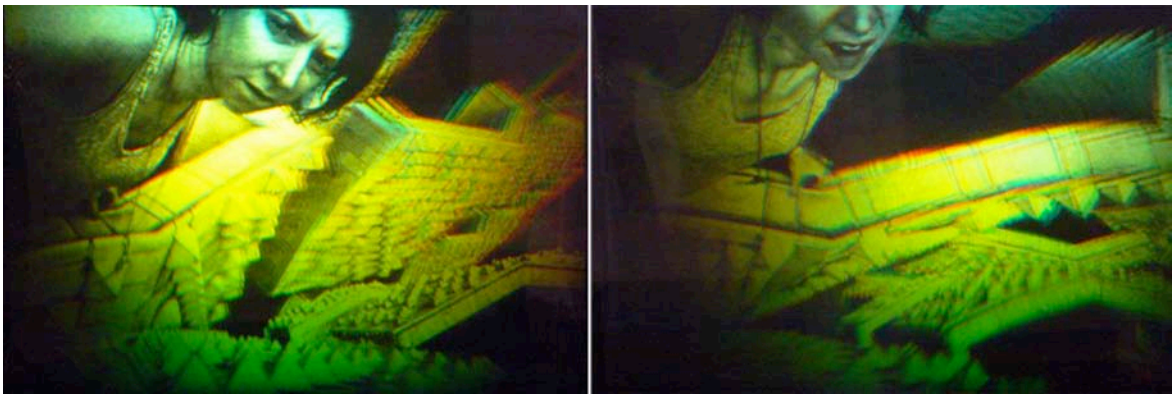


Photograph of hologram and installation, *On the Roof,* 2010
Two-colour transmission 200-frame multiplex hologram laminated to a laser etched frame, 38 x 49 cm
Installed above viewers' heads hanging parallel to the ceiling at *'Explorations of the holographic gaze'*, 2010 (right)
and *'The Emergent Holographic Scene',* 2011

This morning on the balcony reminded me of a dream

Video recordings Pécs, Hungary, 2010
Achromatic 200-frame multiplex hologram
Printed at Academy of Media Arts (KHM), Cologne, 2010
[Ch3.A3 : Gravity as a directional reference and the sensitivity to this orientation]

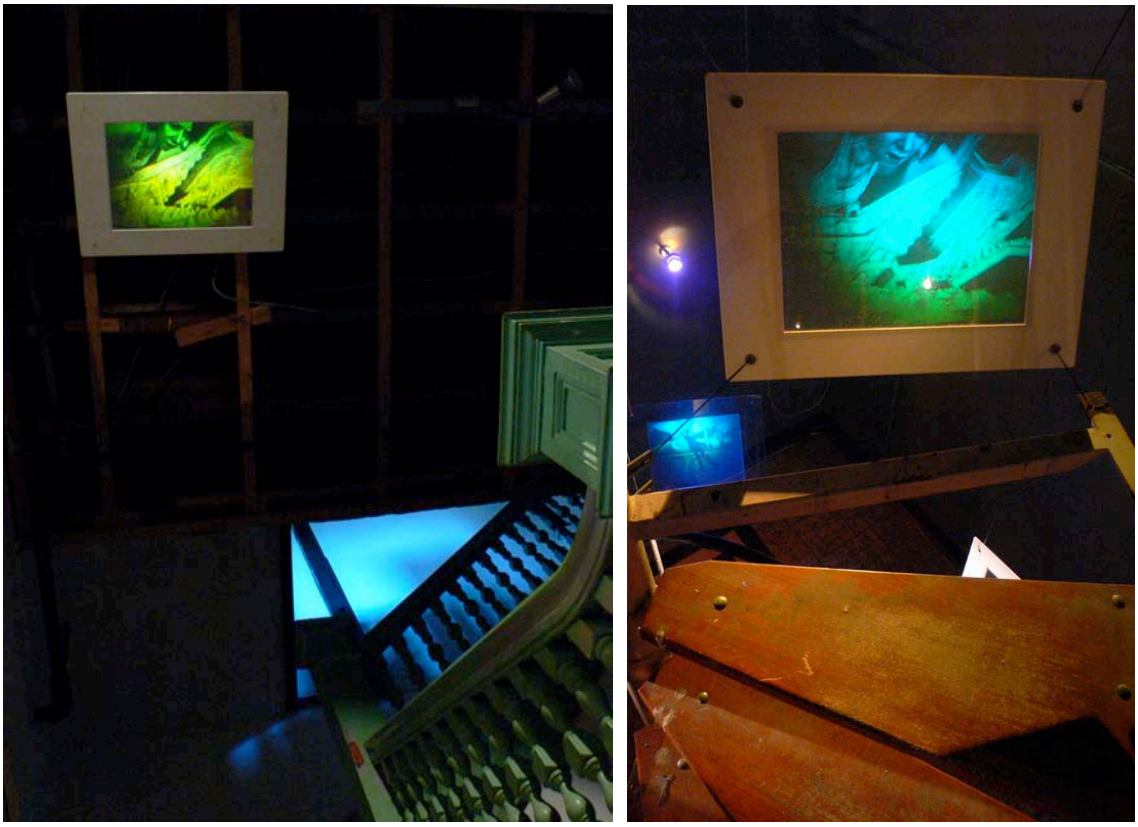
This morning on the balcony reminded me of a dream comprises two video sequences with different lines of movement producing a cavernous depth I poetically describe as 'teeth attempting to swallow me'. The video was shot leaning out over a balcony. In holding this edge, I was physically connected to the balcony while looking up into the camera so as to see into the depth below.



This morning on the balcony reminded me of a dream, 2010
Achromatic transmission 200-frame horizontally animated multiplex hologram, 38 x 49 cm

Across the hologram my expression of apprehension directed at the viewer, gives way to a look of questioning. While capturing *This morning on the balcony reminded me of a dream*[222] I became aware of how – like my imagination shaping the dream-landscape – looking through the camera could heighten a sense of the vertiginous. The hologram was installed parallel to the ceiling for '*Explorations of the holographic gaze'* with viewers tending to lean back so as to look up into the image. As one viewer described, "you lean backwards and realise there is gravity" [223].

[222] In the dream I had climbed out a window and onto a ledge of building with a cliff-like façade, as I shuffled along this ledge it became narrower as I became increasing aware that I could fall.
[223] One on the KNUA holography students visiting the exhibition described her experience of looking at the hologram and associated the vertiginous sense of the work to the feeling of looking up at me – I was a good foot taller than her. Seoul, 16 November 2010, quoted as remembered.



Exhibited in: *'Explorations of the holographic gaze'*, 2010 (top row)
'An Urban Pirate's Life', New York, 2010
'Holography – the art of shaping light', Beacon, NY, 2011 (bottom left)
'The Emergent Holographic Scene', 2011 (bottom right)

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