

Drone Technologies and Dis/emodied Spaces:

A practice-based enquiry into human-
drone relationships through audiovisual
art installation.

Thomas Stockdale Slater
Falmouth University

This thesis is submitted in partial fulfilment of the requirements for the degree of
Philosophy Doctorate at the University of the Arts London.

June 2020

Abstract

This research asks: What new insights can immersive audiovisual art installation offer into the embodied and disembodied spaces that result from the human operation of military drones?

To address this question, I have analysed how technologically mediated space is interlaced with our perceptual capacities and expressed through immersive audiovisual artworks. Practical research was undertaken through a process of creative production realised via three major immersive audiovisual artworks entitled *Hybrid Spaces*, *Compound Terrains* and *Conjured Spaces*. Each artwork functions as a cultural apparatus that affords new apprehensions of the perceived boundary between digital and physical space, reality and virtuality, embodiment and disembodiment. In these artworks, video projection, laser control and ambisonic audio are employed to both produce and problematise the so-called 'virtual' and 'disembodied' spaces that exist inside the screen and between the loudspeakers. In the spectatorship of these works, technologically mediated, spatio-corporeal interactions are formed through the cultural practices of immersive audiovisual media.

The neologism dis/embodied space is used throughout this thesis as a working concept that serves to extend the perceptual frameworks of post-phenomenological thought, specifically Don Ihde's schema of human-technology relations and his concept of multistability. Specific theoretical and contextual analysis was conducted by focusing on the distinct but overlapping human-technology relations in technologies that egress from the relationships between Unmanned Aerial Vehicles (UAVs or drones) and their human operators. By placing drone technologies along a continuum of human-technology relations, this examination provides a necessary cultural context to the abstract concepts of multistability and dis/embodied space as they form the basis of expression for *Hybrid Spaces*, *Compound Terrains* and *Conjured Spaces*. The central assertion of this thesis is that an individual's sense of disembodiment and embodiment do not coexist; rather, they toggle in and out of existence in the course of human relationships with specific technologies.

SECTION ONE: INTRODUCTION

1.1 - Introduction	8
1.1.1 – Aim and Objectives	13
1.2 – Contribution to Knowledge	13
1.3 - Key Terms	15
1.4 - Methodology: Addressing the Question Through Practice	17
1.5 - Section Summaries	24

SECTION TWO: CONTEXT REVEIW

2.1 - The Case for Dis/embodyed Space	29
2.2 - Semantics of Virtuality	34
2.3 - Virtual	36
2.4 - Cyber	40
2.5 - Digital Dualism	45
2.6 - The Mixed Reality Continuum	47
2.7 - Virtual and Mixed Reality in the Arts	49
2.8 - Multistable Spaces	67

SECTION THREE: HUMAN-TECHNOLOGY RELATIONS

3.1 - Human-technology Relations	72
3.2 – Embodiment Relations: [operator-drone]→world	75
3.3 – Hermeneutic Relations: operator→[drone-world]	77
3.4 – Alterity Relations: operator/observer→drone-[world]	79
3.5 – Background Relations: operator/observer-world→[drone]	82
3.6 - Virtuality and the military-industrial complex	86
3.7 - War Games	93

SECTION FOUR: PRACTICE EXEGESIS

4.1 - Theory-Practice Relations	101
4.2 - Approaches to Production	104
4.3 - <i>Hybrid Spaces</i> 2014	108

4.3.1 - Audiovisual Design in <i>Hybrid Spaces</i>	109
4.3.2 - Conceptual Context in <i>Hybrid Spaces</i>	109
4.4 - <i>Compound Terrains</i> 2017-2019	113
4.4.1 - Audiovisual Design in <i>Compound Terrains</i>	114
4.4.2 - Conceptual Context in <i>Compound Terrains</i>	114
4.5 - <i>Conjured Spaces</i> 2021	120
4.5.1 - Audiovisual Design in <i>Conjured Spaces</i>	121
4.5.2 Conceptual Context in <i>Conjured Spaces</i>	122
SECTION FIVE: CONCLUSION	
	134
5.1 - Future Work	141
INDEXED ARTWORKS	
	145
REFERENCES	
	147
WEB REFERENCES	
	155
APPENDIX	
	157

TABLE OF FIGURES

Figure	Caption	Image credit	Page
1	Adaption of Norms of Creative-Production research projects	Scrivener	21
2	Simplified representation of an RV Continuum	Milgrem, Takemura, Utsumi & Kishino	47
3	Linear Perspective Model, Leon Battista Alberti c. 1430	Alberti	61
4	Vanishing Point United Visual Artists, 2014 - 2020	United Visual Artists	61
5	<i>Crystalline Lattice</i> Matthew Schreiber, 2010	Schreiber	62
6	Sculptured light I Margareta Hesse, 2020	Hesse	62
7	Onion Skin Oliver Ratsi, 2017	Ratsi	63
8	Deep Web Robert Henke & Christopher Bauder, 2017	Larmann	64
9	Trevor Paglin Drone Vision, 2010	Paglin	65
10	Eye Machine III Harun Farucki, 2003	Farucki	66
11	Multistable image of pyramid/hallway	Ihde	71
12	Mythical Gorgon monster - Medusa forms part of the logo for Sierra Nevada Corporation's Gorgon Stare, Persistent Wide-Area Airborne surveillance (WAAs).	Sierra Nevada Corporation	81
13	<i>Hybrid Spaces</i> metaphorical framework	Slater	110
14	Hand drawn multistable images - acrylic paint pen on black card	Slater	111
15	Screen experiments with OpenGL in Jitter	Slater	111
16	Laser control unit and initial laser and haze tests.	Slater	112
17	Hardware set up for compositional process and final black box installation	Slater	112
18	Configuration of apparatus forming the compositional and presentational environments for <i>Hybrid Spaces</i> , and <i>Compound Terrains</i>	Slater	113
19	<i>Compound Terrains</i> metaphorical framework	Slater	115
20	New laser and servo control unit.	Slater	118
21	Servo-mounted lasers.	Slater	118
22	Laser array and screen positioning	Slater	118
23	Virtual laser array.	Slater	119
24	Real and virtual laser arrays	Slater	119

25	Configuration of software environments forming the compositional platform for <i>Conjured Spaces</i>	Slater	124
26	Figure 26 <i>Conjured Spaces</i> timeline	Slater	125/6
27	Life Cycle of a Kill Box	Public Intelligence	132
28	<i>Conjured Spaces</i> metaphorical framework	Slater	134
29	Sixteen-point grid shape in position 0. along Z axis.	Slater	158
30	Sixteen-point grid shape in position -6. along Z axis.	Slater	158
31	Sixteen-point grid shape in various positions between 0. and -6. along Z axis.	Slater	159

All images used with permission.

ACKNOWLEDGMENTS

I would like to extend my sincere gratitude to those who have supported my research. Firstly, without the excellent assistance of my supervisors, Professor David Prior and Dr Antti Saario, this work would not have been possible. My receipt of a part-time studentship from Falmouth University, along with several grants from Arts Council England, was essential in supporting my research. Without them, I could not have undertaken this PhD and, therefore, I express my utmost appreciation. Paul Ooman and Peter Halasz of the Spatial Sound Institute in Budapest have offered me keen insights into perspectives I would not otherwise have considered, and the breadth of this work would have suffered without their influence.

My personal, creative and collaborative relationships with Emmanuel Spinelli and Jeremy Keenan have significantly influenced my thinking as well as my creative process, and they deserve thanks for their support and friendship. A specific thank you to Jeremy who gave me invaluable technical and aesthetic support in the creation of *Compound Terrains*. A general acknowledgement should be made to the Arduino and Max/MSP communities for continual technical and creative support, as well as the opportunity to contribute to what I feel is an important body of knowledge and work.

Finally, thanks to my family: Ray, Tim and Rosie Slater and especially my partner Hannah Mason, who gave birth to our two children, Billie and Roman midway through this process. I owe them my sincerest appreciation and thanks.

1 - SECTION ONE: INTRODUCTION

1.1 Introduction

As a researcher into audiovisual art practice, I am interested in how our interactions with technology shape our perceptions of multiple and shifting boundaries between our ideas of real and virtual spaces.

The written component of this thesis is an exploration of how our understanding of spatial embodiment and disembodiment is continually reconfigured by means of specific human-technology relations. With a particular focus on how space can be disembodied and reembodied by the act of flying a drone, this research takes its lead from the post-phenomenologists, whose approach to developing a philosophy of technology begins with the acknowledgement that our cultural lifeworld is a texture of interwoven relationships between humans and technologies. From this base, I have employed a post-phenomenological method, that is to say, I have focused on individual experience in relation to individual technologies (drone pilots and drones) to better understand the cultural malaise that has formed around technologies associated with telepresence, virtuality, cyberspace and disembodiment.

In order to establish a cultural backdrop to this investigation, my research ranges across everyday consumer technologies and their sociocultural contexts, such as smartphones, social media platforms, contemporary art, virtual communities, virtual reality (VR), augmented and extended reality (AR, XR) and mixed reality (MR). The primary focus of my research, however, foregrounds a set of human-technology relations that I believe reconfigure our understanding of spatial embodiment and disembodiment in a far more radical and controversial way than that of networked consumer devices. These are the relationships between military surveillance and combat drones and their human operators. Drone technologies mediate human perceptions of space and senses of being, both embodied and disembodied. They therefore form part of our evolution into a networked species that is now experiencing multiple perspectives of reality and spatial embodiment. Through the infrastructure of military cyberspace, remotely controlled drones afford state actors physical agency across the globe. This type of remote

engagement plays a significant role in the way we perceive human bodies in space, and increases the number of ways in which we define reality.

The practical component of this thesis focuses on the use of spatialised, audiovisual installation art as a means to synthesise abstracted, concentrated and sensorially experiential forms of these multiple perspectives of reality and of embodied and disembodied space. The presentation and analysis of my own artwork is a critical engagement with multifarious issues relating to the human-technology relations inherent in both everyday devices and, in the form of more extreme experiences, in drone warfare and surveillance. The artworks produced as part of this thesis are intended to express fundamental ontological issues surrounding the increased extent of the state's reach across space, via often invisible and seamless military technologies. This thesis is an investigation of these networked, audiovisual spatialisation technologies, both as artefacts that enable artists and audiences to poeticise the perceived differences between virtual and real space, and as utilitarian devices that may tempt state powers to think that we can transcend our bodies via simulation, telepresence and technological hermeneutics. The three original artworks submitted as part of this thesis do not employ digital technologies solely as a vehicle for the narrative arc or as scenographic entities. They are, instead, used in the creation of abstracted instances of the phenomenon of ontological ambiguity in order to leave a clear and undiluted experience of technologically mediated space perception.

Technologies that produce the virtual spaces behind our screens and between loudspeakers have become increasingly embedded in our everyday lives. Ontological concerns related to those explored in digital media arts practices include the ever-increasing digital mediatisation of everyday experiences such as navigating one's own environment and engaging in social activities. One remarkable feature of the progress in this field of research is that traditional notions of perceived boundaries between digital and physical space are changing or being eroded altogether. That said, scholars continue to acknowledge that the academic understanding of this phenomenon is incomplete or lacks conceptual context.

“The academic understanding of what exactly these [drone] technologies bring to individual lives remains incomplete.” (Dilaver 2014: 101).

“Technologies have become extended sense organs, enabling perception of realities never before known to us.” (Friis 2015: 215).

“The use of mobile technologies as connection interfaces blurs the traditional borders between physical and digital spaces.” (de Souza e Silva 2016: 49).

“The pilot-drone relation, when successful, leads to a transformation of the bodily boundaries by technology. What falls by the wayside is an entangled set of concerns about the ways in which the relationship between the pilots and their operational environment is being reconfigured.” (Ekbia & Qaurooni 2017: 54).

I have chosen to focus my research on drones as a configuration of networked digital audiovisual technologies on account of their function as apparatus that enable us to produce or access the three-dimensional spaces created beyond the two dimensions of the screen and between and beyond loudspeakers. From an epistemological and ontological perspective, an artform that can only be experienced via digital technology and that has reality as a driving concern is interesting in several ways. First, obtaining sense data through a technological artefact raises epistemological questions: such perception differs from unaided perception in that the original sensory information has been altered (augmented or distorted) by a technological device. Second, our cognition of embodied artefacts themselves is not straightforward in that we often do not seem to be consciously aware of them. Technologies can become naturalised after an initial

habituation period, fading into the background of our awareness. Today, it would be unusual to experience a so-called acoustic or “unplugged” popular music performance without the presence of a microphone or amplified guitar, and it would appear that the same can be said for the function of virtuality within social and artistic paradigms in contemporary society. In a 2010 article in the *New York Times*, William Ford Gibson described the social actuality of virtual technologies as folded into our physical everyday lives: “Cyberspace has everted. It has turned inside out. Colonised the physical” (Gibson 2010: 9).

Exploring the issues aroused by using networked audiovisual technologies as “site vs. non-site”, “materiality vs. immateriality” or the ubiquity of an artform that is “not here, not there” leads us to notions of space as an embodied and disembodied entity in relation to the technologies we encounter in our daily lives. Networked audiovisual technologies are now taking their place among an array of digital innovations that have thoroughly shaped the last 25 years of human development. The past decade or so has certainly seen a profound shift in our collective understanding of what constitutes “space”. What was once understood as transcendent cyberspace is now experienced as a ubiquitous grid of data and devices which we embody and with which we interact every day, raising new questions about an ontological continuum and the very nature of our corporeal experience in the technologically mediated and networked world.

To borrow from Gaston Bachelard’s theory of *physical innovation*: the alteration of “our space” inevitably alters “our nature” and we don’t yet know what this alteration looks like. Artworks produced with networked devices have often had a strong association with political activism, and artists have used AR and VR technologies to challenge existing hierarchies in capitalist economics, fine art and religion. This is aided by the fact that smartphones and tablets are enjoying unprecedented rates of adoption; within a short time, they have quickly become uniquely important devices. While such observations are compelling, they currently lack a conceptual framework that affords us a full understanding of the convergence of mediatisation and gamification on important societal elements such as protest, art, the military, entertainment or commerce. A growing number of scholars (Levinson 2012, Hiem 2014, Grimshaw & Garner 2015,

Massumi et al. 2016) claim that, increasingly, our experiences of virtual spaces are dissolving into the practices of our everyday lives.

The previously perceived boundaries between the digital and the physical, the real and the virtual, and embodied and disembodied technological experiences have now been eroded to such an extent that they may no longer even exist. The implications of such claims have informed the central question of this thesis: in what ways do immersive audiovisual technologies afford experiences of space that move between embodied and disembodied realms? The main driver behind this question is a desire to understand the ontological shift that is occurring as immersive technologies separate from once utopian or transhumanist agendas and migrate to more mundane and utilitarian implementations in, for example, the workplace, the battlefield, entertainment and commerce. Discourses that attribute absolute and exclusively material understandings of space to aesthetic experience are examined and challenged. From these, a dialectical approach to technologically mediated spatial perception is proposed and, with it, a consideration of the ways in which the practice of audiovisual installation art can engage with the human understanding of space as produced by bodies and technology.

1.1.1 Aim and Objectives

Aim:

The aim of this research is to understand through practice research how human relationships and interactions with military drone technology can impact on perspectives of spatial embodiment and disembodiment.

Objectives:

1. To produce a series of immersive audiovisual artworks that articulate how drone technologies can mediate human perception of spatial embodiment and disembodiment.
2. To generate an original written discourse that provides the context of a general analysis of the human-technology relations associated with our networked digital age, together with a specific and foregrounded analysis of the human-technology relations inherent in the piloting of military drones.
3. To devise original approaches to spatialised audiovisual media installations that use a synthesis of virtual and real spaces as a primary compositional and presentational aesthetic.
4. To develop a new audiovisual composition system, custom-made software and hardware that facilitate the synthesis and synchronisation of animated three-dimensional computer graphics, higher-order ambisonics, large three-dimensional speaker arrays and multichannel laser projection.

1.2 Contribution to Knowledge

To address the research question of what new insights can immersive audiovisual art installation create into the embodied and disembodied spaces that result from the human operation of military drones, I have conducted practice research in the form of audiovisual art-making alongside traditional text-based research. These investigations have led to new artworks and an accompanying written discourse that, together, communicate new insights into the ways in which spaces are embodied and disembodied through immersive audiovisual technologies as experienced in the context of audiovisual art practices. This contribution to knowledge is expressed in the composition of three new digital audiovisual artworks; *Hybrid Spaces*, *Compound*

Terrains and *Conjured Spaces*. The forming of the portmanteau dis/embodied space serves as an underpinning concept that is used throughout the thesis to explain in parallel, the felt, tacit apprehension of knowledge that is gained through the spectatorship of the three artworks.

Each artwork in this thesis contributes to the research question by focusing on different salient elements of the spatial mediations that occur through a pilot-drone interaction. These focal elements are outlined below and explained in detail in section 4.3, 4.4 and 4.5 of this thesis:

- 4.3 *Hybrid Spaces* portrays the technological hermeneutics inherent in pilot-drone relations that afford a dual and multistable spatial perspective of embodied and disembodied space.
- 4.4 *Compound Terrains* communicates the idea of the drone pilot's computer screen as a portal or boundary between real and virtual space and provides us with an environment in which we can feel the extremes of ontological spatial ambiguity that drone pilots report when operating machines at a great distance.
- 4.5 *Conjured Spaces* presents the reorganising of spatial embodiment through the actualisation of virtual data into squares of physical terrain that become perceptible arial footage

Dis/embodied space is used throughout the written component of this thesis as a working concept that serves to extend the perceptual frameworks of the post-phenomenological school and, in particular Don Ihde's concept of multistability. This examination leads to an assertion that an individual's sense of disembodied and embodied space do not coexist in hybridity but toggle in and out of existence quickly and often uncontrollably in response to technologically mediated space perception. Post-phenomenological theory, a deliberate adaption of classical phenomenology, is employed to resolve questions of dis/embodied space in relation to the proliferation of military drone technologies in the twenty-first century. A post-phenomenological perspective is brought to bear on *Hybrid Spaces*, *Compound*

Terrains and *Conjured Spaces* to form a chain of reasoning that is rooted in the relationship between the research question, the context, the method and the outcome of the research.

Connected to our experience of space are the physiological, cultural and technological domains that shape the actions of the individuals and groups who participate in the activities that compose it. Central to both my practice and contribution to knowledge is the development of production methodologies that will facilitate the introduction of multistability via spatialised audiovisual technologies, thereby inducing multiple perspectives of dis/embodied space. A central aim of this work is to encourage those experiences to be observed in an aesthetic context, ultimately enabling new forms of audiovisual installation and spatial practices through the creation of self-reflexive works.

1.3 Key Terms

Several key terms used repeatedly throughout this thesis are often found in contexts different to that of this work. It is therefore necessary to clarify how I use these terms and to be clear about any multiple meanings or ambiguities.

Immersive and networked audiovisual technologies is a term used throughout this thesis to describe configurations of multiple technologies that, in aggregate, form something that could be considered a singular device, machine or infrastructure. For example; “the Internet”, in terms of the entity to which humans can relate, is in reality an assemblage of network infrastructure, computer terminals, screens and audio devices. Similarly, AR and VR devices are configurations of screens, computers, smartphones and prosthetics.

Human-Computer Interaction (HCI) is an interdisciplinary field of research that represents the current field of practice in regard to this thesis. HCI is situated at the intersection of computer science, design, engineering and cognitive ergonomics among several other fields of study. Popularised by Stuart K. Card, Allen Newell, and Thomas P. Moran in their 1983 publication; *The Psychology of Human-Computer*

Interaction, but first used in 1975, the term HCI was initially used in reference to the automation of office systems but its use has now been extended to include mobile devices, Web and Internet services, games, large networked systems and semi-autonomous robotic systems, the latter being termed Human-Robot Interaction (HRI). In the context of this thesis HCI and more specifically HRI is used as a starting point to frame the exploration of human interactions with the specific category of robots known as unmanned aerial vehicles (UAVs), or drones.

Human-Technology Relations (HTR) is a term coined by the philosopher of technology Don Ihde. Further to, and as a sub-category of HCI, HTR provides us with a specific schema based on a post-phenomenological methodology through which the pilot's relationship with their drone is examined. Four categories of HTR, each of which describes a mode of embodiment that humans can experience through specific technologies are used to consider each individual technology that constitutes the technological milieu of pilot-drone operation.

Digital is perhaps the term that has the most contextual ambiguity and will mean different things when applied to different situations. For example, in common usage, digital can refer to any activity once conducted offline but now involving the Internet. Individuals' "digital selves" are often described as lived out through their social media accounts and their use of cloud systems to organise their day-to-day lives. Throughout this thesis, I use the term digital as an antonym to physical and in the context of a profound perception of difference between human activities conducted off and online. I also use it to refer to human interaction with computer-generated sound and imagery.

Virtual/Virtuality are perhaps two of the most central terms to this thesis and are used within it in two distinct ways. The first is interchangeable with 'digital' but used more often as an antonym to 'real' and closely related to an activity that might be associated with the human body. For example, I discuss groups of people who interact professionally and socially via networked computer systems as virtual communities, and computer-generated simulations of visual and auditory spaces as virtual space, in

contrast to real space. The second type of usage is in the context of virtuality within philosophical traditions and how the real/virtual polemic is problematised to the point that the term *actual* replaces real as a counterpoint to the virtual.

Real/Reality are used in as antonyms to virtual/virtuality and to describe spaces that are not simulated, produced, represented or, at the very least, not heavily mediated by technology. Although I acknowledge a philosophical preference to consider simulated spaces real (actual) in human experience, I have adhered to the everyday understanding and usage of 'real' as a way to understand physical spaces that are more fully embodied than their digital counterparts.

1.4 Methodology: Addressing the Question Through Practice

In order to address the research question I began, during the early stages of this research, to develop a working concept which I later named "dis/embodied space". The term expresses individual senses of disembodiment and embodiment that do not coexist but toggle quickly and mostly uncontrollably back and forth in response to a technologically mediated space perception.

My idea of multistability as dis/embodied space has been rendered into a series of artworks that reveal new insights into the embodied and disembodied spaces afforded by audiovisual art installation. Parallel to this I have provide a cultural backdrop of the human technology relations between pilots and their drones. Through these combined practical and contextual research elements I have developed a research methodology that was both replicable and temporally stable. The cultural backdrop has been provided broadly by the exploration of human-technology relations in the context of immersive and networked audiovisual technologies, and specifically by the dis/embodied spaces afforded by operator-drone relations.

To demonstrate how my art practice could deploy its specific way of disclosing new insights I consider the production and reception of my work as a tacit modality of knowing which when joined with the explicit written discourse forms a set of common features that, according to Stephen Scrivener (2002), Robin Nelson (2013), Michael

Gurevich (2014) and Linda Candy (2019) should be shared by practice research PhD projects. Robin Nelson's work on practice research has been particularly useful in enabling me to interlace my practice with my writing. This thesis as a piece of practice research sits within a tradition that has seen an expanded use of the term praxis in post graduate level arts education. Robin Nelson's use of the term praxis is useful here as he employs it to describe "*theory imbricated with practice*" (Nelson 2013, 5) and as a way of identifying knowledge generated by practice. Nelson expands on this through his multimode model for Practice as Research (PaR) epistemology in arts praxis. Contextualised by dance and theatre-making (but useful to other art-making processes) Nelson identifies artistic knowledge as "know-how" or the insider's embodied knowledge of dance making; "know-what" or critical reflection on the artistic tools of composition, methods, terms and processes which "work"; and finally "know-that," defined as an outsider's knowledge of how something can be theorized, discussed, or framed (Nelson 2013: 51).

The Nelsonian method of know-how, know-what and know-that was established in my research through the iterative stages of technical audiovisual systems development, composing, reading/writing, and reflecting, with this latter reflective stage giving rise to new insights and communications which included:

1. The artistic use of technological hermeneutics which give rise to multistable spatial perspective of embodied and disembodied space.
2. The use of screens in audiovisual installation as a means to feel the extremes of ontological spatial ambiguity.
3. The use of data actualisation in the form of recognisable terrain to communicate the reorganisation of technologically mediated spatial embodiment.

Nelson describes know-how as "insider knowledge", synonymous with procedural knowledge and puts it in contrast with the propositional knowledge of know-that (Nelson 2013: 52). Procedural knowledge is gained incrementally and leads to a set of actions such as playing a musical instrument or composing. The know-how of my practice research comes in the form of both prior experience such as my educational

training and professional arts practice and, through a research-while-making of each artwork in this thesis, which includes studio-based experimentation (section 4 of this thesis).

According to Nelson know-what is developed from know-how through a process critical reflection – “pausing, standing back and thinking about what you are doing” (Nelson 2013, 54). Throughout the art-making process of this thesis these reflective phases came in the form of formal discussions with my team of supervisors, formal discussions with experts at commissioning organisations (ISEA, Spatial Sound Institute, MONOM) and informal discussions with my network of expert practitioners and collaborators and my own reflections on the works themselves and associated literature. These discussions along my own reflections and personal experiences of the artworks helped me to consider them from an audience’s perspective from conceptualisation and through each iterative phase of making. Traditional audience studies were not undertaken as part of my research practice as they risked disruption to the creative process and my capacity to capture a meaningfully representative audience dataset was limited and outside of the scope of this research (Waite 2018: 24).

Know-that, Nelson explains, is the closest element in his schema to traditional academic knowledge, is articulated in words and numbers and drawn from reading of all kinds (Nelson 2013: 56). Know-that is a movement from the tacit knowledge of know-how which is inside or close (proximal), through the reflections of know-what to the explicit and outward-facing knowledge that can be experienced, critiqued, and utilised by others (distil) (Ibid). This motion from the concrete and experiential of know-how to the more distant and abstract of know-that is of course a bidirectional oscillation rather than a linear path. During the process of authoring this thesis I often iterated pieces of writing in parallel with art-making and not necessarily in direct relation to one another. As the tacit doing of the art-making process unfolded so too did the process of making and experiencing the artworks explicit.

It was within this methodological framework that choices about the operational and aesthetic results of each work were decided. This was done with an aim that

generalisable methods could be derived so as to enable future artworks and research to come from the principles established by my practical work. In *Hybrid Spaces* and *Compound Terrains* in particular, the literal and perceptual connection between sound, onscreen objects and their actual-space counterparts as laser light establishes a relationship which has the potential spawn a category of practice using light, computer graphics and sound in structurally similar ways with vastly different aesthetic and perceptual results. While themes of embodied presence exist throughout contemporary arts practice, the production of multistable space in my work here can be seen to specify a flexible mode of examination.

Central to Nelson's notion of PaR is the concept of 'praxis': "the possibility of thought within both "theory" and "practice" in an iterative process of doing-reflecting-reading-articulating" (Nelson 2013: 32). A postphenomenological perspective is also brought to bear on the making of the artworks in this thesis to form this cyclical, iterative and eventually imbricated relationship between my research question, the context of pilot-drone relations, the methods of analysis and creative production and the outcomes of the research. Prior to any knowledge of Nelson's ideas and to any attempt at framing my creative practice within a PhD I have found this to be a natural and intuitive method of making artworks. To fold in my theoretical research and overlap my writing and creative practice I found Steven Scrivener's schema of "creative-production" (2002) particularly useful.

Figure 1 below is an adaption of Scrivener's Norms of Creative-Production Research Projects (ibid). A schema that is both reflective and speculative of the relationship between the artworks and their surrounding discourse. Reflective in the sense that it charts the creative and cognitive process that has resulted in the synthesis of practice and theory; speculative in the sense that it cogitates over any novel apprehensions that may be generated because of my creative-production research.

Norms of creative-production research projects	
1	Issues, concerns and interests are identified.
2	These issues, concerns and interests reflect cultural, social, political or/and aesthetic, etc., preoccupations.
3	Apparatus are produced
4	Apparatus become artworks, are of high quality and original in a cultural, social, political or/and aesthetic, etc., context.
5	Artworks manifests these issues, concerns, and interests.
6	Artworks generate apprehension.
7	The creative-production process is self-conscious, reasoned and reflective.
8	The creative-production process is self-conscious, reasoned and reflective.

Figure 1. Adapted from Norms of Creative-Production research projects, (Scrivener 2002.)

From this adaptation of Scrivener's Creative-Production Research Projects I have further developed defined three areas of my research methods and processes to produce artworks and written discourse:

1. Settings and instruments: My research is carried out in studio and exhibition environments that are configured for the production and reception of digital audiovisual installation works. As the practitioner/researcher, I am the primary instrument for gathering data generated by quantitative and qualitative audiovisual spatialisation tests that are designed to anticipate the effect of projected 3D graphics, laser projection and methods of producing and presenting immersive three-dimensional sound.
2. An emergent methodology: I have built a conceptual framework that uses existing post/phenomenological approaches to the analysis of human-technology relations. This framework supports the idea that the human act of engaging with technologies is an existential relationship, and that to experience one's environment through technology is to experience modulating modes of reality. One mode is produced through human-technology relations that are embodied and display varying degrees of transparency. The other is constructed from

relations in which humans and technology produce spaces that are disembodied and become quasi-other.

3. Iterative design and production boundaries: This conceptual framework is used to identify invariant structures – the inherent and elemental ways in which immersive and networked audiovisual technologies mediate our ontological understandings of space. The research action, including audiovisual installation design concepts, emerges from the abstraction and reimagining of these inherent elements into the form of new artistic metaphors that are ready to be embodied in new environments and material situations. The practical research boundaries are defined by my increasingly focused understanding of the area of study and expressed through the production of three major new audiovisual artworks.

I have used the conceptual tools of phenomenology, but more specifically post-phenomenology as methods for generating ideas for my artistic practice and its surrounding discourse. Philosopher Don Ihde's schema of human-technology relations (HTR) is used consistently throughout the thesis to underpin assertions around how spatial perception is mediated through technology and specifically, to investigate ways in which drone technologies mediate between humans and their environment and, how I can express and evoke this techno-spatial mediation through the creation of immersive audiovisual artworks. In addition to these conceptual tools I also developed production methods that have allowed me to build physical multistable spaces and therefore reflect upon my writing through experiencing my own work as an audience would. By building a set of functional compositional tools (laser projection system, bespoke compositional software and multichannel speaker arrays) I was able to make artistic judgments, reflect back on my reading and writing and then make iterative adjustments to the compositional tools and the resulting audiovisual compositions.

The practical research techniques and stability of production through the art-making process were achieved for the most part through the creation and configuration of bespoke hardware and software apparatus. The function of this apparatus was to produce an audiovisual environment through the control and synchronisation of

immersive audiovisual technologies: ambisonic audio, OpenGL screen-based 3D graphics and a specially designed and built laser control system. Once established, this compositional environment would also serve as the vehicle for an audience experience by allowing me to exploit the inherent immersive potential of these technologies and render my concept of dis/embodyed space as a series of three audiovisual art installations.

The material apparatus of the artworks as objects of experience are as important as any apprehensions they may afford. Therefore, my methods, claims to originality and contribution to knowledge are demonstrated through creative outcomes in the form of audiovisual art installations, and the significance and context of these claims are expressed within the written component of this thesis. The written component is not simply a description of the artwork but, rather, an explicit and word-specific representation of the investigative premise, processes and outcomes that emerge from an art-making method that is iterative, speculative, and cyclical, leading to contingent degrees of apprehension. To this extent, the text that sits parallel to the artworks serves as both a narrative about the relationship between action, perception, and cognition, and as a supporting theoretical discourse that contextualises how any new realisations exist in both sensible and intelligible terms.

Hybrid Spaces, *Compound Terrains* and *Conjured Spaces* were all produced in parallel with my theory of dis/embodyed space and the related types of speculative projection that often surround human interaction with relatively new technologies. Indeed, much earlier Luddite and Saboteur-era anxieties were focused on machines replacing human workers in industrial processes. These fears present themselves again with each new technological advance and are almost always linked by a central thread of anxiety over our own replacement by – or disembodiment via – technological interaction. Far more fundamental, however, than our anxieties over the disruption of particular elements of our lives by new technologies is the concern over how new technologies could disrupt our understanding of reality itself. As ever, the technofantasists and the technoworriers both speculate over how our understanding and experience of reality is changed as a result of HTR.

The intended function of these artworks is that of spatial art-making apparatus that can present a question as a physical experience: the question of the multistability of technologically mediated space perception via the networked audiovisual technologies inherent in drone warfare and, how invariant features of this perceptual phenomena can be abstracted, rendered and further explored through immersive audio, video and light installation. By constructing an immersive audiovisual space via the synthesis of three-dimensional audio, video and light rendering technologies I have been able to respond poetically to and engage with these ontologically driven issues concerning human perceptions of materiality, space, embodiment and disembodiment, and the ways in which they are bound to affect how we construct understandings of what is real and what is virtual.

1.5 Section Summaries

In Section Two, I introduce the neologism dis/embodied space. Here, I argue for several factors that, when brought together, define dis/embodied space as an experiential mode that is co-produced by the body and networked audiovisual technologies. By bringing together theories of phenomenology, post-phenomenology and poststructuralism, I propose dis/embodied space as a state of modulation in which our experience quickly and mostly uncontrollably toggles between the embodied and disembodied spaces that are associated with the real and the virtual. I present this notion of ontological oscillation as an alternative conceptual trajectory to that of the dissolving virtuality advanced by Paul Levinson (1997), William Gibson (2010), Michael Hiem (2012) and others. The fading of virtuality is attributed by these scholars to its alignment with human desires and gestures; our sensuous adaption to audiovisual devices causes the gap between the virtual and the mundane to close, and virtuality to dissolve into the reality of the culture that constructed it. It appears self-evident that Levinson, Gibson, Hiem et al. are correct in their observations that the affording audiovisual technologies of virtual spaces and related senses of disembodiment are becoming ever more commonplace components of our everyday activities. What does not appear to be so axiomatic, however, is that the naturalisation of audiovisual technologies is necessarily responsible for the disintegration of virtuality and disembodied spaces, if indeed they are disintegrating! I challenge this assertion that the increasing mundanity of virtuality

signals its disappearance and instead suggest that the opposite may be the case – that as the audiovisual technologies that produce virtual and disembodied spaces become adopted on a mass scale, virtuality and disembodiment proliferate and become ever more profound and important entities within culture.

Throughout my exploration of what spatial embodiment and disembodiment mean for a culture saturated with audiovisual media, bodies and spaces are understood as mutually constructed and inseparable. Thus, Section Three elaborates on how dis/embodied space is the product of human sensory stimulation across real and virtual landscapes. Drawing on Don Ihde's concept of multistability, I argue that this stimulus produces alternations between different subjective perceptions of space, creating multiple plausible perceptual organisations. These multistable alternations occur as a result of rivalries in our selection and binding of sensory information. “Binding”, in this case, refers to the process by which the attributes of objects that fall within our sensory array are organised by our perceptual system to form a plausible interpretation of the world. The rivalry between bound and coherent spatial interpretations causes ambiguous figures and spontaneous reversals in perception. Dis/embodied space is explained as a multistability of technologically mediated space perception that results from human interactions with audiovisual technologies and their function as interfaces or portals to virtuality. The frequency of perceptual alternation between plausible disembodied and embodied spaces relies on the extent to which the technology allows for unencumbered movement across the device portal – from and back to the embodied world.

Instances of disembodied space such as VR require some kind of prosthetic interface, such as goggles or gloves, whilst other instances such as GPS-mapping utilise culturally adapted devices, such as smartphones. I summarise this chapter by analysing the human-audiovisual technology relations embedded within these interactions and conclude that the more transparent and “at hand” the quality of the interface, the higher the frequency of perceptual alternation. Through further analysis of *Hybrid Spaces*, *Compound Terrains* and *Conjured Spaces* within the context of transparent, background technologies, I explain that, although the experience of the three artworks is physically

intense and far from transparent or mundane, it does maintain a “no prosthetics” ethos only achievable with room-scale immersive experiences. I attribute their effectiveness to an integral, multistable spatial aesthetic that forms elemental and abstract expressions of embodiment and disembodiment. Audience’s experience these dis/embodied spaces as synchronised multiple subjectives – experienced free of the encumbrance of isolating prosthetics which often block out layers of experience to stimulate others.

To further develop my working theory of dis/embodied space, I apply it to an analysis of two cultural spheres that have dominated technological innovation over the last two centuries: the military and entertainment. More specifically, I look at the significant correspondence between the human-technology relations inherent in contemporary military shooter-style video games and the piloting of UAVs, or drones in armed conflict. I observe that to pilot a drone or to play a first-person shooter video game is to be part of an ecosystem of human-technology relations that share many overlapping characteristics. Over the course of this penultimate section of the thesis, I attempt to uncover the various invariant structural features of those relations.

By focusing on the specifics of corporeal-techno-spatial relations, as framed by interactions between pilots and their drones or gamers and their game worlds, I evaluate the ways in which spatio-ontological understandings are influenced by the range of disembodied and embodied spaces that arise in relation to the telearchic systems necessarily associated with military drone technologies and networked, screen-based game worlds. Debates surrounding the use of military drone technologies have focused on how the pilot-drone relationship has impacted the ethics of armed conflict. Frequently raised concerns include the “gamification of killing”: state-sanctioned drone surveillance and killing via display screens have been problematised as resembling the experience of first-person shooter video games (Brooks 2012, Brown 2013, Chamayou 2015, González 2015). Concerns over the sense of irreality or detachment present in the pilot-drone relationship are often likened to the disembodied experiences of video game worlds. Drawing parallels with Paul Virilio’s notion of “Military Space”, I reveal, and challenge presupposed ideas of a disembodied omnipresence often associated with

drone pilots and gamers. I suggest instead that gamers and drone pilots experience the multistability of dis/embodiment to its full extent as they, through a profoundly hermeneutic relation with their respective technological ecosystems, interpret and become agents in distant and virtual landscapes.

Section Four discusses the production of the three major audiovisual artworks submitted as part of this thesis. *Hybrid Spaces*, *Compound Terrains* and *Conjured Spaces* are explained and analysed as new regimes of spatio-audiovisual synthesis. I give an account of each artwork and its methods of composition and presentation, including bespoke software and hardware control systems designed and built by myself as a necessary part of this research process. Ambisonic audio, OpenGL screen-based graphics and laser control were synchronised to produce, categorise and problematise two broad experiences of space.

The first category contains notions of space commonly referred to as cyberspace, virtual space, digital space, or disembodied space. These terms are used interchangeably throughout this thesis to describe spaces that rely on sets of user-definable laws that, when applied to audiovisual technologies, produce and govern the topology, geometry and physics of these spaces. These laws are changeable and do not necessarily impact our bodies or the objects with which we interact as we move through this type of space. The second category of space produced by the artworks is profoundly connected to notions of physicality, materiality, reality, or embodiment. In these spaces, topology, geometry, physics, and time are mostly (but with many exceptions) absolute actors as they inscribe their attributes on our bodily senses. I observe this category of space as experienced and understood through a perception that can be described as full-sensory. It is the recognition of a difference between these modes of embodying, disembodied and reembodying space that form the salient creative and theoretical themes of this thesis.

Finally, in Section five, my conclusion argues that *Hybrid Spaces*, *Compound Terrains* and *Conjured Spaces* each function as audiovisual models that are central to the process of apprehending my theory of dis/embodied space. The spatial dimensions of the

artworks' on-screen imagery, sound diffusion and laser projection are equivocal in nature and are designed to both express and invoke the state of ontological modulation that is dis/embodied space. Each artwork and chapter of this thesis hinges on expounding the multistable ontological status of bodies and spaces as produced in conjunction with immersive audiovisual media.

Extant theories of eroding boundaries between digital and physical space are challenged and rerouted to my alternative perspective of dis/embodied space as a multistable ontological phenomenon that results from the ease and frequency with which we modulate between embodied and disembodied spaces. By employing Don Ihde's notion of multistability as an extension of Husserlian eidetic variation, I consistently return to a central principle: that Ihde's multistability – and indeed classical Husserlian variation – is the organisation of the perceptual field into a variety of discrete and stable aspects. Therefore, dis/embodied space relies on perceptual variations between real and virtual spaces. Through this framework, I submit that ideas of a dissolving boundary between real and virtual spaces, as advanced by Paul Levinson (1997), William Gibson (2010), Michael Hiem (2012) and others offer us fewer perceptual aspects and begin to deny the felt difference between reality and virtuality.

My conclusion does accept, however, that as our interactions with technology become normalised through repeated use, the awareness of how these technologies mediate our world moves to the periphery of our attention. We are perhaps tempted then to diminish the distinction between the perceptual variations of reality and virtuality. Instead, I suggest that we consider some aspects of virtuality as existing only in the virtual, and others as occupying an uncertain ground between the virtual and the real, shifting between being imitations and simulations of reality and being real themselves. I propose that by continuing to engage with each of these aspects in an act of "free variation" rather than merging them together, we can vary, and then reflect on the contents of our experience in a more granular way, that is, by considering embodied and disembodied space as two varying states, we can consider more precisely the contributing factors of each.

2 – SECTION TWO: CONTEXT REVIEW

2.1 The Case for Dis/embodied Space

The specific embodied and disembodied spaces produced by the three artworks in this thesis are of course framed by the practices and contexts of academia and twenty-first-century art consumption. Out of these praxes emerges a cultural product that is allegorical in form: extended metaphors with many points of commonality between the story told and the “real life” subject matter. In this case, the artworks provide an extended metaphorical framework to enable audiences to empirically understand my notion of dis/embodied space as a product of our relationships between drone technologies and the ontological ambiguities they produce. To provide scope to reveal the essential relationships that define how a technology can mediate the human experience of space, I have chosen to focus my theoretical discourse on two specific human-technology relations. The primary focus of this study is on military pilots and their relationships with both their remotely controlled UAVs, or drones) and the spaces in which they conduct their operations. A secondary focus examines the experience of video game players and their relationships with the technologies and screen-based worlds in which they play. These two real world scenarios form the basis of a complex ontological and phenomenological exploration from which the abstracted metaphor of the three artworks was developed.

Although both drones and gaming are commonly discussed individually as singular technological entities, they do in fact – in common with most technologies – comprise reconfigurable chains of multiple and often overlapping networked audiovisual technologies. Drones and gaming technologies encompass the full spectrum of human technofantasies and techno-fears. It is from this fundamental ambivalence towards the human creation of these technologies that the perceived boundary between physical and digital realms emerges: an ontological boundary where virtuality and reality meet but remain distinct from one another. However, although this virtuality/reality threshold appears to us through our embodied experience of audiovisual technologies, its ontological status is problematic in that it is often a boundary that lacks a sense of

objectivity, i.e., rooted in some tangible discontinuity between an entity and its surroundings. The perceived location of the boundary is contingent on the social praxis by which the audiovisual technologies are framed. The human experience is now one in which networked, screen-based digital activities increasingly form the focal points of our social and emotional lives. A life in and on-screen is evidently a compelling and absorbing experience for many. In the words of William Gibson:

Everyone I know who works with computers seems to develop a belief that there's some kind of actual space behind the screen, someplace you can't see but you know is there. (Gibson cited in McCaffery 2000: 1).

The phenomenon of remotely piloted drone warfare is organised around networked, screen-based surveillance and killing and should, therefore, be considered as part of this mass behavioural migration to screen worlds. My reason for foregrounding the human-technology relations inherent in drone warfare is the role of the US military as the major driver of the various technologies that exploit telepresence, cyberspace, and VR. VR networked and telepresence systems have been developed by the US Navy, Airforce and Army for situational training and planning as well as live combat operations with regard to navigation, tactics, combat systems, infantry training, hunter-killer operations, surveillance and others (Donnelly 2017: 4). Ciamramitaro and Jones (2011: 226) argue that the US military has had the single largest impact on the production of technologies that form the current global cyberspace and VR ecosystems: its adoption of virtual worlds has had a major impact on the virtual world industry and its spending power acts as a financial inducement to private technology companies. Furthermore, for conservatives and US Government military and intelligence strategists who see the strength of the US as inextricably linked to a vigorous exercise of power through militarised technological exceptionalism, the proliferation of drones in combat situations is part of a justifiable and necessary foreign policy (Donnelly 2017: 6). This policy trend has given rise to a state-created, technological exceptionalism in which the US military defines its own set

of laws and procedures in relation to specific technologies and the space/s in which they operate.

Drones are network-enabled technologies linked by control centres across the globe to display and give access to theatres of war mediated through the filter of screens. By weaponising imaging technologies in this way, nation states have developed the ability to remotely target and kill enemies by moving information at great speed through satellite and ground-based networks. Paul Virilio describes this as one of the latest in a much longer series of developments that have brought about what he calls “military space” – the relationship between military technologies and the organisation of space. (Tucker 2017: 161). According to Virilio, military space has become increasingly situated in the air and in outer space, providing any nation state deploying these technologies with a weaponised and exceptional form of “omniscience” and “omnipresence”. Drones are particularly effective in offering this ubiquitous military capability as they have a “total situational awareness making them like gods, omniscient and all seeing” (ibid). The cybernetics of the military drone produces military space – a cyberspace which Virilio claims supplies another space that escapes the norms of Cartesian space-time coordinates and, therefore, generates disembodied experiences in which communication and interaction take place instantaneously in a new global time. For Virilio, military space and cyberspace are:

disembodied spaces with no fixed coordinates in which one loses anchorage in one’s body, nature, and social community. It is thus for Virilio a dematerialised and abstract realm in which cybernauts can become lost in space and divorced from their bodies and social worlds. (Kellner 2000: 111).

Cyberspace, as both concept and experience, retains an uncanniness for many, arguably attributable to a tradition among commentators of noting its lack of physicality. For Michael Benedikt, cyberspace possesses an “inherent immateriality”, a “mythologic” whose inherent connection is with the fictional and the mystical. For the

phenomenologist Vivian Sobchack, cyberspace is “permanently ephemeral”; she worries that this desire for an ultimate escape demands “getting rid of the flesh” (Sobchack 1993: 577). Similarly, John Perry Barlow famously wrote in the now cult, digital-culture magazine *Mondo 2000*, “Nothing could be more disembodied than cyberspace. It’s like having your everything amputated” (Perry Barlow 1994: 70; Prey 2016: 22). These early conceptions of digital space have since been challenged for their binary demarcations between “real space” and “cyberspace” and between the corporeal and the non-corporeal. Contemporary theoretical exploration of the relationships between and among cyberspace, networked space and embodied space redefines the often-abstract conceptions of cyberspace and the disembodied activities therein. Julie E. Cohen argues:

Cyberspace is neither empty nor abstract and is certainly not separate; it is a network of connections wrapped around every artefact and human being. (Cohen 2014: 22).

Similarly, Jason Farman advances a notion of spatial hybridity as an alternative to binary, spatio-ontological perspectives. In contrast to Virilio’s disembodied vision of telepresence and cyberspace, Farman (2012: 85) rejects spatial dichotomies in favour of a concept of Hybrid Space, which he relates specifically to electronic and networked communication technologies. He rejects on equal grounds the cyber-utopian fantasy of an independent cyberspace and the type of binary spatial analysis now famously proposed by Manuel Castells in his 1996 book *The Rise of the Network Society*. Castells contrasts the embodied space of the lived experience of most of the world’s population – the “space of place” – with a disembodied, placeless space of information flows, the “space of flows” (Castells 1996: 208). Farman takes an alternative Lefebvrian position, that space is not a container that is entered and manipulated, but a phenomenon that is co-produced alongside embodiment. He argues that the tensions created by telepresence – the virtual and augmented realities between the lived experience of the body “here and now” and disembodied experience “over there” – have already begun to dissolve and that we are already living harmoniously with our digitally constructed

realities as we “smoothly integrate the embodied lived experience of the body and the mediated perception of oneself and of the environment” (Farman 2012: 85).

These spaces – whether digital, material or hybrid – are experienced by humans as embodied and situated beings. It is therefore arguably an indication of the strength of our primary corporeal phenomenology that, in our attempt to understand disembodied communications and telepresence, we still tend to observe through the lens of an embodied, situated experience. Technologies associated with telepresence, virtuality and disembodiment – whether in the form of everyday, networked communication devices or remotely controlled military robots – can be considered as spatial apparatus. Our interactions with these devices raise questions as to the discrepancy between unmediated perceptions of our surrounding reality and our perceptions when mediated, transmitted or virtualised by machines. It is through this very discrepancy that cyberspace retains its otherness: its virtual and disembodied status. The specific and culturally situated examples of human-technology (operator-drone) relationships that I use in this thesis reveal enduring differences in perceptions between embodied and disembodied states.

Far from the harmonious and “smoothly integrated” situation suggested by Farman (2012: 85), in which real/virtual boundaries are dissolving, the operator-drone relationship reveals a tense, jarring and anxious lived experience that pulls the drone operators back and forth between embodied and disembodied states, an experience that is recreated and aestheticised through the three artworks. A typical shift for a drone operator is twelve hours; they spend more of their waking hours looking at a video feed of ground terrain thousands of miles away than they do looking at the landscape of their immediate environment. They become cognitively and psychologically immersed in a world that is reconstructed by sensor equipment and fed back to them via their monitor screens. Drone operators’ accounts of lengthy surveillance operations reveal an oscillating sense of remoteness and presence as they describe themselves as being displaced in the drone, watching from a great height, and then returning to the drone’s ground control facility many times over the duration of their twelve-hour shift (Whitlock 2014: 109).

To experience dis/embodied space is to be in a multistable state of technologically mediated space perception. The audiovisual and networked technologies function as the threshold that straddles each state of embodiment and disembodiment. Therefore, dis/embodied space is the product of human sensory stimulation across real and virtual landscapes. Or, as Ihde puts it, through technological mediation we experience a distinction between a “*here-body* and a virtual or image [body]”, the latter experienced as a disembodied “over there” body. The multistability (here-but-not-here) of these two perspectives is experienced in many variations across different social and cultural activities. It is therefore important to examine the technologies as they exist in their cultural context (Ihde 2002: 49). In the context of remote warfare, the drone operator experiences the colour but not the temperature of the surveilled terrain, the movements but not the sounds of the human targets, the flash but not the heat of the exploding Hellfire missile. These elements are disembodied in sequence with the embodiment of another version of the combat operation through the corporeal extensions afforded by the operator-drone relationship.

2.2 Semantics of Virtuality

Audiovisual spatialisation, i.e., the synthesis of spatial properties via multiple loudspeaker arrays and screen-based technologies, is an established field of interest amongst artists and researchers. Digital media arts practice has increasingly incorporated audiovisual spatialisation in a variety of contexts, including electroacoustic music and sound art, theatre, installations, and live electronic performances. Ontological issues related to spatial embodiment and disembodiment via technological artefacts, notions of virtuality, reality, simulation, telepresence, and physicality remain only partially explored despite an extensive corpus of ongoing research, art and literature on the subject. I intend to use the cultural context of the pilot-drone relation, and associated issues of technologically mediated space perception, as a point of departure for both my artistic practice and its accompanying discourse.

By tracing the historical usage of the terms ‘virtual’ and ‘cyber’, we immediately see that a profound relationship between the virtual and the actual always been assumed, as has an equally intimate bond between technology and notions of reality, artifice, simulation, and virtuality. For example, in his seminal text *The Work of Art in the Age of Mechanical Reproduction* (1968), Walter Benjamin claims that the illusory nature of photography and film is “the height of artifice; the sight of immediate reality has become an orchid in the land of technology”. His earlier work, *Little History of Photography* (Benjamin 1931) describes the process of photography as a technological transformation of perception that is “suck[ing] the aura out of reality like water from a sinking ship”. In *Simulacra and Simulation* (1981), Jean Baudrillard categorises the virtual as belonging to the category of simulation, of things not real and not reality but representation. In tracing a line between the writings of Benjamin and Baudrillard, these sentiments appear to resonate with hopes for, and fears of, digital technologies. Baudrillard suggests that social theory itself loses meaning as fixed distinctions between social groupings, political ideologies, classes, and difference dissolve into a “black hole of non-differentiation”.

The physical element of social relations recedes as individual humans dissipate into worlds of simulation, constructed via representational media such as television and computer cyberspace that ultimately led to VR itself. From the 1970s onwards, Baudrillard’s work shares an attitude with the science fiction of the same era in that it anticipates the future by extrapolating from present events to form images of impending techno-dystopias. Baudrillard was a connoisseur of science fiction and his influence is evident in the work of many science fiction writers and filmmakers of the last 40 years, most notably *The Matrix* trilogy (Wachowskis 1999, 2003, 2003) that contains several references to *Simulacra and Simulation*. Semantic fluctuations of the terms “cyber” and “virtual” have a much longer history than that of the Frankfurt School or French poststructuralism. These macro phases in the history of language are directly comparable to the events on a micro scale over the past 30 years or so of technological change:

Claude Thibaut: Isn't this radical uncertainty brought about by Virtual Reality likely to challenge man's vision of himself and the world?

Jean Baudrillard: Certainly because it is the system of representation that is at issue. The image that he has of himself is virtualized. One is no longer in front of the mirror; one is in the screen, which is entirely different. (Jean Baudrillard interviewed by Claude Thibaut 1996, 1)

2.3 Virtual

The semantic variations of “virtual” and “virtuality” begin with the 1st-century Romans, for whom virtual (sharing the same stem as *virilis*, later to become *virile*, both deriving from *vir* meaning a man, a hero) suggested a manly strength and a direct power (Barnhart & Steinmetz 1998: 322). During the mid-1100s, Christian theologians shifted the Roman meaning to distinguish a power existing inherently or virtually (*virtualiter*) as opposed to essentially (*essentialiter*) or actually (*actualiter*) (ibid). This opposition presents the virtuality of a thing no longer as a power sensually present with strength, but rather an inner power. Italian Renaissance writers would change it further into *virtu* – a strong but less visibly intrinsic power. Similarly, in the fourteenth century, the English term “virtual” came to mean something implicit but not formally recognised, present but not openly admitted – something there “virtually” but not really or actually present. This weaker, almost invisible, virtuality would form the basis of new semantics required by the need for computer-based aesthetics in the 1980s. Computers began to simulate in digitised objects recognisably vivid phenomena with many of the characteristics of the primary realities and this needed a new term (Heim 2014: 112). The word “virtual” became a household term during the 1990s and was used, as now, to indicate a form of unreality created by networked and immersive audiovisual technologies. In this general use, “virtual” in the phrase “virtual reality” functions as an adjective, a synonym for artificial which, in this context, means illusory. The first steps towards the simulation of immersive environments fed a familiar set of techno-fears and

technofantasies that cyberspace, as predicted by 1980s science fiction, existed, and would replace “actual” reality.

The word “virtual” does of course exist independently of its popular and fictional associations with networked cyberspace and immersive audiovisual technologies. The Deleuzian philosophical tradition gives precedence to the noun form – the virtual. True to its Latin etymological root, the philosophical concept of the virtual pertains to force and the potential to be forceful. Derived from the Latin word for strength (*viribus*), the definition of the virtual in this philosophical tradition is “potentiality” (*potentium*) or potency. If something has potential, then it may come to be and, if it has been then it once must have had potential. Therefore, the virtual, rather than an illusory opposite to reality, is a facet or dimension of reality, as it pertains to the power or force of something to come into being – its degree of potency.

When considering the virtual spaces which emerge from networked interactions and simulated environments, the cyberspace which houses virtuality is experienced as total abstraction (Pesce, Kennard & Parisi 2000: 11) as a construct of philosophical endeavour. Explained as a “universality without totality” (Deleuze 1988: 96), the virtual is that which is “real without being actual, ideal without being abstract” (ibid.). Following Deleuze, Pierre Lévy, in *Becoming Virtual: Reality in the Digital Age*, defines virtuality as “a complex of trends, tendencies, constraints, goals and forces linked to a creative problem-solving process” (Lévy 1998: 211). Another prominent Deleuzian, Brian Massumi, defines the virtual as a “pressing crowd of incipencies and tendencies which produce a realm of potential but also a lived paradox where what are normally opposites coexist, coalesce, and connect...” (Massumi, 1995: 91). In the minds of this Deleuzian cohort, both the actual and the virtual are fully real: the former has concrete existence, while the latter does not, but it is no less real for that fact. The importance of this distinction can be demonstrated when considering the ontological status of an idea: it may only exist in our heads, or on paper, but its effects are fully real as it is experienced and may also be fully actual. Although initially treated as an esoteric problem by specialists in the field of ontology, the distinction between the virtual and the actual has become of wider concern since the advent and popularisation of telepresence and

networked and immersive audiovisual technologies, because it categorises content seen or experienced on screens or via computer networks as real, even if it is not actual.

It raises the possibility that we might find no less artifice in “natural” perception as reality on-screen. The question of perception is no longer one of truth and illusion, but of differing modes of reality, in the movement of emergence through which the forms of experience come to pass. (Massumi 2014: 56).

Here, Massumi reinforces Deleuze’s assertion that the virtual cannot be separated from the question of perception, whilst acknowledging the tricky question of the appearance of an abstract reality. To tackle this dense problem of the perception of virtuality as a seemingly imperceptible force, Massumi provides us with a framework he calls *Ontopower*: the power to bring to be. In his 2015 book *Ontopower: War, Powers, and the State of Perception*, Massumi gives cultural context to the abstract Deleuzian concept of the virtual and the actual by framing *Ontopower* as interlaced with neoliberal capitalism and the Western, military, industrial complex. He argues that this very entwinement makes the capitalist economy a type of power formation. According to Massumi, the formation of *Ontopower* is a new type of power, characterised by emergency and manifested through soft power (surveillance) and hard power (military intervention). Through a close examination of post-9/11 behaviours and the War on Terror, Massumi identifies the emergence of military pre-emption, which he labels as the “operative logic of our time” (Massumi 2015: 26). Security threats, regardless of the existence of credible intelligence, are now felt into reality. Through persistent, near-permanent surveillance and pre-emptive strikes, power is refocused on what may be, as the potential presents itself to feeling. As an “affective logic of potential” (Massumi 2015: 49), *Ontopower* is a mode of power embodying the logic of pre-emption across the full spectrum of US military force, from the hard to the soft.

Predator and Reaper drones and their associated networked audiovisual technologies are the devices through which the pre-emptive hard and soft powers of the US Military

are projected across foreign territories. The thinking into being of a future and unspecified threat is affectively held in the present, in a perpetual state. Through drone surveillance, data on human behaviour are collected and kill lists are generated by machine-learning algorithms. Human behaviour is abstracted through the formation of nodes of interest and vectors and vertices that represent connections between potentially threatening human behaviours. Actualisation is then triggered through drone strikes that are, in the context of Ontopower, not only self-propelling but also ontologically indefinite as they stem from a virtual root whose potential can never be exhausted through a single actualisation, or strike. Massumi offers Ontopower as a necessary way to consider theories of power that address a disconnect between operations and policy across many areas of governance.

In the case of the drone technologies deployed to wage this pre-emptive war, we are seeing a new set of human-technology relations emerge that have radically altered how bodies can embody, disembody and reembody space. We are entering a drone age in which the technology of surveillance and remote engagement is changing the way in which humans embody and disembody the world. Since around 2011, the US and other countries have increasingly deployed drones and their associated networked audiovisual technologies across the globe to form a network of image-gathering and data-collecting machines. As drones redefine contemporary warfare, their impact filters into general culture and they are now becoming the subjects of investigation by artists and those humanities and ethics scholars concerned with issues of agency, power, visibility, technology, and fear. While I acknowledge the importance of a thorough analysis of the ethics of drone warfare, my intention throughout this thesis is, as far as possible, to set aside my own judgements on morality and ethics. My intention has been rather to conduct a close analysis on the human-technology relations inherent in drone warfare, how these relations produce spaces that are multistable and dis/embodyed and, further, how these can be explored through the making and spectatorship of immersive and multistable audiovisual art.

2.4 Cyber

The term 'cyber' is derived from 'cybernetic', which in turn stems from the Greek word 'kybernetes', meaning steersman, pilot, rudder, guide or governor. The term is first thought to have been used by Plato in *The Alcibiades*, to signify the governance of people (Barnhart & Steinmetz 1998, 333). The word *cybernétique* appeared later, in mid-19th century France, as used by the physicist André-Marie Ampère to describe his classification system of human knowledge (ibid.). Our modern use of the term is much more closely bound to technological systems of governance than to previous socio-political taxonomies. In the period immediately after the Second World War scientists began to consider the informational aspect of life. Theoretical frameworks such as information theory, control theory and communication theory were applied to areas ranging from neurology to molecular biology, electrical engineering to anthropology. The development of communications theory by Claude E Shannon (1948), cybernetics by Norbert Wiener (1948) and genetic information by Erwin Schrödinger established our contemporary understanding of cybernetics as the discipline that studies communication and control in living beings and the machines built by humans.

The current semantics of the terms 'cyber' and 'virtual' as prefixing adjectives that relate to the technological adaption of an object or activity began in the early 1980s. VR is an ontological state or mode of being in which humans engage in a full range of activities: cybersex, cybercrime, cyberwarfare, cyberterrorism, cyberactivism, cyberlaw - the list goes on. The very first iterations of the notion of a cyber or virtual space in which human beings can in some way exist come not from the computer science fraternity, nor from philosophers or humanities scholars, but from popular culture in the form of science fiction literature. This is where my fascination with the possibilities of so-called virtual space and the virtual objects that exist therein began. My experience of the popular culture of the 1980s and 1990s has undoubtedly formed a significant part of the framework of motivation that drives this research. In 1982, William Ford Gibson wrote *Burning Chrome*, part of a collection of short stories centred around what would become the classical form of future techno-dystopian narrative. It is within this collection of sci-fi tales that Gibson coined the term "cyberspace" and would continue to use this newly

assembled word in his next work, and first novel, *Neuromancer*. For Gibson, cyberspace is a “bodiless” place, accessed via a cyberdeck – a console type device that facilitates human interaction with the matrix:

The matrix is an abstract representation of the relationship between data systems. Legitimate programmers jack into their employers’ sector of the matrix and find themselves surrounded by bright geometries representing the corporate data. Towers and fields of it ranged in the colourless non-space of the simulation matrix, the electronic consensus-hallucination that facilitates the handling of massive quantities of data. (Gibson 1982: 196).

The term “cyberspace” is now commonly used to describe a network of systems that govern or facilitate the handling of massive quantities of data, or any system controlled by technology. It is concrete in the sense that we can alter its behaviour by changing the governing functions of the system. VR is the ontological state that emerges from a phenomenology of cybernetics/space. Unlike the systematic and mostly predictive nature of cybernetics, the dynamics of a reality, particularly the virtual kind, is far more slippery to pin down:

Cyberspace. A consensual hallucination experienced daily by billions of legitimate operators, in every nation, by children being taught mathematical concepts ... A graphic representation of data abstracted from banks of every computer in the human system. Unthinkable complexity. Lines of light ranged in the non-space of the mind, clusters, and constellations of data. (Gibson 1984: 76).

Bodilessness, non-space, representational geometries, telepresence, virtuality: these digitally induced ontological ambiguities were recurring themes in the popular culture of the 1980s and 1990s, widely consumed through comic books, television series, novels and feature-film adaptations including *Tron* (1982), *Jonny Mnemonic* (1982),

Neuromancer (1984), *Star Trek Next Generation* (1987–1994), *Ghost in the Shell* (1991–1997), *Lawnmower Man* (1992), *Freejack* (1992), *Ghost Rider* (1994), *Existence* (1999) and *The Matrix* trilogy (1999–2003). All these employed some version of the same narrative trope: a protagonist that moves between “real” and “virtual” worlds – most commonly cyberspace – and can necessarily circumvent many of the laws of topology, geometry and physics that govern the real world. Cyberspace and VR were formed in the collective cultural imagination; yet both terms lacked semantic content. The first serious attempts to locate this content were made by Michael Benedikt of the University of Texas, who organised the first International Conference on Cyberspace: 1Cyberconf. The resulting collection of papers were published by MIT as *Cyberspace: First Steps*. Benedikt began his contribution to the proceedings:

Physical space - the space of the everyday world - in relation to what can be said about the nature of the artificial or illusory space(s) of computer-sustained virtual worlds. Because virtual worlds - of which Cyberspace I will be one - are not real in the material sense, many of the axioms of topology and geometry ... can be violated or re-invented, as can many of the laws of physics. (Benedikt 1991; 119).

At the time, this blank conceptual canvas invited the projection of desires and dreams, inventions and fantasies:

Assembled word cyberspace from small and readily available components of language. Geologic spasm: the primal act of pop poetics. Preceded any concept whatever. Slick and hollow - awaiting received meaning. All I did: folded as words taught. Now other words accrete in the intersect. (Benedikt 1991: 27).

In the early days of VR and cyberspace, emotional reaction to the potential of the technology seemed split: cultural artefacts such as film and print media presented widely dystopian narratives, whereas the academic and intellectual activist

communities were far more optimistic about VR's utopian possibilities. One projection came from the utopian VR visionary Jaron Lanier, responsible for coining the term "virtual reality" and for first developing arguably the most enduring symbols of VR – the data glove and head-mounted display system. Lanier's concept of a nonverbal, pretextual VR was anticipated as a force that could displace mundane reality (Heim 2014, 115). By slipping on goggles and gloves, one could move into a surreal hyperspatial environment that would eventually revolutionise modern culture – an immersive three-dimensional realm would separate a new shared space where humans could overcome their bodies, no longer tethered to their own physicality or personal identity (Lanier, 1987, 1992, 2001; Zimmerman, 1991; Hiem, 1993). These bodily extensions raise questions that are epistemological in nature and relate to self-identification and perception. For example, the nature and reliability of technologically mediated perception have already become an important issue in the philosophy of science, in which it forms part of epistemological studies of scientific instrumentation (Hacking, 1983; Brown, 1990; Ihde, 1990; Achterhuis, 1999; Verbeek 2000). More recent questions raised by human interaction with digital networks, VR and intelligent machines have added new dimensions to the concerns of artists as they contemplate a wider social discourse around the human experience of differences and correspondences between virtual and physical worlds and the transformations between them. Indeed, my own artistic practice is motivated by a desire to understand how interpenetrating techno-spatio-corporeal experiences could affect our deepest notions of who we are, including the full range of desires and imaginations. Ihde (2002) addresses this emotional sensitivity in terms of "technofantasies" and "technoworries":

Yet these fantasies are actually mild ones compared to the bodily social fantasies now being promoted by techno-utopians. The hype claims that eventually virtual reality will be better than real life. These stronger fantasies revolve around the notion of hyperreality, virtuality and virtual bodies and are expressed in the sometimes heard undergraduate statement, "reality isn't enough anymore". These examples illustrate how we can "read" or "see" ourselves by means of, through, or with our artefacts. We can - in technological culture -

fantasise ways in which we get beyond our physical limitations or our social problems by means of technologies created in utopian imaginations. In this mode of technofantasy, our technologies become our idols and overcome our finitude. (Ihde 2002: 211).

Don Ihde is a leading figure within a group of contemporary philosophers of technology that includes Hubert Dreyfus, Donna Harroway, Albert Borgmann, Hans Achterhuis, Peter-Paul Verbeek, and Andrew Feenberg. During the late 1990s and early 2000s, they came to represent a new, empirical direction in the philosophical study of technology that was developing mainly in North America and The Netherlands. In place of the grand philosophical schemes of the classical generation of European philosophers of technology (including Martin Heidegger, Jaques Ellul and Hans Jonas), this generation of Dutch/American thinkers addressed concrete technological practices and the co-evolution of technology and society in modern culture.

Heidegger is undoubtedly one of the most-discussed classical philosophers of technology and, therefore, most likely to be deemed to require development. For Ihde, Heidegger's central weakness was his notion of technological *Gestell*. Heidegger applied the concept of *Gestell* to his exposition of the essence of technology. He concluded that technology is a fundamental condition of being and, as such, the essence of technology is *Gestell*: "Gestell, literally 'enframing', is an all-encompassing view of technology, not as a means to an end, but rather a mode of human existence" (Godzinski 2005: 4). Ihde saw this type of analysis as "useless since it could not discriminate between the results of playing a musical instrument, also a technological mediation, and the process of genetic manipulation!" (Ihde 2006: 271); for Heidegger "every technology ended up with exactly the same output or analysis" (ibid.). Heidegger's insights were necessarily circumscribed because a homogenous approach to epistemological and ontological questions raised by human-technology relations leaves untouched many thought trajectories that could be pursued when investigating the numerous ways in which technology manifests itself.

The diverse range of thematic treatments undertaken by this Dutch/American school of philosophers of technology are far more precise, balanced and, therefore, more useful investigations than the polemic standpoints adopted by the optimistic “technofantsists” of 1Cyberconf or the pessimistic “technoworriers” of so-called digital dualism. Important contributions to specific areas of philosophy of technology include Dreyfus’s engagement on the limits of artificial intelligence (1972–1986), Borgmann’s work with technology and everyday life (1984), Harroway’s perspectives of the cyborg and its attendant blurring of boundaries (1985), Feenberg’s explorations of the cultural and social possibilities opened by technologies (1995–2008) and Ihde’s conception of the place of technology in the lifeworld (1973–2016).

2.5 Digital Dualism

The term ‘digital dualism’ was coined in 2011 by Nathan Jurgenson in an article posted on his blog *Cyborgology*, through which he made a regular contribution to the discourse on technology in society:

Digital dualists believe that the digital world is “virtual” and the physical world “real.” This bias motivates many of the critiques of sites like Facebook and the rest of the social web. (Jurgenson 2011)

While many authors have published theories on the negative social impact of human-technology interactions, it is Sherry Turkle who best embodies the essence of the digital dualist – the so-called “technoworrier”. Turkle has written several books in which she claims that technology defines the way humans behave and our sense of identity (2001), and she offers a cautionary narrative on how people now have difficulty in distinguishing between themselves and computers (2004), noting the dangerous trade-off between time spent in the offline, real world and time spent in the digital, virtual or online world. From the late 1990s onwards, a significant number of publications have shared a common theme of techno-dystopia: *The Dumbest Generation* (Bauerlein 2009), *The Shallows* (Carr 2011), *The Net Delusion* (Morozov 2012), *Alone Together* (Turkle 2013). As the titles of these publications suggest, they share a common rhetoric

specifically related to the notion that the increasing amount of time spent by people on social media, playing online games or using their smartphones is detrimental to both individuals and the very fabric of our society. It was also Sherry Turkle who coined the term “2nd self” in relation to a person’s digital profile, alluding to a kind of schizo-corporeal existence:

The Second Self remains a primer in the psychology of the people’s relationships with computers. Computational objects, poised between the world of the animate and inanimate, are experienced as both part of the self and of the external world.” (Turkle 2005, 5)

Jurgenson rejects this notion of separate realities and, instead, suggests that our reality is both digital and physical at the same time. In two online articles – “Towards Theorising an Augmented Reality” (2009) and “Digital Dualism versus Augmented Reality” (2011) – Jurgenson directly challenges Turkle et al. by proposing the notion of AR as an alternative thought trajectory to Digital Dualism:

This speaks to a fundamental way of conceptualising and theorising the Internet specifically, and spaces and places generally: that digital and material realities dialectically co-construct each other. For example, social networking sites (e.g., MySpace, Facebook) are not separate from the physical world, but rather they have everything to do with it, and the physical world has much to do with digital socialising. (Jurgenson 2009: 1).

I fundamentally think this digital dualism is a fallacy. Instead, I want to argue that the digital and physical are increasingly meshed and want to call this opposite perspective that implodes atoms and bits rather than holding them conceptually separate AR. (Jurgenson 2011: 4).

Far from inventing the notion of AR, Jurgenson borrowed the concept from the real-time graphics community. More than a decade before Jurgenson applied AR as a way of conceptualising human experiences in a digitally networked world, Paul Milgrem and Fumio Kishino (1994) advanced their theory of the “virtuality continuum”. Milgrem and Kishino placed real environments and virtual environments at opposite ends of a spectrum that included various levels of “mixed” realities, hence the coining of the term MR and its application to a “virtuality continuum”.

2.6 The Mixed Reality Continuum

In 1994, Paul Milgrem, Haruo Takemura, Akira Utsumi and Fumio Kishino proposed the idea of a reality-virtuality continuum ranging from completely real environments to completely virtual environments and encompassing a range of technological configurations termed "Mixed Reality". In their paper *Augmented Reality: A class of displays on the reality-virtuality continuum*, Milgrem et al. attempted to define the relationship between, augmented, virtual and physical realities. Rather than regarding virtual and physical concepts of reality simply as antitheses, Milgrem suggests understanding them as occupying opposite ends of a continuum, which he refers to as the Reality-Virtuality (RV) continuum. This concept is illustrated in Figure 2 below.

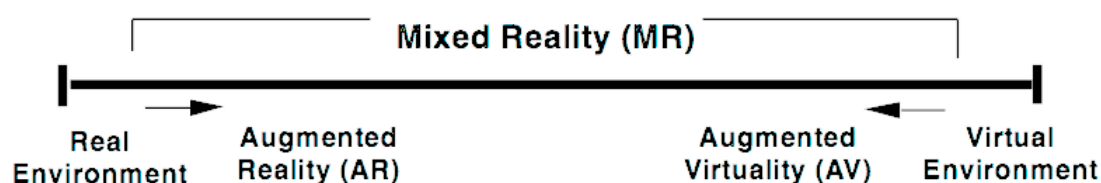


Figure 2: Simplified representation of an RV Continuum

Milgram et al. describe the MR schema thus:

The case at the left of the continuum defines any environment consisting solely of real objects, and includes whatever might be

observed when viewing a real world scene either directly in person, or through some kind of a window, or via some sort of a (video) display. The case at the right defines environments consisting solely of virtual objects, examples of which would include conventional computer graphic simulations, either monitor-based or immersive. Within this framework it is straightforward to define a generic MR environment as one in which real world and virtual world objects are presented together within a single display, that is, anywhere between the extrema of the RV continuum. (Milgrem et al. 1995: 3).

Although the analysis of Milgrem et al. reflects only upon visual display technologies, his endeavour to produce a taxonomical scheme for mixing real and virtual worlds within the general framework of MR can be extended to the felt experience produced by the three artworks in this thesis. That is to say that Milgrem et al. assert that digital technologies can and will generate perceptual effects that appear to dither between real and virtual spaces:

Of course, as computer graphic and imaging technologies continue to advance, the day will certainly arrive in which it will not be immediately obvious whether the primary world is real or simulated, a situation corresponding to the centre of the RV continuum” (ibid.).

This schema demonstrates that elements of the virtual environment (VE) can be added to a real scene to create an AR, or real elements to a VE to create an “augmented virtuality” (AV). Around the same time as Jurgenson’s article *Digital Dualism versus Augmented Reality* (2011), artists and media theorists were also starting to use terms such as ‘AR’, ‘MR’ and ‘hybrid space’ in place of the polemic prefixes ‘virtual’ and ‘cyber’. Many of the artists and theorists concerned with networked digital technologies as a creative medium simply use the term “AR” without using AV, but Milgrem and Kishino specifically noted that more or fewer real and virtual objects may operate within a

system. The three artworks produced as part of this research are primarily concerned with generating new apprehensions of the role that digital, MR technologies play in our evolving conception of spatio-corporeal relationships.

2.7 Virtual and Mixed Reality in the Arts

Milgrem and Kishino's virtuality continuum proved to be a useful taxonomy of realities for discussing both the technology-focused artworks being produced at the time and those that would follow. Computer hardware and software had become both sufficiently advanced and accessible for artists to be able to realise environments that were completely immersive, and, in this way, art could now be experienced as a reality that was not physical but virtual. Three of the earliest artworks to be made with VR computer systems were Brenda Laurel and Rachel Strickland's *Place-holder* (1993), Char Davies's *Osmose* (1994–95) and Yacov Sharir and Diane Gromala's *Dancing with the Virtual Dervish* (1994). Both *Place-holder* and *Osmose* used VR technologies to build landscapes that imply a prehistoric, pre-technological time, while *Dancing with the Virtual Dervish* created equally impossible spaces by exploring the interior of the human body. In her 1997 article *Changing Space: Virtual Reality as an Arena of Embodied Being* Davies describes *Osmose* as:

an immersive interactive virtual reality environment installation with 3D computer graphics and interactive 3D sound, a head-mounted display and real-time motion tracking based on breathing and balance. *Osmose* is a space for exploring the perceptual interplay between self and world, i.e., a place for facilitating awareness of one's own self as consciousness embodied in enveloping space. (Davies 1995: 4).

For *Osmose*, Davies wanted to evoke the sensation of complete immersion she had experienced while deep-sea diving. To achieve this, Davies and her technical team devised an innovative wearable system that would allow users (later termed "immersants" by Davies) to "float" through virtual space. The interface incorporates a head-mounted display and motion tracking vest that, when worn against the body,

senses the wearer's patterns of breathing and movement. Using their own breath and balance, immersants are able both to orient themselves in and move through a series of 12 virtual worlds as seen through the head-mounted display. The first virtual space to be encountered is a "three-dimensional Cartesian Grid" which functions as an orientation space. The grid then gives way to a forest clearing. Davies describes the 12 world-spaces of *Osmose* as:

based on metaphorical aspects of nature including Clearing, Forest, Tree, Leaf, Cloud, Pond, Subterranean Earth, and Abyss. There is also a substratum, Code which contains much of the actual software used to create the work, and a superstratum, Text, a space consisting of quotes from the artist and experts of relevant texts on technology, the body and nature. Code and text function as conceptual parentheses around the worlds within. (Davies 1995: 7).

The immersive experience of *Osmose* lasts 15 minutes, after which a symbolic lifeworld appears through which the immersant returns to the forest clearing encountered at the beginning of the experience: "the lifeworld of *Osmose* reappears and then slowly but irretrievably recedes, bringing the session to an end" (Davies 2000: 82). *Osmose* is unique amongst other virtual artworks in that the physical self, rather than the conscious mind, is the locus for user interaction. The immersants are affected by a virtual space in the same subtle way that we are shaped by our unconscious apprehension of our physical environment. As Davies quotes from Gaston Bachelard's *The Poetics of Space*, "By changing space, by leaving the space of one's usual sensibilities ... we change our nature." Davies put into practice Bachelard's theory of "physical innovation" and found that, given the use of an embodying interface as in *Osmose*, "immersive virtual space can coexist with an apparent three-dimensionality of form, and feelings of disembodiment can coexist with those of embodiment" (ibid.). These seemingly paradoxical aspects, in combination with the ability to kinaesthetically interact with elements within the space, create a novel experiential context and, as Bachelard suggests, cause a shift in environment that will trigger powerful emotional and psychological responses.

Since mid-1995, more than 20,000 people have experienced *Osmose*. Davies and her team have been extremely thorough in their attempt to capture the resultant experiential data, and several thousand immersants have communicated their experiences by responding to written questionnaires, video interviews and visitor comment books, giving a powerful insight into the overall effect of this artwork. The combined physical and psychological effect of *Osmose* is complex, with emotional intensity “ranging from euphoria to tears of loss” (Davies 1995: 22). Relatively small samples taken from the *Osmose* Book of Comments at the Museum of Contemporary Art, Montreal and the Barbican Art Gallery in London feature a high frequency of adjectives, such as “contemplative, meditative peace”, “fascinating, awe-inspiring depth” and feeling “gently cradled”. Transcriptions of video interviews read in a similar vein: “an almost religious experience, certainly a meditation, very close to yoga...”, “I discovered in myself a fascination for the depths. I am surprised and eager to understand the deep sense of my own being in this real unreal space.” Although the tone of these accounts could be considered rhetorically esoteric, they provide a compelling justification of Davies’s extension of Bachelard’s poetic insight into the psychological effects of “changing space” (Grau 2004: 31).

In comparing their reactions with those generated by psychological research into traditionally induced altered states of consciousness, I have come to believe that full-body immersion in an "unusual" virtual environment can potentially lead to shifts in mental awareness. That this may be possible has many implications, some promising, some disturbing. (Davies 1998: 49).

The appropriation of mixed-reality technologies and a related theoretical discourse by artists began to galvanise around certain groups in 2010. Key authors and artists within this movement were either members of the Manifest.AR group or contributors to the few substantial collections of articles on mixed and augmented reality art at that point: Aceti and Rinehart’s *Not Here, Not There* double issue of Leonardo Electronic Almanac

(2013); Bedford and Giannaci's *Performing Mixed Reality* (2011); Geroimenko's *Augmented Reality Art* (2014) and Grimshaw's *The Oxford Handbook of Virtuality* (2014).

Manifest.AR was the first artist collective to use AR to create art and activist works. The group conducted its first intervention in 2010 during the We AR exhibition held at the Museum of Modern Art (MoMA) in New York. Mischievous and politically charged, this intervention was truly ground-breaking in that it was able to circumvent MoMA's curatorial hierarchy by inviting selected artists to place artworks inside and around the museum. The participants invited included most of those who would later initiate the forming of Manifest.AR: Sander Veenhof, Mark Skwrek, Tamiko Their, Will Pappenheimer, Christopher Mansion and John Craig Freeman (Geroimenko 2014: 52). In 2011, Vladimir Geroimenko, in collaboration with a number of artists from Manifest.AR, led an augmented reality intervention at the Venice Biennale. The artists produced works that used emerging mobile AR technologies to geolocate virtual artworks inside the normally curatorially closed spaces of the Giardini della Biennale. These interventions, unlike physical artworks, cannot be removed by the Biennale organisers and will remain at their locations for as long as the artist's desire. They absolutely undermine the role played by location in canonising works of art and the power of the curator as the gatekeeper who controls access by artists to these sites that consecrate works of art into the high art canon. Manifest.AR continues to explore what makes AR unique as a medium, separating it from other forms of new media such as VR, web art, video art and physical computing. Since its inception in 2010, Manifest.AR artists have produced artworks for or at events including the ISEA Istanbul 2011, ZERO1 Biennial San Jose 2012 and FACT Liverpool 2013.

These artists utilise the inherent ontological ambiguities highlighted by AR technologies to comment on power hierarchies within the art world and on notions of social and public space. It seems that their aim is not to analyse the role of technology in defining what reality is or how it is perceived, felt, and detected but, rather, an attempt at understanding contemporary space and the definition of art that overlays and occupies that space. An excellent example of this can be found in the symbolic work *The Apparition of the Unicorn, Pink and Invisible at the Same Time* by the artist collective

Les Liens Invisibles. By taking the phenomenon of web-based religious parody, these artists/activists used AR to create an event that demonstrates the illegal, unauthorised use of public space. The work first appeared in 2011 as a cyber-monument in St Peter's Square in Rome. The square in front of St Peter's Basilica is not located in Italian territory, as the Vatican City is an independent state. It is also an undemocratic state, where protests and demonstrations of any kind are strictly forbidden, and this prohibition enforced by tight security. The cyber-monument, which is a symbol of atheism, was permanently placed in the middle of the square; all passers-by can experience the work by installing the popular, free Layer AR application:

The Invisible Unicorn is not a joke and it won't be removed from its current position. The virtual sculpture is real, (in)visible and it has to be taken into serious consideration: it is the way a decontextualised symbol can alter, challenge and reshape the perception of public space - especially a very closed and symbolic one like the St. Peter's Square in Rome. (Les Liens Invisible 2011: 72).

The virtuality continuum devised by Milgrem et al. provides a framework in which an unlimited number of configurations of real and virtual objects and spaces can exist. Although the examples of these configurations diverge in their detail, they share important underlying characteristics in that they establish complex relationships between physical and virtual spaces, employing networks to create distributed structures that interconnect objects and environments to produce space. Artists have integrated live performances by actors and audiences with digital media and employed rule-based-type structures more commonly found in computer games. The artistic experience is interwoven with everyday activity; these experiences have been described as "MR performances" (Bedford & Giannachi 2011: 59) in their book *Performing Mixed Reality*. The term is intended to express both the mixing of the real and virtual and the combination of live performance and interactivity.

Landmark examples of mixed-reality performance are evident in a series of works developed by the Mixed Reality Laboratory (MRL) at the University of Nottingham in

collaboration with the interactive media arts collective Blast Theory. These works show how mixed-reality performances generate hybrid realities that span physical environments and virtual worlds. These *Hybrid Spaces* tend to encompass events that occur on different points on the mixed-reality continuum and are often juxtaposed or adjacent rather than superimposed. In the early 2000s, Blast Theory produced a series of locative works that included *Can You See Me Now?* (2001) and *Uncle Roy All Around You* (2003). These works are designed through several participatory channels that are communally constructed via collaborations that span physical and virtual environments. *Can You See Me Now* is a location-based game in which online players are chased through an online virtual model of a city by four street performers who must negotiate the streets of the physical world via handheld GPS trackers and computers. These devices relay the position of the online players in the virtual model of the city to the street performers who must chase and capture the online players by occupying the same grid reference (Benford, Crabtree & Flintham (2006: 131). This work enabled online players to “experience the city through another person” (ibid.).

Uncle Roy All Around You is another location-based game, this time creating a hybrid experience by merging aspects of computer games with live performance. Participants must venture into a city in search of an actor playing the character of ‘Uncle Roy’. Online participants can track their progress in a parallel online virtual model of the same city. As in other Blast Theory pieces, the street participants are given a handheld computer and GPS tracking device and are tasked with tracking and capturing a person who is actively trying to avoid them. The handheld computer shows a digital map that corresponds to the game area and shows the position of the street participants. The online participants can then communicate with the street participants in real time via text message and audio-link to direct home to physical locations and clues as to Uncle Roy’s whereabouts. *Can You See Me Now* and *Uncle Roy All Around You* are distinctive in the way they support performances that span online and on-the-street participants, simultaneously occupying multiple points on the virtuality continuum, and can be thought of as a mixing of realities that generates spatial hybridity.

Technologies associated with MR are found in a diverse set of fields and a wide range of configurations. These fields cover most sections of our society: the military, finance, health, the arts, leisure, and education (Grimshaw 2014: 19), supporting Milgrem and Kishino's observation that a mix of real and virtual objects may exist in a given system (Milgrem et al. 1995: 7). Whilst ontological questions of virtuality and simulation in relation to consumer devices such as smartphones, networked desktop computers, social media platforms and VR and AR gaming platforms are well observed and analysed, the non-civilian use of similarly networked but weaponised digital devices have not been subject to the same level of analysis. It is true that a significant amount of academic scrutiny has been applied to the ethical and moral dimensions of military technology in the networked digital age; however, questions of human-technology relations within the context of networked, remotely controlled machines of war remain under-explored. The US military's use of networked digital technologies associated with common notions of virtuality is of particular interest throughout this thesis. The US military spends some six billion dollars a year on virtual and simulated training programmes. While some of this amount is spent on training simulators and wargaming software and hardware, digitally networked computers play a huge role not just in the simulation of and training for war, but also in the actual waging of wars (Tucker 2017: 145). In an important 2017 article entitled "Virtuous War/Virtual Theory", prominent International Security Studies expert James Der Derian describes the US military as spearheading this virtual revolution:

America's diplomatic and military policies are increasingly based on technological and representational forms of discipline, deterrence, and compellence that could best be described as virtuous war. (Der Derian 2017: 19).

Here, Der Derian is aligned with Massumi's concept of Ontopower, in that he advances the notion of virtuous warfare driven by a technical exceptionalism coupled with an ethical compulsion to threaten, and ultimately actualise, violence from a distance – all justified by a precision that causes minimal collateral damage on one side and reduces

casualties to zero on the other. With a particular focus on drones, Der Derian (2017: 19) describes this replacement of the flesh of the fighting body with remotely controlled machines as being “at the heart of virtuous war”, reflecting a desire for “using networked information and virtual technologies to bring ‘there’ here in near-real time and with near-verisimilitude”. Video footage streamed from drones appears filmic and “virtual” in many ways and has ushered in a new way of looking and the new concept of a “militaristic gaze” (Richardson 2018: 86; Tucker 2017: 169). For some, military technologies enabled by virtual networks have elevated war to a higher moral plane – from the “virtual to the virtuous” (Der Derian 2017: 107). To return to our Graeco-Roman etymology: the two words ‘virtual’ and ‘virtuous’ share an origin rooted in a medieval notion of the supernatural power of a divine being endowed with inherent natural virtue. Both virtual and virtuous carried the same moral weight, derived from the Greek and Roman sense of virtue – proper moral conduct – but their meanings have diverged in modern usage, with virtual acquiring a morally neutral and more technical tone, while virtuous lost its sense of action or influence through physicality. Now, in the context of Ontopower and virtual networked technologies, they are being joined again through moralised martial means.

In an essay entitled “To See Without Being Seen”, Svea Bräunert (2015: 11) addresses the phenomenon of the military drone as a political subject with a “powerful aesthetic trajectory” and asserts that some of the most compelling positions on drone warfare and the attendant political, conceptual, and ethical issues are explored in an artistic context. Several visual artists have explored drone-related issues of surveillance and secrecy, obfuscation and intelligence services, invisibility, and deniability, and have attempted to render these abstractions into tangible artworks. In addition to authoring “To See Without Being Seen”, Bräunert co-curated with Meredith Malone the 2016 exhibition *To See Without Being Seen: Contemporary Art and Drone Warfare* at the Mildred Lane Art Museum. This exhibition presented a collection of artworks that critically engage with the many ethical and political issues related to drone warfare and surveillance by raising fundamental questions about undeclared wars, increasingly invisible, undeterred surveillance and the seamlessness of increasingly virtualised military technologies.

The artworks presented in this exhibition employed technologically inflected immersive audiovisual media, including video, sculpture, installation, photography, and web-based projects. *To See Without Being Seen: Contemporary Art and Drone Warfare* is one of several recent curatorial endeavours which have contributed to an active discourse around the interrelated themes of drones, surveillance, telepresence and state violence afforded by digitally networked machines of war. Other exhibitions include *Fire and Forget: On Violence* at the KW Institute for Contemporary Art, Berlin 2014, curated by Ellen Blumenstein and Daniel Tyradellis and themed around ideas of distance enforcement and killing, and *Decolonized Skies* at Apexart, New York 2014, curated by Hi & Low Bureau (Yael Messer and Gilad Reich), which focused on aerial perspectives of power and control. The artworks in *To See Without Being Seen: Contemporary Art and Drone Warfare* share the same intention of catalysing discussion about the ethical concerns surrounding the disconnected violence and concealment that are seen to characterise military drone technology. For example, Huran Farocki's double-channel video installation *Eye/Machine III* (2003) and Trevor Paglin's film *Drone Vision* (2010) both examine the complex notion of Operative Images: images that are not intended to be looked at aesthetically or reflectively but to be studied as objective, technical tools inciting action. That is to say that operational images do not represent things in the world but rather, the machines and the images they produce do things *in* the world (Paglen 2014: 12).

In his text "Phantom Images" (2004), Farocki provides this definition:

In my first work on this subject, *Eye/Machine* (2001), I called such pictures, made neither to entertain nor to inform, 'operative images.' These are images that do not represent an object, but rather are part of an operation. (Farocki 2004: 16).

Farocki's theory of the operative image is useful in understanding the processes at work in the ARGUS-IS system. He describes a shift away from seeing images as representational in favour of implementational and as visual procedures which may or

may not be intelligible to human viewers. In an operative image, what is displayed on the screen is merely a by-product of the operation the image helped to perform. There is therefore little need to make digital images interpretable to "meat-eyes" (Paglin 2014: 4) and what follows is an image culture where humans are at times a secondary audience.

In the footage Farocki used for his piece "Eye/Machine" and which he uses as an example of an operative image, there is very little for human viewers to see. The video is primarily used as input to guide the flight of a drone. Here, the visual is subjugated to the procedure of navigation and the work fluctuates between visualisation and non-visual processes. While operative images are not necessarily intended to communicate with the human senses, they do so nonetheless. There is a digital residue for us to look at, though we may not understand what it represents. Harun Farocki's work on operative images has been described as an exploration of how to see like a machine (Paglin 2014: 7) and it offers a useful perspective on the human interpretation of images intended for computers.

This hierarchical restructuring of visual images towards operationally relevant data and away from direct perception is especially evident in the often fragmented presentation of three dimensional forms as a consistent visual aesthetic throughout my practice research. *Hybrid Spaces*, *Compound Terrains* and *Conjured Spaces* all utilise a wireframe geometric graphical design that only occasionally suggests a visual semblance of anything that might correlate to lived human spaces. For example, from 03'34" to 05'12" in *Conjured Spaces*, spare lines and angular constructs display a reductive abstraction of an empty polygon that previously framed portions of land that could have contained vehicles, human dwellings, or parts of the built environment, rendered unrecognisable by the target view and reoriented towards military ends, just as a drone searches for a flight path using digital video, verifying landmarks as it flies, and adjusting its course accordingly. Even when the image coheres into room-like forms, for example at 04'44", these again are only vaguely redolent of spaces with perceptually salient features at a human-scale. In this way, the work exemplifies this transformation of visual salience

away from direct human perception towards a conception of the image as operational data with primarily military utility.

Artist Hito Steryl's video installation *HOW NOT TO BE SEEN: A Fucking Didactic Educational .MOV File* and Adam Harvey's project *CV Dazzle* both address the issue of how to become invisible from surveillance technology. Through the theme of counter-surveillance, they engage with a visual form of politics, based on going undetected and becoming or remaining obscure.

In 2015, sound and performance artist Samson Young presented a solo show at the Team Gallery, New York entitled *Pastoral Music* which centred around a live performance piece called *Nocturne*. For this work, Young used video footage of night bombings collected from news programmes and the Internet. US attacks on the Middle East, ranging from the Gulf War to ISIS, were edited into a six-hour-long film. Young used the video as a score, which he performed with conventional percussion, household objects and "live foley" techniques to recreate the sounds of exploding bombs and flying debris as accurately as possible. These "sound effects" are part of what Young describes as a "Sonic Warfare Training Program" (Young 2015: 1) with the artist taking on the role of a training combatant. Young places *Nocturne* within a tradition of direct artistic involvement in warfare. In his artistic statement, Young attributes his inspiration to the Ghost Army. Officially known as 23rd Headquarters Special Troops, the Ghost Army was a US Second World War unit made up of artists, sound technicians, musicians, actors, painters and set designers. The unit's primary function was to deceive the enemy, which they did by using fake radio transmissions, recorded combat sounds and inflatable tanks in order to create the illusion of military activity. This convergence of artistic virtuality and actual military strategy creates the template for *Nocturne*.

Although the works mentioned so far in this section do indeed use digital technologies to produce tensions between notions of virtual and actual through *Hybrid Spaces*, mixed and augmented realities, they do so in the service of an ethical narrative, political discourse, or aesthetic experience does not primarily address the direct human-technology relations inherent within the operation of devices themselves. The

interactive urban games of Blast Theory, the mischievous interventions of Manifest.AR, the more politicised and illegal activities of Les Liens Invisibles or the ethical and moral provocations put forward by the artists in To See Without Being Seen, each address important socio-political issues pertaining to the impact of technology on balances of power. In contrast, Contemporary Art and drone Warfare, Fire and Forget: On Violence and Decolonized Skies are centred around asymmetry of power that occurs when humans become drone strike victims and surveilled subjects. These themes are certainly of interest to me and have certainly fed into the conceptualisation of my practical work. In addition to this conceptual influence, I have drawn equally on the work of another group of artists whose methods utilise similar configurations of technologies and therefore share more closely an experiential aesthetic.

Artists and collectives such as United Visual Artists, Mathew Schreiber, Marshmallow Laser Feast, Carlo Bernardini, Robert Henke, Oliver Ratsi, Margareta Hesse and 404Zero to name a few have advanced audiovisual art practices that poeticise spatial perception through immersive audiovisual art installations. Their approaches to creating environments in which audiences are placed in direct contact with immersive technologies so as to create felt senses of spatial ambiguity have greatly influenced my own creative practice. As in two of my submitted artworks, *Hybrid Spaces*, *Compound Terrains*, and the appendix piece *Illusory Contours*, the use of lasers as a creative medium to explore technologically mediated space perception is a theme that runs through the work of Robert Henke, Matthew Schreiber, Margareta Hesse, and United Visual Artists (UAV). Both their work and mine similarly engage with lasers and geometry as tools for the creation of spatial perception. Geometry has played a central role in Western art history, enabling important advances in the human understanding of lines, volumes, proportions, and perception of space.

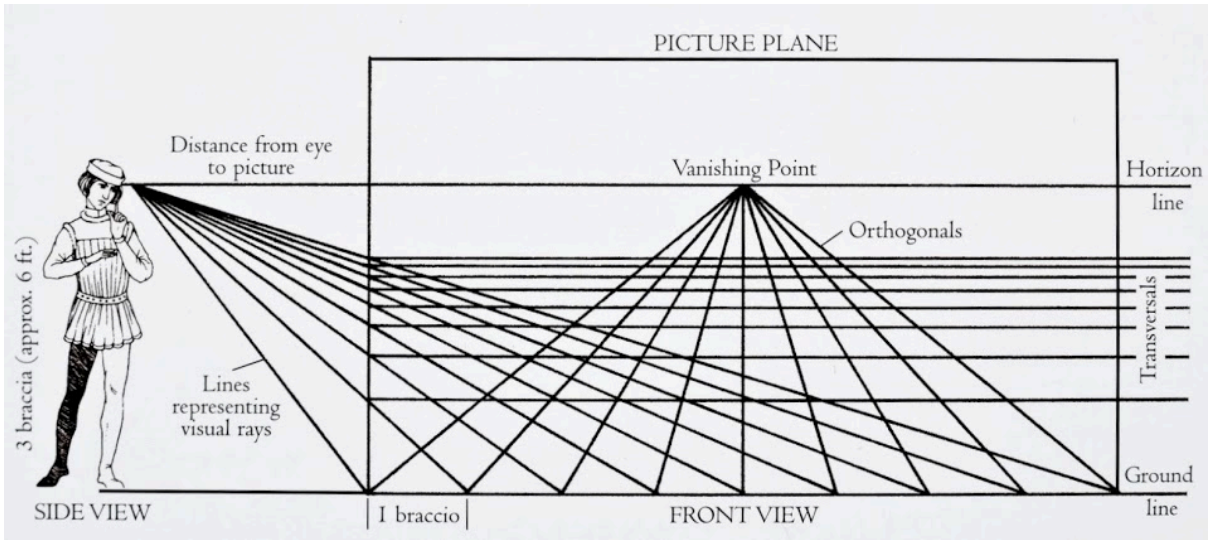


Fig 3 Linear Perspective Model, Leon Battista Alberti c. 1430



Fig 4 Vanishing Point United Visual Artists, 2014 - 2020

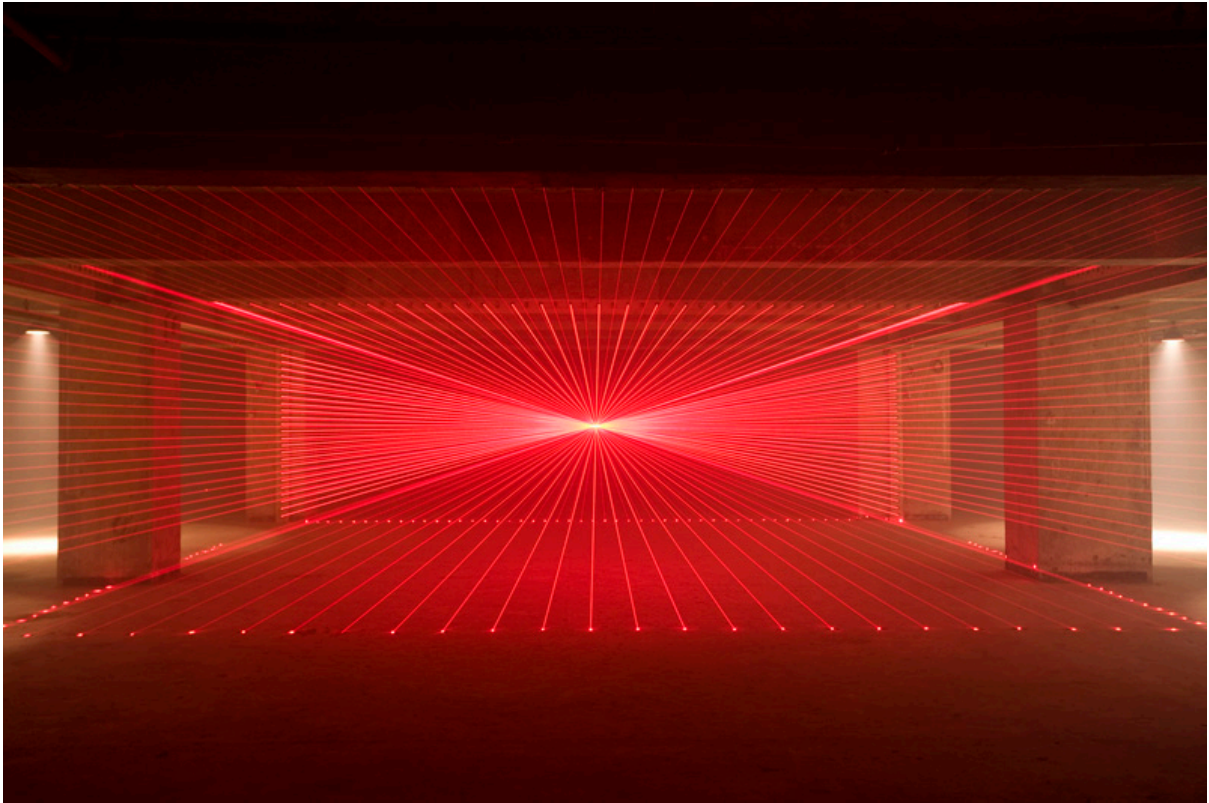


Fig 5 Crystalline Lattice Matthew Schreiber, 2010

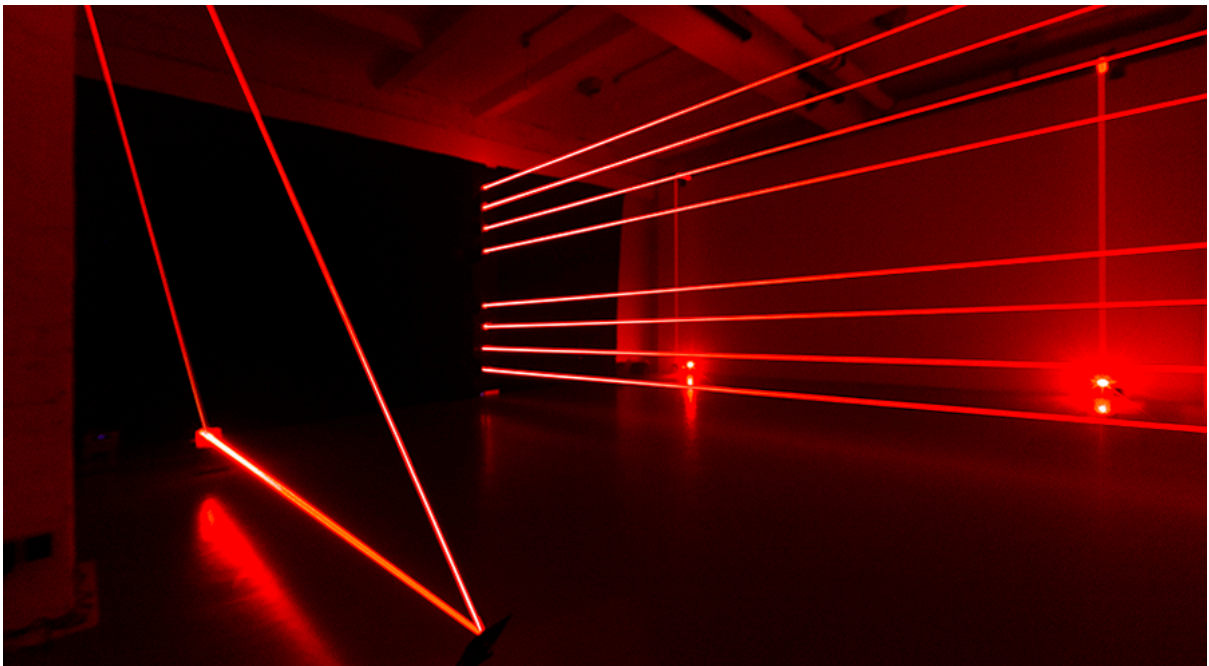


Fig 6 Sculptured light I Margareta Hesse, 2020

UVA, Schreiber, and Hesse use lasers to create architectural space. *Vanishing Point*, *Crystalline Lattice* and *Sculptured Light* rely on the use of perspective created by simple

lines in the same ways that *Hybrid Spaces*, *Compound Terrains* and *Conjured Spaces* do to create and define physical and virtual space.

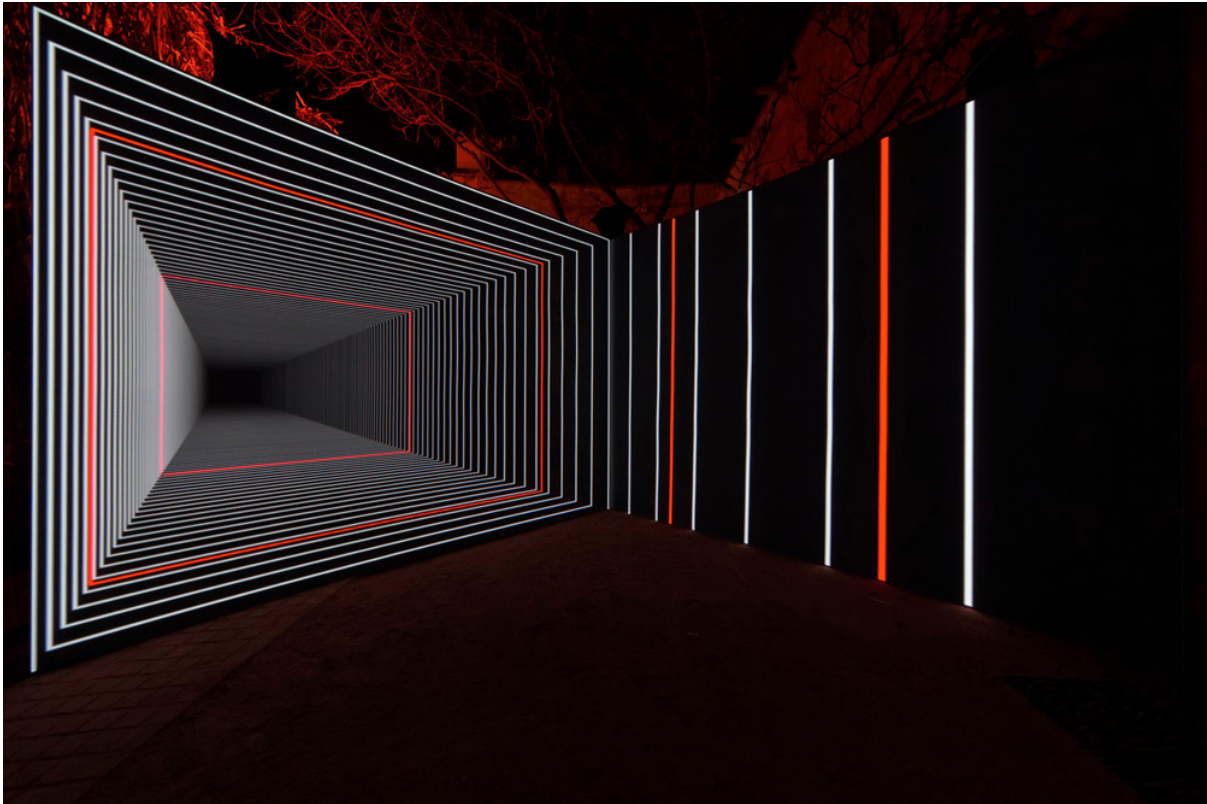


Figure 7 Onion Skin Oliver Ratsi, 2017

Onion Skin by Oliver Ratsi is a work of computer graphics animation that is projected onto two perpendicular surfaces and exploits the virtuality of three-dimensional screen space. A similar approach to graphical animation was taken in the composition of *Hybrid Spaces*, *Compound Terrains*, and *Conjured Spaces*. The creation of the illusion of a three-dimensional space that extends behind and below the projection surfaces of these three works was combined with laser projection in physical space to create a further illusion of space that existed in the same physical location as the audience members.



Fig 8 Deep Web Robert Henke & Christopher Bauder, 2017

Deep Web by Robert Henke and Christopher Bauder used motorised lasers to create and animate geometric forms as tangible three-dimensional vector drawings suspended in air. I took a similar approach in *Compound Terrains* which deployed 24 lasers mounted to servo motors. This allowed me to compose using animated geometric light shapes that could occupy physical space and interact with the animated computer graphics that occupied the virtual screen space.

The overarching theme of the technological mediation of human perceptions of spatial reality and virtuality can be expressed in the abstract via the production of spatial geometry through light and sound. It was the blending of these abstract spatial poetics with the more figurative styles of Forocki, Paglin and the artists' contributions to Contemporary Art and drone Warfare, *Fire and Forget: On Violence and Decolonized Skies* that profoundly informed my production of *Conjured Spaces*. This audiovisual artwork forms the latter part of my research trajectory as it brings together the two dominant themes of this thesis: dis/embodied pace and the specifics of space perception that pertain to the human-drone relation.



Fig 9 Trevor Paglin Drone Vision, 2010

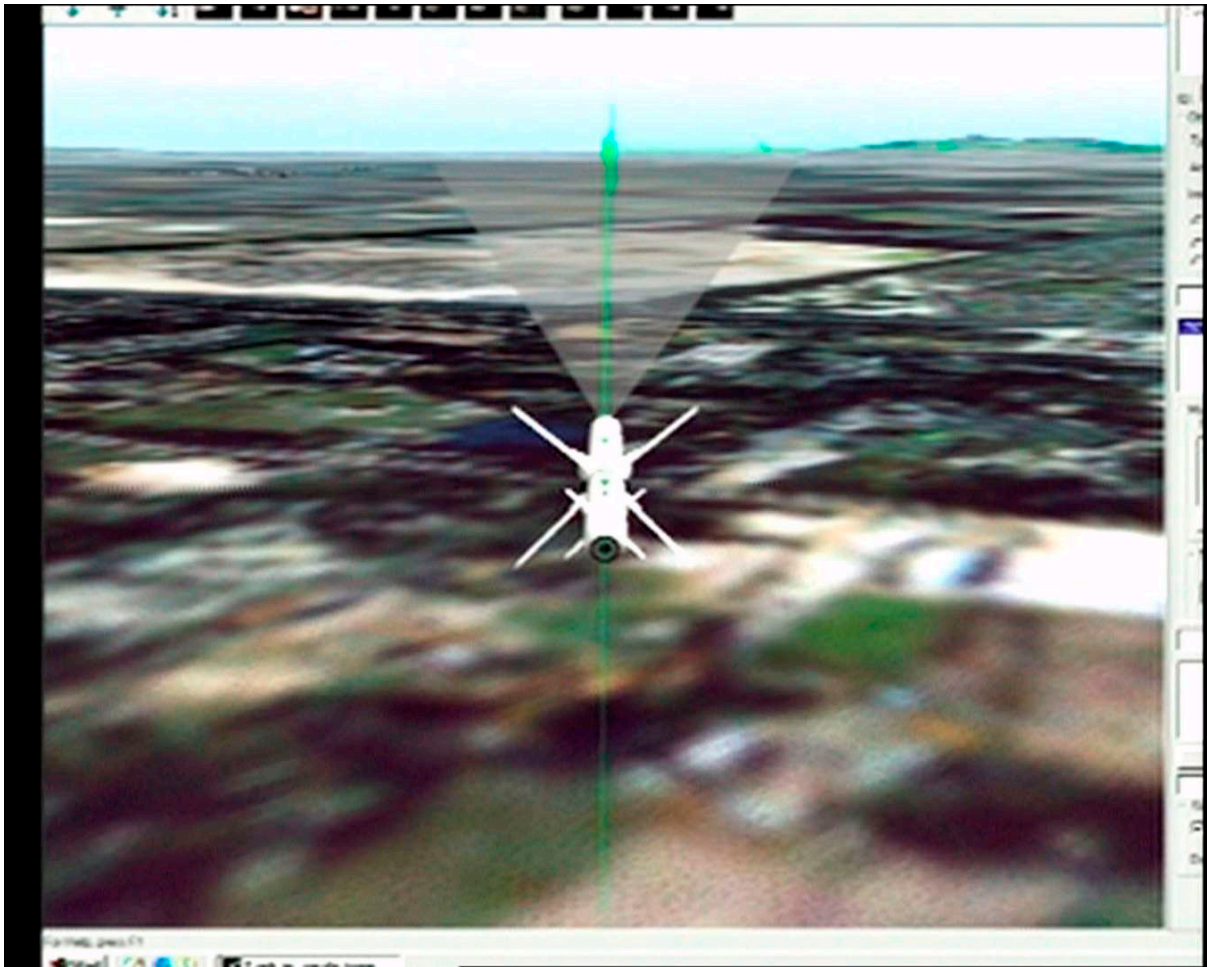


Fig 10 Eye Machine III Harun Farucki, 2003

Like both *Eye Machine III* and *Drone Vision*, my work audiovisual work *Conjured Spaces* incorporates figurative approaches to explore the disembodiment of machine vision. *Drone Vision* uses actual drone footage that is overlaid with text and numbers derived from the drone's on board sensors, whereas *Eye Machine* uses camera footage from ballistic missiles and computer generated graphics that depict the terrain beneath the missile's flight path. *Conjured Spaces* uses terrain imagery scraped from Google Earth View (a website that hosts a collection of thousands of high-resolution satellite images) to evoke the machine vision of the drone. These images of earthly terrain are interspersed with abstract geometry, and it at this point in my practical work that the geometric abstractness of spatial poetics converge with the figurative specifics of drones as machines that afford dis/embodyed space converge

My interest, the focus of this thesis and the subject of my artistic practice is the HTR inherent in drone warfare. As seeing machines, drones operate through images and, at the same time, produce images that have the power to effect changes in modes of human's perception of space. Their systems of operation are based on human-screen interactions that confront us with urgent questions about the changing meaning of proximity and distance in the remote operation of machines via screen operations and the speed at which a space can be disembodied and reembodied through the same machine.

One example of this is a visual paradigm shift that is the result of a transition from the linear perspective that has until now dominated our vision, to vertical perspective and the evolving significance of the aerial views that are inherent in technologies of drone surveillance and combat. While the drone is the specific cultural focus of these explorations, I intend that the three artworks presented as part of this thesis function as abstractions of this phenomenon. Moreover, it is my hope that they embody a much broader discussion about the multistability of dis/embodyed space that is shaped by the networked systems that are so embedded into our daily existence, our ideologies and beliefs. These themes are picked up later in this thesis; the seemingly coexistent feelings of disembodiment and embodiment are termed dis/embodiment and further interrogated through a post phenomenological lens. This examination leads to the assertion that an individual's sense of disembodiment and embodiment do not coexist in hybridity as suggested by Farman and Davies, among others, but toggle in and out of existence in response to digitally mediated space perception, a phenomenon that philosopher Don Ihde refers to as "multistability".

2.8 Multistable Spaces

According to Ihde (2002), a special class of artefacts can engage in "symbiotic" relationships with the human body. Such human-technology relations are often simple: seeing through telescopes, feeling through probes, hearing through aids, and similar items. However, these bodily extensions raise questions that are epistemological in nature and relate to self-identification and perception. For example, the nature and reliability of technologically mediated perception have already become an important

issue in the philosophy of science, in which it forms part of epistemological studies of scientific instrumentation (Hacking, 1983; Brown, 1990; Ihde, 1990). More recent questions raised by human interaction with VR and networked audiovisual technologies have added new dimensions to the concerns of artists and, indeed, a wider social discourse around the human experience of differences and correspondences between virtual and physical worlds and the transformations between them. This interpenetrating techno-spatio-corporeal experience affects our deepest notions of who we are and encompasses the full range of desires and imaginations.

Yet these fantasies are actually mild ones compared to the bodily social fantasies now being promoted by techno-utopians. The hype claims that eventually virtual reality will be better than real life. These stronger fantasies revolve around the notion of hyperreality, virtuality and virtual bodies and are expressed in the sometimes heard undergraduate statement, “reality isn’t enough anymore”. These examples illustrate how we can “read” or “see” ourselves by means of, through, or with our artefacts. We can - in technological culture - fantasize ways in which we get beyond our physical limitations or our social problems by means of technologies created in utopian imaginations. In this mode of technofantasy, our technologies become our idols and overcome our finitude. (Ihde 2002: 106).

The task of describing the concepts of multistability and dis/embodiment and the dialectics that surround them is a necessary one, at least in the context of the issues I wish to discuss, is necessary. A central aim of this thesis is to further describe and examine the particularities of the terms “multistability” and dis/embodiment, as they exist in the context of both remotely controlled military drones and digital media installation practice, with an equal focus on wider philosophical understandings of the dis/embodiment of space through technological artefacts.

A significant amount of discourse relates to the subject of spatial embodiment, and an exhaustive overview of the literature would be impractical within the scope of this thesis. It is necessary, however, to examine some of the dominant perspectives in order to understand how different conceptions of embodied and disembodied space as a general phenomenon occupy conceptual territories that interpenetrate those of technologically mediated space, informing and directing how we perceive spatio-corporeal interactions. The conceptual tools of phenomenology and post-phenomenology are useful here both as a method of enquiry and to provide an analytical framework for the purpose of generating discourse that is relevant to my practice. The philosopher Don Ihde has developed significant arguments around bodies in technology; by investigating ways in which certain technologies can mediate between humans and their environment, Ihde (2002: 74) asserts that “technologies are artefacts through which we interpret and embody our environment”. I will consider what Ihde calls the embodiment relation, i.e., “the relation of something in the world through an artefact, a technology” (ibid.) as intrinsic to the dialectical nature of multiple and dis/embodied perspectives of space and would like to examine the definition of the embodiment relation with the aim of applying it to the lived experience of military drone operators and the three artworks in their function as experiential abstractions of operator-drone relations.

My appropriation of post-phenomenology as a methodological framework for generating practice-related theories is not intended to produce a collection of particular facts about technologically mediated space perception but, rather, accounts of the essential features of such perception. This approach raises questions as to how this aim can be achieved given that the methods of phenomenology historically consist of the careful description of experience. The Husserlian answer to this problem is a thought process that he calls “eidetic reduction”, the purpose of which is to bracket out any considerations concerning the contingent and accidental, and to concentrate on intuition i.e. the “essential natures or essences of the objects and acts of consciousness” (Husserl, 2012). This intuition of the essential paves the way for what Husserl calls “free variation in imagination”:

We imagine variations on an object and ask, “What holds up amid such free variations of an original as the invariant, the necessary, universal form, the essential form, without which something of that kind would be altogether inconceivable? (Husserl 1977: 46).

Ihde wishes to retain from classical, Husserlian phenomenology the methodological aspect of variational theory – Husserl’s method of free variation – which is closely connected to eidetic reduction but which, in post-phenomenology, does not lead to essences but rather to Ihde’s important notion of multistability.

But what I retain of phenomenology – and I think this is really the core of classical phenomenology – is what I call variational method. This method implies that you, in your analysis, want to do a go-through of the range of possibilities to see what things variant and what things are not variant, and out of that emerges the model of what I call multistability. So, if you will, my substitution for Husserl’s essences is the notion of multistability. (Ihde 2008: 192).

By utilising the programmatic methods of phenomenological enquiry, I have employed a typical philosophical device: analysing a totality into components and introducing a simplification, in this case, three audiovisual artworks that are experiential abstractions of a global and complex relationship between networked, remotely controlled military drones, their operators and the embodiment and disembodiment of the space they co-produce. A central visual theme within the three artworks is that of the illusory and multistable: phenomena that are exceedingly familiar and deceptively simple, inspired by the line drawings often found in psychology textbooks. Geometric forms appear to oscillate between the two-dimensional space of the page and a three-dimensional space that extends beyond or extrudes from the page.

Compared to a fully etched, representational drawing, the image in Figure 1 is simple, bare, and suggestive in its abstractness. This abstractness can be perceived as a

simplification of two ordinary things: a hallway and/or a Mesoamerican pyramid. When questioned on the orientation of the image, viewer's responses are divided: some report seeing either a pyramid or a hallway, but most report being able to see both variations and that these alternate quickly and almost uncontrollably (Ihde 1977: 90). Elucidated here is a methodology for creating sliding perspectives of dithering, multistable spatial imagery and methods of concrete phenomenological analysis that I will use to address these effects. The multistable audiovisual installations created and presented as the three artworks in this thesis serve as abstract representations of what I believe has now become an ordinary yet complex phenomenon: a multistable and dis/embodyed perceptual state. This state is inherent and uniquely intense in the operator-drone relationship, as it is induced by the simultaneous and bidimensional representations of digital space alongside physical space that are the lived experience of drone operators on combat and surveillance missions.

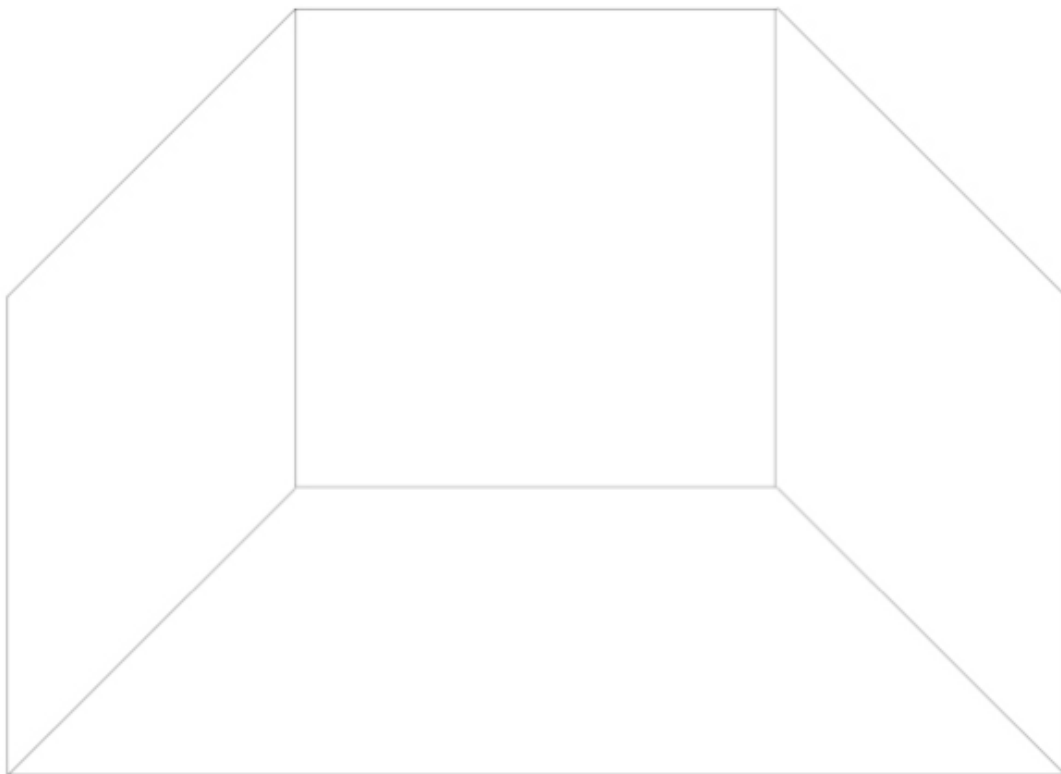


Figure 11. Multistable image of pyramid/hallway Don Ihde 2002

3 - SECTION THREE: HUMAN-TECHNOLOGY RELATIONS

3.1 Human-technology Relations

The analytical approach employed in this section has its basis in phenomenology. Phenomenological approaches share a common goal of understanding the lived experience of human beings, and an assumption that knowledge is embedded in our everyday world and cannot be reduced to quantitative measures. My methods of enquiry draw primarily on the Dutch/American post-phenomenological school of thought and on the work of Don Ihde. Ihde's approach is described by fellow leading philosopher of technology Carl Mitcham (2006) as a "pragmatic phenomenology" influenced by American pragmatism. Arguably, Ihde's most significant work on the philosophy of technology is *Technology and the Lifeworld* (2006) in which he examines the role of technics within the cross-cultural dimensions of historical and contemporary society.

Ihde makes a compelling argument that, even though the "non-neutrality of technology manifests itself in many physical ways and across many different geographies, time periods and traditions" (Selinger 2006: 147), it nevertheless remains the case that "human activity from immemorial time and across the diversity of cultures has always been technologically embodied" (Ihde 1990: 112). This emphasis on embodiment is significant because it enables Ihde to capture what he describes as the "primary structural features of technological intentionality" (Selinger 2006: 172). Ihde expresses these primary structural features in terms of how our experience of the world is mediated by our relationship with technologies and how this experience can be characterised by placing four distinct but overlapping correlates along a continuum of human-technology relations. Each human-technology relation positions us in a different mode of perception and focus on relation to a technological artefact. He classifies these modes as embodiment relations, hermeneutic relations, alterity relations and background relations.

Ihde's multiplication of bodies and human-technology world relations will now be applied to the operator-drone relationship in two specific UAV systems: the MQ-1

Predator and MQ-9 Reaper drones. The aim of this theoretical application is to gain a corresponding phenomenological insight into the specific and invariable elements of the spatial dis/embodyment experienced by military drone operators whilst flying the drones. The invariant dis/embodyed elements were then extrapolated as the audiovisual building blocks of experience in the spectatorship of the three artworks.

The reasoning behind my analytical focus on these human-technology relations is threefold. Firstly, the Reaper and Predator drones represent some twenty years of human-machine interaction and evolution and approximately two million flight hours (Guilmartin 2015: 96). Secondly, the images of these machines are widely recognised in popular culture and have been aestheticised within a range of media from contemporary art to Hollywood films. Thirdly, as a result, these machines occupy a special place in the collective cultural imagination and have been at the centre of discourse and scrutiny by military experts, humanities and ethics scholars, political activists, artists, journalists and the pilots themselves (Rothstein 2015: 301). Through this discourse, questions arise in relation to established cultural, political, legal and ontological understandings of human-technology-space relations. At the core of the tensions surrounding our relationships with drone technology is what Chamayou (2013: 230) terms a “tendency inscribed in the material development of the [drone] weapons system”. I will explore the nature of this tendency inherent in drone technology, concentrating on the virtualising and augmenting of real-time digital spaces that emerge from the human relationship with these remotely controlled systems.

Since 2010, there has been an increasing alignment of opinion between US congressional bureaucrats and highly influential US think tanks on the effectiveness and efficiency of drones in combat scenarios (Tierney 2010; Ciamramitaro & Jones 2011; Wolf 2013; Warren et al. 2015). Senior representatives from the National Security and Foreign Affairs Committee, the Brookings Institute, the Hoover Institute, the US Congressional Defence Acquisitions and Technology Committee and others have all ultimately concluded that drones and other unmanned fighting systems provide unequivocal fiscal, technical, and tactical advantages over their manned equivalents (Tierney 2010, 81). The unique technological attributes of drones are exploited by the US military

during so-called 3D “dull, dirty, and dangerous” missions (Tice 1991, 317), including long-distance flights and reconnaissance operations that require many hours of circling one area, or combat situations that present a high risk to the pilot. The greatest appeal of drones, however, is not that they avoid pilot boredom or that they make operations safer for pilots but, perhaps, that they afford a level of soldier augmentation far beyond what has been previously possible (ibid): a remotely secured soldier, visually augmented, smartly weaponised, and always networked. The collective position of the relevant US congressional committees and contributing think tanks seems to be – albeit with occasional caveats – generally at ease with the proliferation of drones in combat scenarios, an ease problematised by what Lucy Suchman has labelled “the problematics of separation”:

So how might we theorize the entangled relations of this ever expanding apparatus of networked warfare, and the intensified commitment to greater detachment of “our” bodies from its effects? The inter-relation of body machine intimacies and the problematics of separation are at the core of war fought by remote control. (Suchman 2015: 8).

One clear aspect of the pilot-drone relationship requiring analysis is, as Suchman puts it, “separation”: the physical distance between the pilots and their drones. A second and more complex layer that compounds the objectiveness of physical distance is the subjective reconfiguration of human-technology-space relations. To better understand this separation and reconfiguration, I will now turn to two of Don Ihde’s key post-phenomenological theories: those of embodied and disembodied modes of experience, and human-technology-world relations. Ihde writes extensively about the dialectic of technologically mediated, spatio-corporeal experiences and articulates several senses of body in relation to our experiences of being embodied. Our motile, perceptual, and emotive being-in-the-world is what Ihde defines as “body one”, or our “*here-body*”. Our *here-body* understands sense data from our organs, and imagines in the first-person, while body two, our *there-body*, imagines in the second person and observes from a

distance the phenomena of the world. Traversing these zones of bodily significance is a third dimension, the dimension of the technological. It is within this realm that Ihde's schema of the human-technology relationship is situated, and it is perhaps the most familiar state in which we experience and re-experience being a body, as we extend our senses across space via technological instrumentation, computer networks, simulations and VR.

3.2 Embodiment Relations: [operator-drone]→world

Embodiment relations can be characterised as a relationship through a technology that affords a symbiosis of artefact and human within action and is the point at which we can begin to reveal the essential relations that define how technology can mediate the human experience of the world. For a human-technology relation to become embodied, it must have a significant degree of perceptual transparency. Driving a car is an excellent example of embodiment relations, containing many overlapping examples of all four human-technology relations. The car can become an extension of oneself: the contours of the road are fed back to the driver's body through the suspension system and resistance of the wheel. As the driver looks through and beyond the windscreen, willing the car to navigate the road, the physical sequences demanded of the driver fade to a focal periphery much like walking, as the driving action is naturalised and becomes transparent. O'Regan and Noë's 2001 article, "A Sensorimotor Account of Vision and Visual Consciousness" explores the "feel" of driving a Porsche:

There are characteristic ways in which the vehicle accelerates in response to pressure on the gas pedal. There are definite features of the way the car handles in turns, how smoothly one can change gears, and so on. What it is like to drive a Porsche is constituted by all these sensorimotor contingencies and by one's skilful mastery of them, one's confident knowledge of how the car will respond to manipulations of its instruments. (O'Regan & Noë 2001: 48).

I employ much the same phenomenological methodology in my work here as O'Regan and Noë, to understand the “feel” of operating Predator and Reaper drones. As with driving, this exploration raises several issues centred around embodiment and hermeneutics. However, the difference between the immediate control of a conventional car and the remote control of a drone is obvious and significant, as the remote-control element is clearly a major component of the overall operator-drone relation. From an operational perspective, a drone's crew consists of a pilot and a sensor operator, whose combined function is that of a coordinating centre where downloaded sensory information is aggregated, interpreted, and decided upon, after which action commands are relayed to the drone for execution. A major subset of the communication between the crew and the drone is navigational in nature, intended to render the pilot-plane relationship as seamless as possible (Qaurooni & Ekbia 2016: 55). From a phenomenological perspective, the pilot-drone relationship leads to a reorganising of bodily boundaries via technology.

This reorganisation is at the heart of what Ihde calls an “embodiment relation”. The operator-drone-world relationship is here reconfigured as [operator-drone]→world. “Operator-drone” appears in brackets to denote the fusion of the drone apparatus into the very way in which the operator embodies the spaces over which they are flying. First-hand and detailed subjective accounts of what it is like to operate a military drone are rare, but they do exist. Perhaps the most comprehensive explanation available comes from Lt Col Matt J Martin's first-person narrative *Predator: The Remote Control Air War over Iraq and Afghanistan: A Pilot's Story* (Martin and Sasser 2010). The embodiment relationship between pilot and drone is evidenced here through Martin's account of his experience of operating drones over Iraq and Afghanistan. For example, Martin describes how he crouches forward across his monitor screen to look over the nose of the drone that is, in fact, thousands of miles away from him (p22); he refers to the drone and himself as one entity (p34), and he describes the drone as at times feeling “sluggish” to him (p63).

3.3 Hermeneutic Relations: operator→[drone-world]

Traditionally, hermeneutics is the theory and practice of interpreting religious texts. Ihde has adopted this notion of interpretation and applied it to human-technology relations as a reading of the world through technology. This relation may therefore be described as something a human has with or towards a technology and through which something else is gleaned. Although the focus may be on the technology, what we make sense of is not the technology itself but, rather, the world to which it refers. The technology is therefore semi-opaque and requires a certain degree of prior knowledge if it is to be read correctly and according to its intended function. To return to our example of a car, the temperature gauge on the dashboard illustrates a hermeneutic relation: the position of the temperature dial as the car begins to overheat must be interpreted before the driver understands that the radiator is leaking. This knowledge is obtained without any direct bodily contact with the hot engine but relies on the driver's understanding of the symbols on the instrument panel of the dashboard. This relational shift from embodied to interpretative is experienced by the drone operators as a shift from the drone fusing with the body to the drone fusing with the world. In the latter relation, the drone becomes a reference to something in the world beyond itself. For the drone operators, the instrument panel and monitor screens of the control centre afford a relation to the landscape that its symbols represent. Following Ihde's human-technology relation schema, the operator-drone-world relation can be described as operator→[drone-world].

For drone operators, it is technological transparency that makes present the battlefield or surveillance target. When the drone operators read and interpret human and animal heat signatures, altitude readouts and numbers representing GPS coordinates, the enemy and the space they inhabit is made present. However, this hermeneutic presence does not occur only through the reading of instruments, but also in the interpretive context of the operator's technical abilities. The operator's experience of the targeted space is technologically mediated, and it is through their technical know-how that their experiential phenomena occur. Through hermeneutic relations, the drone operator can interpret themselves into a space thousands of miles away without physically being

there. It is from this interpretation – by the drone operator of the space in which they are intervening – that a multistable, dis/embodied spatial experience is produced. Thousands of miles away from their targets, they observe with a disembodied eye and can reach out and fatally touch with a disembodied arm. Although the operator’s primary – or flesh – body is not present, a mechanical version of their body is as they are projected into the same space as their targets. The violence of airstrikes and the intimacy of surveillance is experienced or reembodied through the very same technology that physically disembodies the operators from the spaces that their targets occupy.

For the operators to interpret the world through their drones rather than to perceive it through their primary flesh bodies, an additional hermeneutic transparency is necessary. In conducting a surveillance or combat mission, the drone operators are required to monitor a wide range of instruments. To break the experience down further would be to consider the instruments as comprising shapes and colours that themselves require interpretation. While such chains of interpretation are apparent, it is their degree of transparency that allows the drone operator to interpret the spaces and people they are targeting beyond their screens. The drone operators cannot simultaneously see the shapes and colours of their instruments and the landscapes, people, infrastructure and vehicles they are targeting – to do one is always to lose sight of the other (Gertz 2014, 106). This transparency of technological instrumentation in the operator-drone-world relation is an essential feature of how the operators can come to use the drone as if it were an extension of themselves. Airman First Class Brandon Bryant, one of the few drone operators to have spoken publicly, provides testament to this sense of bodily extension:

He says that when flying missions, he sometimes felt himself merging with the technology, imagining himself as a robot, a zombie, a drone itself. (Powers 2013: 8).

Returning to Lucy Suchman’s “problematics of separation”, we can now see how the operator-drone-world relation can serve as a microcosm for an ontological discourse

that frames the ethics of remotely controlled machinery, telepresence, technologically mediated space perception, multistability and my concept of dis/embodied space.

3.4 Alterity Relations: operator/observer→drone-[world]

Ihde's explanation of embodied and hermeneutic relations helps us to understand a drone being experienced by its operators as "quasi-me or as quasi-world" (Gertz 2014, 109) respectively, while a third layer of human-technology relations can be described as "quasi-other" (ibid.). This sense of technological otherness occurs when machines appear to take on a life of their own as they no longer serve to mediate the human experience of the world, but instead become the object of experience. The materiality or objectness that emerges as another facet of human-technology relations is what Ihde terms an alterity relation. This type of relation is one where technology is imbued with a degree of otherness which, while weaker than the otherness attributed to animals or humans, is stronger than the materiality of a mundane object such as a chair or a sink. An alterity relation is therefore described as a relation to a technology in which the technology is a *quasi*-other. An example of an alterity relationship can be seen in the anthropomorphism and zoomorphism of cars by their drivers: genders, names and moods are often attributed to vehicles – "she's playing up today" or "she's purring like a kitten". It is easy to see how a drone could be an example of this otherness, as it appears to move on its own, respond to its environment and act in a way that humans do not expect. This unexpectedness comes primarily not from the perspective of the operator but from an observer of the drone; the alterity relation is therefore more strongly formed by the latter in relation to the former. The addition of an observer variation into the phenomenological analysis of human-drone-world interaction constitutes the third relational configuration: operator/observer→drone-[world].

In 2012, the International Human Rights and Conflict Resolution Clinic of Stanford Law School (Stanford Clinic) and the Global Justice Clinic at New York University School of Law (NYU Clinic) produced a report called *Living Under Drones*. This was an investigation into drone strikes and the extent to which they conform with international law in the context of harm and injury to civilians. The report contains first-hand accounts from more than 130 interviews with victims and witnesses of drone strikes,

medical experts and civilians who live in the now constantly surveilled Pakistani region of Waziristan.

Civilians are becoming increasingly familiar with the visual imagery of Reaper and Predator drones. The silhouettes have entered contemporary culture with their distinctive, dome-shaped noses and inverted-V tailfins. The lack of windows at the front end of a flying machine large enough to carry humans gives the impression of cold and detached blindness: they do not see but sense their surroundings. As Steven Coll describes in his *New York Times* article “The Unblinking Stare: The drone war in Pakistan”, they “look like giant flying robotic bugs” and can “provide an unblinking stare at a target” (Coll 2014: 4). Drones have sensors not only for eyes but also ears and other organs. For example, “Predator and Reaper drones also can interpret communications from radio, cell phones or other communication devices” (Barnes 2009: 2). The alterity of this observer-drone relation is evidenced by the accounts of Iraqi soldiers who surrendered to unmanned flying drones during operation Desert Storm (Stirling 1997, 3) and those from civilians who live under drones or are strike victims or witnesses. These people describe the drones as having semi-autonomous and animal-like qualities:

Drones are always on my mind. It makes it difficult to sleep. They are like a mosquito. Even when you don't see them, you can hear them, you know they are there. (Nasim Rahman (anonymised name), in Stanford Clinic: 2012, 12).

The quasi-otherness of the human-drone-world relation shows us that humans may relate to technologies as focal entities that receive the range of attentions that they give to animals, humans, gods and mythical beasts. Philosophically, the term “alterity” is borrowed from Emmanuel Levinas’ *Totality and Infinity* (1969: 36). In that work, the term is explained as “the radical difference posed to any human by another human, ‘an other’ (and by the ultimate other, God)” (Ihde 1990: 98). Ihde modifies Levinas’ sense of human otherness by returning to an analysis of human-technology relations and asking; “how and to what extent do technologies become other, or at least quasi-other?” (ibid.).

In 2009, US drones produced the equivalent of 24 years' of video recordings (Chamayou 2015: 40). DARPA's Autonomous Real-Time Ground Ubiquitous Surveillance Imaging System (ARGUS-IS) can produce several terabytes of data per minute. DARPA continues to fund the Gorgon Stare research programme conducted by cognitive scientists to construct "integrated cognitive systems for automatised video-surveillance" (BAE Systems plc. 2019).



Figure 12 Mythical Gorgon monster - Medusa forms part of the logo for Sierra Nevada Corporation's Gorgon Stare, Persistent Wide-Area Airborne surveillance (WAAs).

Through the Gorgon Stare and ARGUS-IS systems, drone sensor operators are able to observe entire cities in detail:

A whole city, so there will be no way for the adversary to know what we're looking at and we can see everything. (Nakashimi & Whitlock 2011: 2)

Gorgon and ARGUS-IS were designed as "persistent surveillance systems" (ibid.) for Reaper drones and have been in operation since 2011. The names given to these drones and the surveillance systems they carry reveals an alterity relation between the systems and their makers. In Greek mythology, Argus – the figure with 100 eyes – was also known as Panoptes, "the one who sees all", while the Gorgons are three immortal sisters, the most famous being Medusa. This alterity relation is experienced from two perspectives: the first is from the exponents of this technology - the military technocrats who conceive of and give names to these seeing machines. By giving these drones and the surveillance technologies they carry names such as Reaper, Argus and Gorgon, their creators go

beyond the earlier zoomorphic and anthropomorphic examples of a car with animal-like qualities and enter a kind of theomorphic realm, in which. That is, they have ascribed the characteristics of a God-like or mythical creature to a technological device. The second perspective of the alterity relation is that of the surveilled and attacked civilians and non-civilians, observers, or strike victims, who may not specifically link it to a Gorgon's stare or the Grim Reaper collecting souls, as these are particular to Western thought. However, the power of a far-reaching, and penetrating vision is profoundly experienced as the processes of being seen and being killed are fused.

3.5 Background Relations: operator/observer-world→[drone]

Perhaps the most changeable and multistable human-technology relation of all is the background relation. Background relations are largely felt as an absence in that they are not directly experienced yet give structure to direct experiences. Although background relations can be considered as existing on our perceptual horizon – by definition, they occur on the periphery of our perceptual focus – they quickly modulate to a central focal point. The climate control system that maintains the interior of our example car at a comfortable temperature goes mostly unnoticed. An initial temperature is set and little, or no, subsequent intervention is required. The system only comes into focus if it is set to a temperature that is uncomfortable and therefore needs resetting by human intervention. Ihde (1990: 201) describes our existence in the industrially developed West as “technologically textured” in the sense that the technologies with which we form background relations are mostly understood as feelings or fabrics that are interwoven into how we live. The technological milieu that remains largely unnoticed in the background of perception is considered by Merleau-Ponty to be a necessary ground for perceptual figures. For him, this “perceptual ground” forms the very conditions of possibility for the current focus of perception (Merleau-Ponty 2012: 281). Thus, all perception, according to Merleau-Ponty, has a fundamental figure-ground constitution (Ekbia & Qaurooni 2016: 64), and it is this constitution that I shall keep in mind as I now consider the technological texture of human-drone-world relations.

One of the fundamental conditions for drone warfare is met by a Beyond Line Of Sight (BLOS) satellite datalink, like those used by television news networks to beam their coverage around the globe (Poss 2017: 1). Just like the background nature of the climate control system in our example car, the daily workings of the BLOS datalink require no attention from the drone operators. The experience of the BLOS datalink infrastructure and the data itself form a background relation which is phenomenologically distinct as a kind of absence. This technology is transparent, in that it is given no attention by the operators, and yet it can be said to be perceived as a present absence, as it nevertheless forms part of the field experienced by the drone operator and a component of their immediate environment. The drone operators relate to their targets and their drones through their datalinks, not only seeing them but interpreting them, coming to know not only their targets' daily routines and those of their friends and family but also the difference between their targets' heat signatures. Drone operator Brandon Bryant describes the view on his control screen as it fuses heat-sensor information and camera feeds through the datalink into a coherent whole:

I switched from the visible spectrum—the muted grays and browns of day TV—to the sharp contrast of infrared, and the insurgents' heat signatures stood out ghostly white against the cool black earth. (Bryant cited in Powers 2013: 5).

Bryant goes on to describe his view after he fired a missile at the insurgent's position:

The smoke clears, and there's pieces of the two guys around the crater. And there's this guy over here, and he's missing his right leg above his knee. He's holding it, and he's rolling around, and the blood is squirting out of his leg, and it's hitting the ground, and it's hot. His blood is hot. But when it hits the ground, it starts to cool off; the pool cools fast. It took him a long time to die. I just watched him. I watched him become the same color as the ground he was lying on. (Ibid)

What appears to be happening, as Bryant embodies the audiovisual information fed to him in the drone control centre, is a kind of machine-automated hermeneutics experienced as a background relation. As Bryant “switches from the visible spectrum - the muted greys and browns of ‘day TV’ - to the sharp contrast of infrared” (Bryant cited in Powers 2013: 7), he is toggling between the seen and the interpreted images that are processed in the datalink before they reach his screen. Retired Air Force General James Poss was part of the team that oversaw the development of the Predator drone. Poss draws attention to the fabric of technologies that exist on the periphery of the operator’s focus, and how they fuse images and data across multiple screens into what is ultimately embodied and understood by the drone operators:

“It’s about the datalink stupid. The craft is essentially a conduit, an eye in the sky. Cut off for its back end, from its satellite’s links and its data processors, its intelligence analysis and its controller, the drone is as useless as an eyeball disconnected from the brain. What gives the drone its singular value is its ability to provide perpetual, relatively low cost surveillance, watching a target continuously for hours, days, weeks even months. With steady, real-time surveillance a controller can strike with the target in his sights. He can, for instance, choose a moment when his victim is isolated, or travelling in a car, reducing the chance of harming anyone else. (Poss 2017: 3).

It is this very datalink, funnelling information from the battle space to the control centre and back again, that lies at the centre of a collection of technological anxieties around distance killing, telepresence and disembodiment of military technologies (Virilio 1997: 89), virtual combat (Dunnigan 2017: 556), the gamification of killing (Andersen 2014: 363) and a new kind of “willingness to fire” that is specific to the operator-drone relation (Hussain 2013: 7). Since the experience that Bryant and other drone operators have of combat events has been through a datalink: there is a tendency to reductively treat them as non-experiences, non-events or “a virtual battle over an actual war” (Bryant cited in Powers 2013: 9). Despite the fundamental remoteness inherent in drone warfare, the drone operator’s body is not absolutely detached from the battlefield. There is an

interplay of physical objects (the theatre of war) to be embodied and to be read which relates to Ihde's post-phenomenological observations on the world of our multiple, compound, and fractured perspectives. These perspectives can again be explored through Ihde's concept of here-body, there-body. This post-phenomenological exercise reveals a variation between a full or multidimensional experience in the drone operator's here-body, which sits in the drone cockpit, and the visual objectification of a presumed out-there-in-the-battlefield body which is spectacle-like and experienced through the hermeneutic relation of the datalink. The multistability of Ihde's here-body, there-body provides an abstracted and useful lens through which to understand the drone operator's dis/embodied spatial experiences and lies at the heart of what I have tried to express through the three artworks.

During the years after 9/11, the US military under George W Bush adopted a strategy of war as revenge, as it focused on dismantling Al-Qaeda networks by hunting and killing specific personnel. Under Barack Obama, the strategy changed to one of risk aversion, focused on troupe reduction and a significant increase in the use of drones, particularly for surveillance (Gertz 2014: 119). This focus led to what could arguably be seen as the dawn of the age of "unmanned warfare", a war capable of being fought from ever-increasing distances and with an ever-decreasing need for the traditional soldier-on-the-ground. Ethical concerns over drone proliferation have often included comparisons between drones and video games. Several critics (Hussain 2013; Andersen 2014; Dorrian 2014; Hessen Schei 2014; Whitson & Simon 2014; Chamayou 2015, Qaurooni & Ekbia 2016 among others) have suggested that the latest cohort of drone operator recruits is from the "video game generation" (Chamayou 2015: 169), and that the interface design of drone control cockpits follows that of games console controllers, affording a "common virtuality of gaming and drone operating" (Hessen Schei 2014). Further, the culminated opinion of the critics is that drone warfare is essentially a disembodied form of warfare.

This video game analogy is vehemently rejected by exponents of drone warfare; drone operators, military analysts, and senior officers (Strawser 2010; Bryant 2013; Poss 2017) rebuff comparisons between drones and video games as over-simplistic. While this is arguably true, the video game/drone analogy does, however, provide us with a method

of parallel analysis that I will demonstrate to reveal a set of invariant ontological components deeply rooted in our understandings of technologically mediated spatial embodiment and disembodiment. On both sides of the drone warfare debate, an assumption of a certain virtuality is applied to both drone warfare and video game play.

3.6 Virtuality and the military-industrial complex

Notions of human activity as virtualised by the affordance of a technological infrastructure are not exclusive to the utopian VR pioneers of Cyberconf 1. Technological developments in computer networking date back to the early 1980s, funded by US taxpayers and incentivised by the desire of the US Congress for global advantages in military technologies. Journalist Howard Rheingold has written extensively about the history of what he calls “Virtual Communities” and recounts the first “closed” networking systems that were developed by US national defence initiatives and operated under the strict implementation of an “acceptable use” policy that ruled out any commercial activity. The use and development of this new networking technology were limited to DARPA researchers and later expanded to include other military and government-funded scientific researchers. The key factor in the funding and development of networked, multi-terminal, accessible supercomputing was DARPA’s recognition of the many-to-many characteristics of virtual communities and how these could accelerate the generation of and access to cutting-edge knowledge. The definition of “acceptable use” would later be expanded to scientific and academic communities and relaxed further by US Congress in 1993 when regulations were widened to include commercial initiatives, and the Internet began to privatise (Rheingold 2000: 199).

The reason the US Congress continues to allocate funds to develop increasingly powerful networks is that it has been told that America is in danger of falling behind, either in supercomputer research or in military and competitive economic advantage. Educational and citizen uses, and rights of access are a relatively recent issue. Supercomputer and military development competition, not a recognition of the

intrinsic intellectual value of computer networking, was the key factor.

(Rheingold 2000: 212)

Rheingold traces the beginnings of modern virtuality back to the types of human-technology relations first afforded by the DARPA researchers. The “Virtual Communities” that formed during those early years of the military, and other government-sanctioned research working groups, would soon spread into the domain of everyday usage as word processing became a common and permanent feature of personal computing. Until the mid-1990s “Virtual Communities” were text-based environments composed of chat rooms, forums, multi-terminal access servers and games experienced through text-interactive decision trees. These environments evolved into animated graphics on platforms such as Active Worlds (1995), and OLIVE (1998). In 2003, the VE Second Life would make possible interactive social learning experiences which would, in turn, engender a simulator industry whose central concern was to develop and sell training products that would allow operators of complex machinery to learn and practise within a simulated environment tasks which would be difficult, dangerous, and expensive to perform in unsimulated situations.

Since 2005, the US military has directed significant resources toward activities within virtual world hosting and the development of the platforms Second Life and OpenSimulator. This has led to major initiatives, such as Coalition Island (Military Lands website 2009: 1), now superseded by the US Army Advanced Training Systems Division’s (ATSD) development programme Military Open Simulator Enterprise Strategy (MOSES). The main function of MOSES is “to provide independent and secured access to a virtual world” (Military Lands, n.d.). In 2007, the Federal Consortium for Virtual Worlds (FCVW) was formed and has since become a significant actor within the US military-industrial complex. Composed of over one hundred US federal government agencies and private contractors, including the Department of Defense and the CIA, the FCVW is concerned with “Exploring the use of virtual worlds in government, sharing best practices and policies, creating shared repositories and networking” (Harris 2008: 1). This rather vague statement is inevitably open to interpretation but certainly includes

combat training and battle-strategy simulation, alongside supercomputing and AI initiatives that aim to identify the behavioural indicators of enemy combatants and other “persons of interest” in both online and offline spaces (Ciamramitaro & Jones 2011: 128).

In 2011, US military spending on virtual, augmented and MR training systems was approximately eight billion dollars (ibid.); it is predicted to reach around eleven billion dollars by 2022 (Radu 2018: 1). In addition to the geopolitical significance of this strong US military presence on our world, the trajectory of federal spending – combined with consortia of government agencies and private technology companies – could be interpreted as the expression of a deep desire to expand US global military supremacy across the spatial frontiers of virtuality, creating virtual communities for the purpose of accelerating the research and development of defence technologies, and simulated virtual worlds for testing and training. These two spheres – simulation and accelerated communication – were recognised by Michael Heim as two discrete components of virtuality in his description of the conceptual polarity that emerged in the early narrative of cyberology:

The First Conference on Cyberspace exhibited a certain polarity:

1. VR as a portal to a world of simulation where physical senses are immersed by prosthetics, where users temporarily “forget” the primary sensory world.
2. VR as a communication tool where human contact transcends the constructions imposed by limited sensory data passing through the electronic network.

(Heim 2014: 116).

The first pole represents the aspiration of precise mimesis and the creation, not of an illusory reality but, rather, a replacement of reality. This involves cybernetic systems of prosthetics that fabricate a first-person experience of “being there”. Like lucid dreams,

this strand of virtuality can provoke a sense of presence in users that is sufficiently profound to elicit automatic, involuntary physical responses to digital audiovisual stimuli like those experienced in the non-digital world (Bracken & Skalsi 2010: 188; Slater 2012: 64). This type of high-resolution mimesis is perfect for military (and other) training scenarios and was therefore deployed via Second Life and OpenSimulator to replace Live Fire Exercises, as high levels of immersion can offer combat experiences very similar in many ways to live training, but without the risk. There is indeed a long history of military-training simulators that dates to 1929 and the first Link Trainers built by Link Aviation Devices, Inc.

The second pole is driven by the human desire to maintain a shared connectivity that goes beyond the boundaries of our corporeal limitations. In the case of the early DARPA research groups, the value of the virtual communities afforded by networked multi-access supercomputers lay in the removal of bottlenecks created by the inefficient dissemination of important research to the right people. These early closed networks enabled scientists in quickly moving fields to create their own project-specific databases, based on the understanding that the process of science is embedded in group communication. The first virtual communities at DARPA saw an unprecedented acceleration in both the number of scientists who could contribute to a research project and the speed at which they could compute and communicate. Both Heim's poles are forms of telepresence; both represent ways to overcome our corporeal and cerebral limitations by redefining the physics of our environments. Through networks, we can see and hear further than ever before and even extend our physical reach into areas of the world previously untouchable. This transcendence of the physical by extended reach has long been the holy grail of military technological research and development.

Heim's observation of mimesis and accelerated interconnectedness as polemic components of virtuality may have been accurate during the early stages of semantic development and discussion at Cyberconf 1. Today, however, the situation is different: cyberspace is composed of a growing array of AR and VR simulation technologies deployed in conjunction with network distributed environments. Driving research and development into this synergy of virtual technologies are the US military group MOSES

and others in the OpenSimulator environment. DARPA, MOSES and the US military's use of the OpenSimulator platform are amongst many examples of how virtual spaces created by the US military can function as development and testing ecosystems that afford a highly advanced state of readiness for global conflict. In addition to the virtual training grounds and networked research groups which develop and prepare technology and human operators for conflict, a more immediate command and control space has emerged from which actual war is waged. Modern combat theatre is increasingly composed of information either rendered as a figurative representation of the world or containing modifications that make the real information still more valuable. This value is measured simply in terms of degrees of asymmetrical military capability: the larger the deficit between the military technological capability of one power compared to its enemy, the more valuable that technology becomes.

One enduring question asked by military technological strategists is how to intervene without danger in hostile places. In 1964, the engineer John W Clark produced a study of "remote control in hostile environments". Clark discussed the range of possible scenarios arising from planning operations in hostile environments such as irradiated zones or the depths of the sea and identified three workable solutions: to place a machine in the hostile environment, to place a protected human, or – the most preferable option – to employ a vehicle in the hostile environment operated under remote control by a human in a safe environment. Clark coined the term "telechiric machines", derived from ancient Greek and literally meaning "technology of manipulation at a distance". In a 1964 article for the *New Scientist*, Clark writes:

In the telechiric system, the machine may be thought of as an alter ego for the man who operates it. In effect, his consciousness is transferred to an invulnerable mechanical body with which he is able to manipulate tools or equipment almost as though he were holding them in his hands. (Clark 1964: 300).

Without the living flesh of the human body, this mechanical body is invulnerable to the hostilities of the environment in which it operates. The use of machines in this way implies a particular mode of conceptualising and organising space, a specific topography for which Clark devised a basic schema. For Clark, space is divided into two zones: hostile and safe, with the latter sheltering a power in a physically safe space, which can be considered as telearchic or pertaining to a frontier. To be useful, the border to this frontier must be asymmetrical: it must protect the power from external intrusions while allowing the power to project itself into the hostile environment. As a potentially threatening area, the hostile zone mostly remains derelict but kept under surveillance; it may be exploited for its resources but not necessarily occupied. The power intervenes in the hostile zone and patrols it with a view to securing new territory, bases, or platforms for reasons of future security (Chamayou 2015, 23). During this early period of technological development, Clark viewed the new possibilities afforded by remotely controlled machines through a philanthropic lens. Tasks in environments hostile to human operators such as firefighters, miners, astronauts and submariners could all be safely undertaken by robots:

With technology being as advanced as it is today, it is unnecessary to require a man to expose himself to physical danger in order to earn a living. There is no hazardous task performed by men today that cannot, in principle, be performed by remotely controlled machines. (Clark 1964: 300).

However, Clark's explanations of the potential benefit to humankind brought by telecheric machines were, in the mind of one articulate and anonymous reader, incomplete. The response was published in the same *New Scientist* volume as Clark's original article:

The minds of the telearchics are grappling with the problems of employing remotely controlled machines to do the peaceful work of man amid the hazards of heat, radiation, space and the ocean floor.

Have they got their priorities right? Should not their first efforts towards human safety be aimed at mankind's most hazardous employment - the industry of war? Why should twentieth-century men continue to be stormed by shot and shell when a telechiric Tommy Atkins could take his case? (Anonymous 1964: 405).

Indeed, remotely controlled machines had already been in military use for several decades before Clark's 1964 article, but not precisely in the way he advocated. The Curtis-Sperry Ariel Torpedo and the Kettering Bug were deployed towards the end of the First World War, and the Nazis used V1 and V2 rockets to bombard London from 1944. In the same year, the Radio Plane Company began to supply the US Navy with radio-controlled "target drones", designed for ships' gunners to practise their shooting. Although these machines successfully fulfilled the universal military desire to be able to conduct operations and attacks without risk to the operator's life, they offered no kind of useful control. Once launched, they provided no feedback to the operator, who was therefore unable to control the machine beyond any significant distance. After many more iterations of unmanned surveillance aircraft, the US military finally weaponised the first generation of armed UAVs in 2001. The successful testing of a Hellfire missile strike – launched from a Predator drone – marked the birth of the first comprehensively remotely controlled weapon, swiftly deployed in both surveillance and combat operations in Afghanistan by the end of that year. Through the eyes of the operators of these weaponised unmanned surveillance aircraft, the enemy had become the hostile terrain or the dangerous material to which Clark imagined humans would no longer have to subject themselves. Moreover, through the networked optical feedback and precise control over the UAV's movements and weapons, the drone operators began to fulfil Clark's prediction of the transferral of consciousness to "an invulnerable mechanical body" as they intervened in hostile zones via a screen and from within an enclosed safe zone.

The US military has ushered in an era of radically unilateral and asymmetric warfare in which modern military drones operate within a configuration of networked, audiovisual

technologies that organise spatial data into an AR. If VR represents the real world via simulation, the AR created through the interaction between drone and drone pilot intervenes in real-time and in a semantic context with the immediate physical environment. The result is an oscillating and, therefore, multistable tension between absence and presence, the embodied and disembodied, distance and intimacy, and striking and surveillance that is specific to drone technologies. Drones are celebrated for improving operational capacity and precision whilst keeping the drone crew safe from harm. Entangled in this military logic of maximum operational asymmetry with the enemy is a human-technology-space relationship that is being radically reconfigured.

The next section of this thesis will analyse the manifestations of this reconfiguration and situate the human-drone relationship within the context of the operator-drone, their operational spaces and the technological ecosystem through which this relationship is mediated. Subsequently, parallel and connecting themes emerge from a broader set of civilian sociotechnical practices; the digital cultural phenomena of video games, virtual communities and contemporary art practices are explored through the same analytical lens as the aforementioned pilot-drone relationship and give a further account of *Hybrid Spaces*, *Compound Terrains* and *Conjured Spaces* and the role they play in articulating and understanding my concept of dis/embodied space.

3.7 War Games

As humans in contemporary Western society, we are constantly surrounded by and connected through digital technologies that mediate our perception of space. I refer to these technologies as audiovisual spatialisation technologies because they predominantly affect the aural and visual senses which capture most of the information, we use to understand ourselves in the spaces we inhabit. The Dutch/American school of pragmatism and post-phenomenology has taught us that technology exists within social, political, and constructive dimensions (Ihde 2009: 7) and that any analysis of a technology is more precise and balanced when the investigator proceeds from the continental philosophical approach of the Heideggerian *Gestell*. Heidegger's phenomenological examinations of modern technology are mostly singular and

classified – a hydroelectric power plant, an aeroplane, a highway intersection (Heidegger 1977: 17), whereas the post-phenomenologists of the Dutch/American school reveal technological systems comprised of interconnected technologies with complex rules and interactivity concealed within the structure. While single or small clusters of technologies are designed, constructed, run and adopted willingly by individuals or societies, technology as a whole is a complex assembly that develops in a manner that cannot be manoeuvred fully by human intervention.

To conduct phenomenology on a set of specific human-technology relations is to uncover the various invariant structural features of those relations. In attempting this phenomenology, I will initially focus upon features that are made recognisable through experience, centred on the ways in which we physically engage with technologies or, as Don Ihde puts it, “the various ways in which I-as-body interact with my environment by means of technologies” (Ihde 1990: 72). By focusing on the specifics of corporeal-techno-spatial relations that are framed by interactions between pilots and their drones – and gamers and their game worlds – we can evaluate the ways in which spatio-ontological understandings are influenced by the range of technofantasies and technoworries that arise in relation to the telearchic systems inherent in military drone technologies and the bodilessness of screen-based game worlds.

Since 2012, debates surrounding the use of military drone technologies have been focused on how the operator-drone relation impacts the ethics of armed conflict. Frequently raised concerns include the “gamification of killing”: state-sanctioned drone surveillance and killing via display screens offering drone operators a first-person perspective of the battlefield has been problematised as being resembling too closely the experience of first-person shooter video games (Brooks 2012; Brown 2013; Chamayou 2015; González 2015). Concerns over a sense of unreality or detachment afforded by the pilot-drone relation are often likened to the disembodied experiences of video game worlds. Paolo Pedercini and Jim Munroe, creators of the video game *Unmanned* have inverted the narrative of drone warfare as reducing the experience of war to a video game. Pedercini and Munroe attempt to paint a mundane picture of the everyday life of a drone operator by letting us play the role of one: to play *Unmanned* is to adopt the

first-person perspective of drone operator and act out a series of typical everyday scenarios, such as shaving, eating breakfast and surveilling a suspected terrorist for hours on end. *Unmanned* contains a rhetorical narrative that advances the notion that a drone pilot's life is split between war whilst at work, and peace in his home life. The split, however, is not clear as the day-to-day routines of both worlds are intertwined in such a way as to make them impossible to disentangle. As Pedercini explains:

Disconnection is a theme that runs all the way through *Unmanned*. It is embedded in the split screen and dual gameplay that reflects the schizophrenic life of the protagonist, and in the characters' lives as well: in the father and son's difficult bonding, in the protagonist's potentially challenging relationship with his wife. It's even hinted in some conversations about the transformation of the battlefield and the changing relationship with the enemy. (Cited in Orland 2012)

The media focus on drone activity is predominantly centred around Hellfire missile strikes on "high value" targets; however, the vast majority of a drone pilot's time is spent conducting intelligence-gathering surveillance using the Gorgon Stare system. Named after the mythical Greek monsters whose gaze turned people to stone, the Sierra Nevada Corporation's Gorgon Stare surveillance system was first carried by drones in Afghanistan in 2011. Developed to surveil urban areas, it can capture motion imagery over a four-kilometre radius and simultaneously streaming the images back to the drone operator, the Pentagon and a tablet-sized device in the hands of a soldier on the ground. The manufacturer's literature – complete with snake-haired Medusa emblem and the words *oculus semper vigilans* ("the always watchful eye") – states the mission of the Gorgon Stare to be "city-sized, 24/7 persistent surveillance" (Sierra Nevada Corporation 2014). Pilots who have described their experiences of operating these surveillance drones provide strikingly similar accounts. In a 2013 article for *Elijah*, Solomon Hurwitz interviews several drone pilots (who asked not to be named) based at the Holloman Air Force Base in New Mexico, and they describe what they typically surveilled:

It's mostly people in Middle Eastern towns and cities going about their daily lives - it might be little things like a group of kids throwing rocks at goats, or at each other, or an old man startled by a barking dog ... You get a sense of daily life. I've been on the same shift for a month and you learn the patterns. Like, I'll know at 5 a.m. this guy is gonna go outside and take a shit. I've seen a lot of dudes take shits. (Anonymous pilot 1, cited in Jones 2016)

Another time we followed this guy outside his house for hours, and all he did was go scoop water from a stream. (Anonymous pilot 2, cited in Jones 2016)

I'm overpaid, underworked, and bored. (Anonymous pilot 3, cited in Jones 2016)

The role of surveillance in everyday life and our anxieties about it are a common narrative in video games (Chandler 2014: 103). Games such as *Watch Dogs* (released in 2014 by Ubisoft) incorporate the experiences of watching and being watched into gameplay and, thus, offer something different from representations of surveillance more commonly found in other media such as film and television. In Carrie Andersen's 2014 article "Game of Drones" (Andersen 2014: 8), she compares the representation of drones in video games to representations in other media to highlight how closely military surveillant technologies are tied to games and how this, in turn, shifts the discourse of the soldier-hero closer and closer to the soldier-gamer (Whitman & Simon 2014). Anderson argues that the first-person shooter video game *Call of Duty: Black Ops II* (released by Activision in 2012) reflects the US military's trajectory in the reimagining of a soldier's role in war. The proliferation of drone technologies is causing this role to shift from a position of perceived heroic and physical strength to one that is relatively disembodied and weak. Although video games that feature military science fiction often

“function as virtual enactments and endorsements for developing military technologies”, (Smicker 2009) *Black Ops II* offers an unusually complex vision of the future relationship between pilots and their drones. The experience of heroic diegetic violence in *Call of Duty: Black Ops II* is superseded by a gaming experience designed to reproduce the banality and boredom that has become associated with drone operation. This shift of the soldier image from heroic to banal is also present in *Unmanned*, which foregrounds the mundane, nonviolent aspect of drone piloting. Instead of depicting the physical and emotional stress of on-the-ground-combat, games like *Black Ops II* and *Unmanned* depict the act of drone operation as monotonous, distant, and disembodied (Anderson 2014: 12).

The notion that video games can be seen as a reflection of the contemporary vision of the US military is nothing new. *America's Army*, the first-person shooter platform developed by the US military has been available free of charge since 2002. Its primary use as a recruiting tool is at the forefront of a strategy to use virtual environments to prime young people for enlistment. It is marketed as way for youngsters to explore the possibility of a military career, to test their resolve in a “have you got what it takes?” style challenge. More than that, however, it was also one of the first experiments in exploring the correlation between the techniques and skills developed by gamers and those needed on the battlefield (Pearson 2015). Since the release of *America's Army*, the US military has spent \$13 million on a recruitment facility that functions as a video games arcade, providing local young people from the age of 13 free access to military-themed video games. The US Army Experience Centre at the Franklin Mills shopping mall in northeast Philadelphia has 60 personal computers, 19 Xbox 360 games consoles and a series of interactive screens describing military bases and career options. The US military is not alone in integrating video games into recruitment and development strategies: Tonje Hessen Schei, director of the 2014 documentary *Drone* describes how she witnessed military recruiters in Sweden and Norway attending large Local Area

Network events, or LAN Parties,¹ speaking to gamers as young as 13 about the potential of a career as a drone pilot. She also reports that the military regularly consults with the gaming industry on user-interface design for drones, asking for specific guidance about the most familiar and comfortable methods of interaction and information presentation for a high frequency gamer. PlayStation and Xbox controllers have also been adapted for the development and prototyping of drone instrument panels and control mechanisms. Speaking to various ex-pilots, Schei found that many have strong gaming links, and that games were certainly part of the recruitment process (Schie 2014: cited in Brekwell 2016).

To pilot a drone or to play a first-person shooter video game is to be part of an ecosystem of human-technology relations that share many overlapping characteristics. We turn again to the multistability of Ihde's *here-body, there-body* concept to understand how a video game world might be felt through the virtual on-screen body, and how players connect to that virtual body through their actual engagement with a physical controller and animated images. Media narratives have been present for well over a decade that express these overlapping characteristics through a dystopian lens. Commentators in the US press began to talk of a "Play Station mentality", according to which depicting murder on the screen involves a virtualisation of the consciousness of homicide. Articles in US newspapers reported flippant responses from drone pilots when asked, "How do you feel about killing through the intermediary of a screen?" The responses, such as "Oh, it's a gamer's delight" (The Tucson Citizen 2007) and "It's like a video game. It can get a little blood thirsty but it's fucking cool" (The Minneapolis Zenith 2010) fed into a public relations disaster which must have lead military press officers to debrief their pilots. Since 2012, there has been a drastic reduction in statements of this kind (Chamayou 2015: 107). When *New York Times* reporter Mark Mazzetti visited a drone base in 2012, he noted, "As more than one pilot told me, a bit defensively, 'We are not just playing video games here'" (Mazzetti 2012, cited in Chamayou 2015).

¹ LAN Parties are events in which multiplayer games are played over a series of networked computers and/or games consoles, together forming a Local Area Network. Gatherings often exceed several thousand gamers and can host as many as 17,000 gamers and game terminals.

In contrast, some military drone operators, who have also flown combat missions in 'manned aircraft' such as F-16 fighter jets, say that the technological mediation of UAV systems is more visceral and phenomenologically complex than a video game experience, largely due to the advanced camera systems of the drones. With UAVs, one particular pilot claimed to feel:

more connected with the ground fight than I ever did when I was flying over the top at 20,000 feet, the reason being that I am much more involved in coordination and contact with those ground forces that are taking fire than I ever was in a F-16 ... it comes together to create a much more tangible, much more real event ... then [sic] I experienced when I was dropping bombs from F-16s. (Gough, cited in Rattansi, 2010)

In his article "Moral Predators: The Duty to Employ Uninhabited Aerial Vehicles" (2010), Bradley Strawser supports the use of drones on the grounds of their ability to "significantly reduce American casualties". He extends this support of drones to a recent development in Israeli missile technology. The Seeker system allows the drone pilot to see through the eyes of the missile itself by means of a high-definition camera mounted in the nose cone of the missile: "As the missile gets closer to the target, the picture gets clearer and the video image sent back from the Seeker via fibre-optic link appears larger in our gunner's display" (Strawser 2010: 19). He also asserts that this would have no impact other than providing the pilots with "greater technologic capabilities at making determinations of combatants' status" (ibid.). In a phenomenological study of pilot-drone relations, this connection between drone and pilot via optical technologies is, experientially, at least as important as the objective modes of perception afforded by the drone. This description shows the physical distance between operators and victims being transcended as the operator imaginatively projects himself into the lives of those being perceived and, likewise, projects those being perceived back into their own lives. As Major Dan puts it, "it is not the case that drone pilots are like video gamers, detached from the reality of their actions. They are far more

attached” (cited in Gertz 2015). The experience of such attachment calls into question the role of the various technologies in how and why such attachments occur and how and why it is taken for granted that such attachments do not take place. When considering the latter questions, both critics and supporters of drone warfare tend to see it as blurring, if not completely relocating, the boundary between war and peace. This loss of clarity is considered to require operators to similarly lose the distinction between warfare and gaming. In his 2013 article “The Sound of Terror: Phenomenology of a Drone Strike”, Nasser Hussain writes:

While many commentators worry about the video game style warfare of such footage, the comparison is both exaggerated and inapt. Contrary to drone footage, video games offer a deeply immersive environment in which at least the virtual player’s life is at stake. Perhaps what fuels the comparison of drone footage to video games is the aura of detachment they share. The worry is the detachment eases the ability to kill. (Hussain 2013: 103).

There is, on both sides of the drone war debate, the assumption of a certain sense of unreality emerging from the operator-drone relationship. For Hussain, the drone operator lacks a “deeply immersive environment”, one that Hussain believes is experienced more by gamers than drone pilots. Strawser, conversely, believes in a distance, a “disjunct of this level of remote weaponry”, a division that exists even when operators are privy to a missile’s eye view as they fire. While both Hussain and Strawser clearly understand the importance of the role those optical technologies play in the pilot’s operational judgements, neither appears to acknowledge the potential roles that drone technologies could play in our embodied identities and how they affect human-technology relations.

4 - SECTION FOUR: PRACTICE EXEGESIS

4.1 Theory-Practice Relations

Hybrid Spaces, *Compound Terrains* and *Conjured Spaces* are the three major audiovisual artworks that form the practical outcome of this thesis. *Illusory Contours* (see appendix) is included as a supporting work and a precursor to *Conjured Spaces* which is the final piece and the culmination of this practice research trajectory. The status of these works is that of cultural apparatus that afford new apprehensions of the multistable and dis/embodied spaces that emerge from the human-technology (operator-drone) relations inherent in drone warfare.

In order to explore how our relationships with networked audiovisual technologies and how they mediate our understanding of real and virtual space I could have focused on a number of techno-cultural phenomena. Much insight could have - and has been gained by researchers through studies into the proliferation of the Internet, social media and the ideas of the second self, digital dualism and digital/physical hybridity, (Turkle, Jurgenson et al; Section 2.5 of this thesis) and to the use of XR by artists and activists to challenge power structures and explore ideas of disembodiment (ManifestAR, Davies, UVA et al.; Section 2.7 of this thesis). It is, however, my belief that the beginnings of our contemporary understanding of the boundary between real and virtual space can be found in the HTR first afforded by the “Virtual Communities” that formed during those early years of DARPA military research into networked supercomputing (Section 3.6 of this thesis). It was from there that, driven by commercial potential, both the technology and the conceptual framework of virtuality would soon spread into the domain of everyday consumer usage.

Military research has a uniquely powerful influence on how society imagines and ultimately has meaningful relationships with certain technologies. If the roots of our virtual lives can be traced back to military initiatives, then so too can our current experiences and understandings of disembodied space and telepresence. Although the profoundness and intensity of HTR as experienced by a military drone pilot can never

be fully known by the vast majority of wider society, we can and do gain a secondary understanding through military drone camera footage that is widely available on the Internet. Furthermore, drone footage is now commonplace in feature films and widely used in law enforcement and commercial applications from border control to construction and conservation. The widening of exposure to military drone footage and the proliferation of drone use across civil society introduces new HTR and, therefore new collective perspectives on how the networked audiovisual technologies that constitute a drone ecosystem can alter our perception of the relationship between real and virtual spaces.

The research narrative established through my written discourse expresses the idea of my audiovisual art practice being one of spatial multistability and that I have termed this dis/embodied space in relations to the wider cultural context of pilot-drone relations. This research narrative has fed into and overlaps with the with the three artworks that form the practice research component of this thesis. This particular example of multistable embodiment in turn informed the aesthetic and experiential quality of these works. The partial embeddedness of the artistic experience in this real-world experience served as a host site for the generation of its perceptual effects. Directly referencing a contemporary example of multistable relations within my submitted works focused the experience on the conveyance of a particular situation, that of the drone operator, while simultaneously suggesting its relationship to other similar multistable embodiments. With this particular relationship established, a network of other associations are enabled, suggesting potential vectors for related themes, but with similarly structured technological elements.

In these works, a synthesis of carefully calibrated video projection, laser control, ambisonic audio and computer graphics animation is deployed to both produce and problematise the dis/embodied spaces that exist behind the screen and in between loudspeakers. Through the production and experience of these works, spatio-corporeal interactions are transformed within the context and cultural practice of immersive media art installation as a way of constructing a lived experience from the multistable, invariant experiential elements inherent in operator-drone relations. The possibility for categorical expansion in the examination of multistable relations in the course of

everyday life are numerous. More quotidian situations such as walking while using a mobile phone for example show situations where a multistable set of relations between consciously attended objects creates a common kind of dis/embodied multistable presence. The increasing prevalence of multistable perceptual states in daily life will continue to generate fertile ground for the exploration of phenomenal multistability in future artworks.

The word “drone” conjures up notions of ethically problematic mass surveillance and the horrific reality of drone strikes. In the case of this thesis, however, drones provide new forms for artistic expression and avenues of investigation into human-technology relations. Drawn by the radical reconfigurations of spatial understandings afforded by drone technologies, I am trying to further explore our relationship with drones through immersive audiovisual installations. The aim is to explore the operator-drone relation as a subject of artistic production, and the approach is both practical and theoretical, combining my own practice of digital, audiovisual art with research into humans’ relationship with drones as weapons of war. The word drone is derived from the name for the male honeybee and the sound it produces. The buzzing of a bee shares sonic characteristics with engine noise, and has become synonymous with unmanned aircraft. In the border area between Afghanistan and Pakistan, the sounds of military drones have been frequently heard and, here, Drones are called *bangana* (بنگانه), Pashto for buzzing wasp, for their eerie sound. (Cavallaro & Sonnenberg et al. 2012: 32)

While the sound of the drone’s engines can be heard from the ground beneath them, the drone pilots have no audio feedback as their video feed is silent, abstracted, and dehumanised. This absence of sound for the drone pilot stands in stark contrast to the terror of the engine sounds over areas of conflict, an asymmetry that emphasises dis/embodied nature of the pilot-drone relation. In *Conjured Spaces*, this prolonged drone persists between different permutations of the visual field, following their structured, tactical movements but never abating. This ubiquity of the auditory drone in the work, and its timbral homogeneity, describes an experiential dichotomy between the operational scheme of drone operations and the affective state of their subjects. As the visual facet of the work presents the reductionist, tactical space of the drone, the

auditory aspect of *Conjured Spaces* is its sensory obverse; a relentless sonic force that gives no indication of its structural organisation to one who has no access to its visually encoded operational designs.

The production of these works is a manifestation of my concerns with and interest in how an operator's relationship with the drone they are piloting produces experiences of space that move between embodied and disembodied realms. I have, as an arts practitioner, constructed these works as time-based, immersive, audiovisual environments that physically place the audience within the work. As observers of these works, the audience must make sense of their environment. The intended result of this sense-making process is to generate culturally novel apprehensions of the ontological ambiguities afforded by the operator-drone relation. The term 'apprehension' is used deliberately here to describe the audience's mental process of laying hold of something physical, as opposed to 'understanding' which is used to describe the arrival at comprehension via a purely cognitive process.

My research and creative output continue the trajectory of theoretical explorations into our relationships with drone technologies as initiated by the curatorial endeavours of Hi & Low Bureau (Yael Messer and Gilad Reich), Ellen Blumenstein and Daniel Tyradellis, and Svea Bräunert. It shares a common thread in the exploration of networked, immersive, audiovisual technologies undertaken by artists such as Char Davies, Manifest.AR, Blast Theory, Samson Young and Les Liens Invisibles as a means to understand the impact of these very technologies on spatial ontologies within our cultural, social and political landscape.

4.2 Approaches to Production

The central aim and intended function of the three artworks is to provide an intuitive and felt experience that overlap with the rational arguments set out in the previous chapters, completes this thesis. The three artworks provide a way of knowing that foregrounds the physical self rather than the process of logical thinking; thus, the audience experience is affected by the dis/embodied spaces that each artwork produces. Each artwork renders in subtly different ways the core cultural themes outlined within

this thesis: general understandings of virtuality in relation to everyday mobile and networked technologies and the unique and specific multistable facets of the operator-drone relation within the context of drone warfare. Traversing these cultural themes are my theoretical attempts at understanding connected computer spaces through the framework of dis/embodied space. The artworks are both inspired by and deployed as tools to further understand and communicate the cultural themes explored throughout the written component of this thesis. Like the human experience of these cultural themes, each artwork evokes feelings of dis/embodied space, as how the audience feels space is the aim of any immersive artwork. Therefore, the felt experience of these artworks refers to a primary sensual way of knowing, just as any feeling of an environment is established by unconscious exchanges of immersive information.

The only way to proceed is by example, catching the virtual in the act, then looking closely at how it works, and working from there to press its paradox into service in order to see what difference might be made in how we think about perception. In other words: to realise the virtual in thought, from and for experience, through exemplification. (Massumi 2014: 56).

According to David N Lee and Eric Aronson, optical and auditory arrays of the type found in simulated environments such as the cinema contain two types of sensory information. The first helps humans to understand the layout of objects in their environment, and the second is used by humans to understand the location of their bodies in the environment. In a non-simulated environment, the exproprioceptive information we receive is usually consistent but, within the simulated audiovisual environment of the cinema, we receive contradictory exproprioceptive information from two sources. Optical and auditory information fuse to create disembodied eyes and ears that move with the camera and speaker array, while the surface of the skin and sense of movement or lack thereof in our internal organs tell us that we are stationary and sitting in our seats (Lee & Aronson 1974: 15). My concept of dis/embodied space

frames this oscillating, contradictory sensual experience within the cultural context of the human experience of military drone operation. In the process of making these artworks, I have identified invariant, multistable, audiovisual features that were then abstracted from the framework of their cultural context before being rendered into concrete forms for the audience experience.

Lee and Aronson's example of the cinema experience is just one among many audiovisual simulations that could be used to highlight the perceptual contradictions and paradoxes brought about by technologically mediated space perception. Both the written and practical components of this thesis focus specifically on the sense of disembodied space afforded by the audiovisual synthesis and resulting exteroceptive and exproprioceptive phenomena that occur through drone operation. Both analyse the totality of the drone operation, reduce it to its components and introduce a simplification that is abstracted and artistically expressed through the physical interactions between laser projection, ambisonic sound and video projection. The three artworks go beyond a representational expression of dis/embodyed space to produce dis/embodyed space. Thus, the knowledge generated by this thesis is felt, or apprehended, through each artwork as well as comprehended through text.

In Section Three of this thesis, I used Ihde's concept of multiple bodies and human-technology world relations as a tool to reveal invariant features of spatial dis/embodyment experienced by military drone operators. These invariant features emerge from the embodiment, alterity, background, and hermeneutic relations experienced by the operators as they pilot their drones. It is indeed the invariant features of these relations that allow the drone operators to disembody their eyes and ears by interpreting themselves into distant battle spaces. As the drone operators surveil and attack human targets, these battle spaces are then reembodyed through the very same array of disembodying audiovisual technologies. Here the visual stimulus from the drone operator's screen becomes dominant and can override the exproprioceptive preservation of balance that is provided by the semi-circular canals in our inner ears and the pressure sensors in our feet. Even without stimulus to the semi-circular canals

or feet, some drone operators describe leaning as they turn and crouching forward as if to peer over the nose of their aircraft (Martin and Sasser 2010: 22, 34, 63).

Somewhere between Husserl's bracketing out of the contingent and accidental, through free variation in imagination, and the multistability of Ihde's *here-body, there-body* construct lies dis/embodied space. By bringing forward Husserl's and Ihde's variational theories and Ihde's use of simple and abstract drawings to express his concept of multistability, I have made three artworks that, through the synthesis of on-screen optical illusions, auditory illusions and the production of an intimate spatial relationship between the physicality of the laser projection and the on-screen virtuality of the video projection, physically render my idea of dis/embodied space.

The terms 'optical and auditory illusion' to describe the simulated three dimensional spaces created by the artworks are of course at least as problematic as the term 'virtual'. It is used here as a critical provocation and point of departure in attempting to explain the audiovisual compositional sequences contained within each artwork. The idea of sensory illusion within these artworks seems a good place to begin their critical analysis, as they share the same invariant multistable features as the concept of dis/embodiment that permeates this thesis. Illusory audiovisual phenomena could be seen as an awkward exemplar given that the very term of optical illusion contradicts what appears under the perceptual conditions of these artworks as real. If we now consider the lines and shapes produced by both the on-screen animation and laser projection in *Compound Terrains*, we will observe, in the simplest terms, separate and intersecting green lines against dark and black backgrounds. The animation and arrangement of these green lines, or vectors, sometimes intersect to produce a series of vertices that yield to what appears to be two-dimensional shapes. Each separate line and shape occupy a fixed position along an axis that stretches directly out in front of the viewer, much like a straight road that is perpendicularly bisected by a horizon.

However, it is not necessarily the lines or shapes themselves that grab focal attention. The lines and shapes are toggled on and off in quick succession to create a series of chasing sequences that suggests a single moving line or shape. What exists is an array

of 24 green lasers and 24 computer-generated green lines, each of which occupies a fixed position along the Z-axis in both real and virtual space. Focal attention is grabbed by the screen, the boundary between real and virtual space, being crossed quickly and with ease by the illusion of the singular moving lines and shapes. To say that the toggling back and forth by the lines and shapes across the screen boundary is suggested would be an understatement. It is not only perceived; it is impossible not to perceive it. It jumps out so vividly that it thrusts the existence of the screen boundary to the background, together with the actuality of the laser and screen-based geometries fixed along the Z-axis. It is at this point that the concept of dis/embodied space is rendered physical and available for experience by audiences, as it flashes forth in the moment of perception to take centre stage. Now we can return to the problem of the terms “illusion” and “virtual” as we are always tempted to call something that is not in fact present an illusion. What, though, do we call an illusion that we cannot but see? What do we call an illusion that insistently refuses not to appear? The appearance of the green lines and shapes oscillating between virtual and physical space make a difference, as this oscillation, this dis/embodied space appears in effect. And it is the very effectiveness of dis/embodied space appearing in this way that determines the experience of the three artworks. Considered in this way, the spatial illusions created in the spectatorship of the three artworks each satisfy the criteria for being real.

4.3 HYBRID SPACES 2014

Year	Exhibition	Funding	Partners	Collaborators
2014	Falmouth Performance Centre	NA	NA	NA
2016	ISEA Vancouver	ISEA, Arts Council England	NA	NA

Hybrid Spaces was the first artwork to be completed and was directly influenced by my reading of Ihde’s schema of human-technology relations and his concept of a spatially multistable *here-body, there-body*. By using HTR to conduct a phenomenological analysis of the pilot-drone relation (see Section 3 of this thesis), I was able to extract some invariant multistable audiovisual features of this relationship and reproduce them as an audience experience.

4.3.1 Audiovisual Design in *Hybrid Spaces*

In *Hybrid Spaces*, the audiovisual scheme engages the threshold of screen space and embodied presence through a combination of event onsets and synthesis parameter changes which follow morphing onscreen geometries. The multistable moment is structured by the onset of the coincidence between a laser traversing the space and the attack of the synthesiser voice, the connection then further reinforced by subsequent timbral changes that occur in conjunction with those geometries. Audio synthesis parameters are synchronised with on-screen motion and spatial movements, enhancing the perception of a fused audiovisual. 3-dimensionality. Internal timbral motion in the sound synthesis, such as occurring at 1.00 minute in the *Hybrid Spaces* video, sometimes occurs before an onset event to reinforce connections between unseen event and their visible counterparts, reinforcing the multimodal structure and thereby enabling a sense of multistability across sensory and spatial domains. The intervallic pitch structure of the work is implemented to differentiate geometric and spatial elements, and its specific fundamental frequencies were chosen through trial and error on the basis of their ability to provide that differentiation, without adding extraneous musical information.

4.3.2 Conceptual Context in *Hybrid Spaces*

The visual aesthetic and design decisions taken during the production of *Hybrid Spaces* are direct descendants of the imagery used by Ihde to illustrate his concept of multistability. This visual aesthetic forms a continuous theme through all my artworks as it proved to be a simple, uncompounded way to effectively communicate the core concept and invariant features of technologically mediated space perception. Through audience spectatorship *Hybrid Spaces* contributes to the research question by communicating the technologically hermeneutic element that is inherent in the pilot-drone relationship. This hermeneutic relation is explained (Section 3.3 of this thesis) as something a human has with or towards a technology and through which something else is gleaned. Although the pilot's primary focus may be on the technology, what they actually make sense of is not the technology itself but rather the world it refers to; the pilot makes sense of the space beneath the drone through the camera feed that is displayed on screen in the cockpit. *Hybrid Spaces* communicates this hermeneutic pilot-drone relationship by presenting the audience with an abstraction of this hermeneutic

relation in the form of animated computer graphics; the audience makes sense of simulated three-dimensional space through the geometry rendered on screen.

When operating a military drone the pilot has two distinctive spatial experiences. This dual spatial perspective is explained using Don Ihde's theory of *body-one*, *body-two* or the *here-body*, *there-body* (Section 3.1 of this thesis). Our *here-body* understands sense data from our organs and imagines in the first person, while body two - our *there-body*, imagines in the second person and observes from a distance the phenomena of the world. Figure 13 below shows how *Hybrid Spaces* provides a metaphorical framework for audiences to empirically understand how pilot-drone relations produce experiences of space that move between embodied and disembodied realms.

Audience experience	Drone pilot experience
In the case of the audience's experience of <i>Hybrid Spaces</i> <i>body-one</i> is experiencing the immediate surroundings of the gallery: images on screen, lasers and surround sound. While <i>body-two</i> reads the space of the three-dimensional geometry through a computer screen.	In the case of the drone pilot <i>body-one</i> is experiencing the immediate surroundings of the cockpit: images on screen, and communications through a headset. While <i>body-two</i> reads the space of the battlefield through a computer screen.
Through a screen the audience experiences space as abstract geometry constructed from data. The audience experiences the space created by the surrounding sound and lasers in an embodied mode and mostly unmediated.	Through a screen the drone pilot experiences space in a disembodied mode as an image of terrain constructed from data. The pilot experiences the space created by the surrounding cockpit in an embodied mode and mostly unmediated.

Figure 13 *Hybrid Spaces* metaphorical framework

In June 2014, I presented the first in the series of three artworks at The Performance Centre, Falmouth University. *Hybrid Spaces* is an installation designed for a black box style presentation space and uses rear video projection, a haze machine, an Arduino microprocessor, six 50mw green laser modules and 16 loudspeakers. The laser modules, rear projection graphics and loudspeakers are all driven from a central computer running the OpenGL graphics environment within Jitter, a third-order encoder/decoder within Max/MSP, and serial communications script uploaded to the Arduino microprocessor. I began to experiment with hand drawings (Figure 14) which led to wireframe 3D computer models (Figure 15) that could function as multistable images and be manipulated in the OpenGL environment. These led to the quadrilateral

variations that were used in the final piece. The vertices of these quadrilaterals are defined as pixels in Cartesian space, as are the locations of sound sources in ambisonic space.

This sharing of a computationally defined X, Y, Z positioning enabled me to create the illusion that a pixel on a screen and a sound source were sharing the same space and, indeed, moving through space as one. I could therefore synchronise a synthesised sound source in ambisonic space with the movement of 3D graphics along any plane. I then constructed a laser control unit (Figure 16) that could pulse the six laser modules on and off. The final audiovisual work was composed in the Jitter and Max/MSP programming environments (Figures 17), and the lasers were aligned with the vertices of the projected imagery to achieve the effect of creating discrepancies between the natural direction of the viewer's line of sight and the line of sight implicit in the perspective of the artwork. Since 2014, and considering further developments to the compositional environment, I have reworked several elements of *Hybrid Spaces*. The ambisonic decoder is now set for a 25.2 channel loudspeaker array, and the physical layout of the screen and laser positions have been adjusted to fit the same infrastructure as *Compound Terrains*.

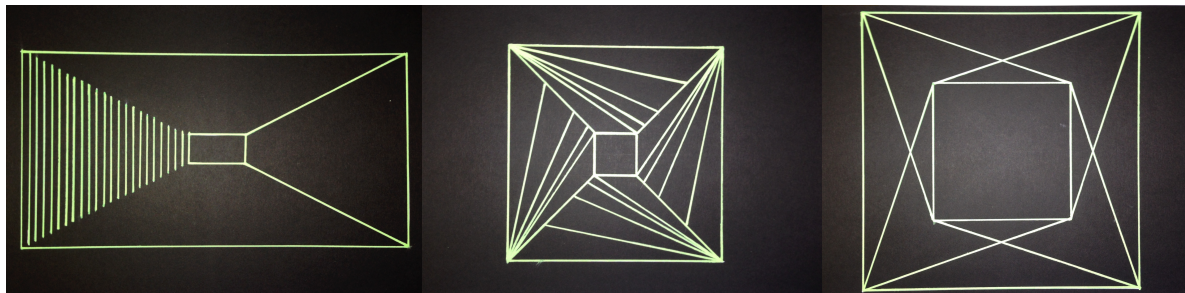


Figure 14 Hand drawn multistable images - acrylic paint pen on black card.

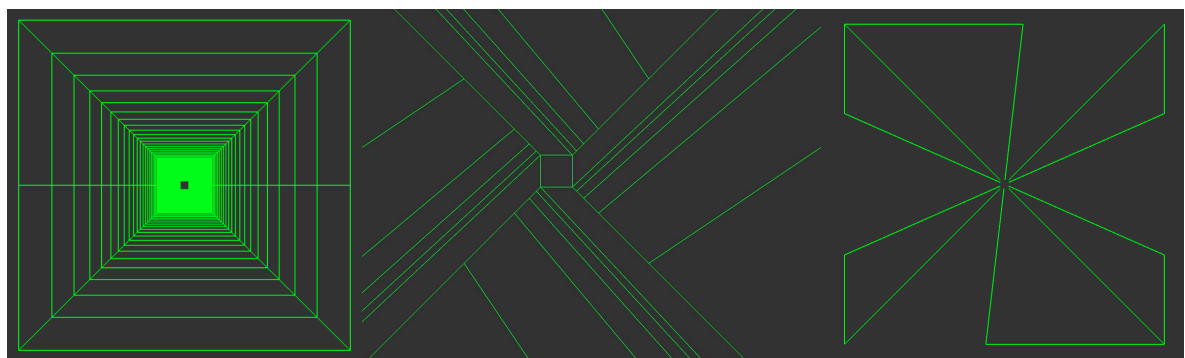
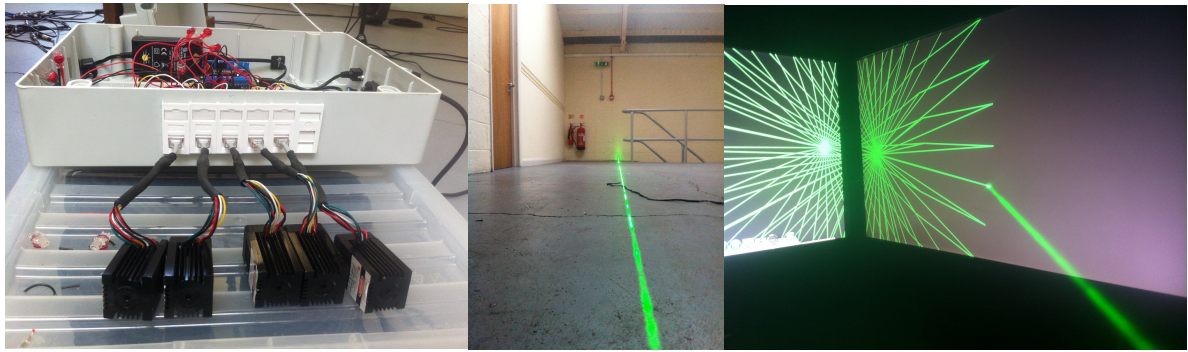
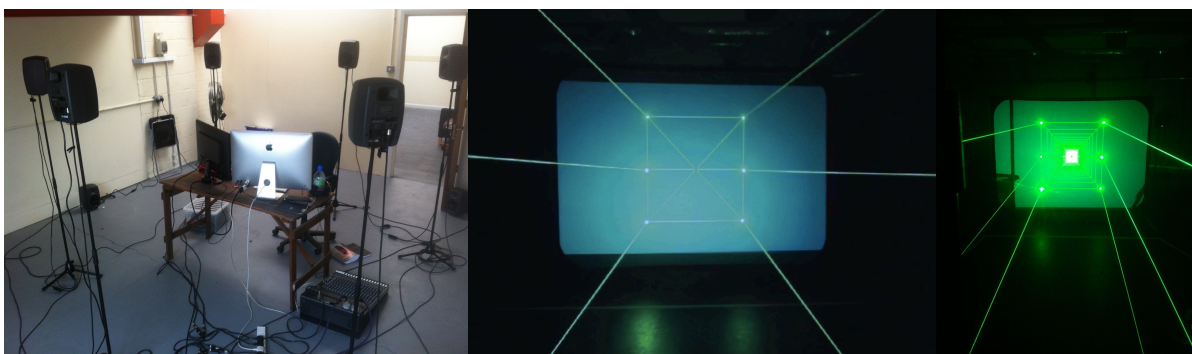


Figure 15 Screen experiments with OpenGL in Jitter.



Figures 16: Laser control unit and initial laser and haze tests.



Figures 17 Hardware set up for compositional process and final black box installation.

The spatial dimensions of the on-screen imagery of *Hybrid Spaces* are equivocal in nature and akin to the multistable line drawings described in Section Three. The vectors and vertices projected onto the two-dimensional space of the screen are mapped to an aural, three-dimensional ambisonic space which serves to further reinforce dimensional ambiguities and evokes the notion of the disembodied eye: projecting the ego centre to locations in space outside the body and, thereby, being able to adopt a variety of vantage points. *Hybrid Spaces* uses laser beams that occupy physical space to intersect with the screen-rendered geometry of digital space, creating a kind of anamorphosis – an augmentation of both realities in both directions. I apply my idea of dis/embodied space to describe this experience of modulation between embodied and disembodied realms. Figure 18 below shows a single point of control as applied to the synchronisation of lasers, graphics, and sound. This one-to-many schema, developed for *Hybrid Spaces*, was subsequently used for *Compound Terrains* and *Illusory Contours*.

Compositional Platform

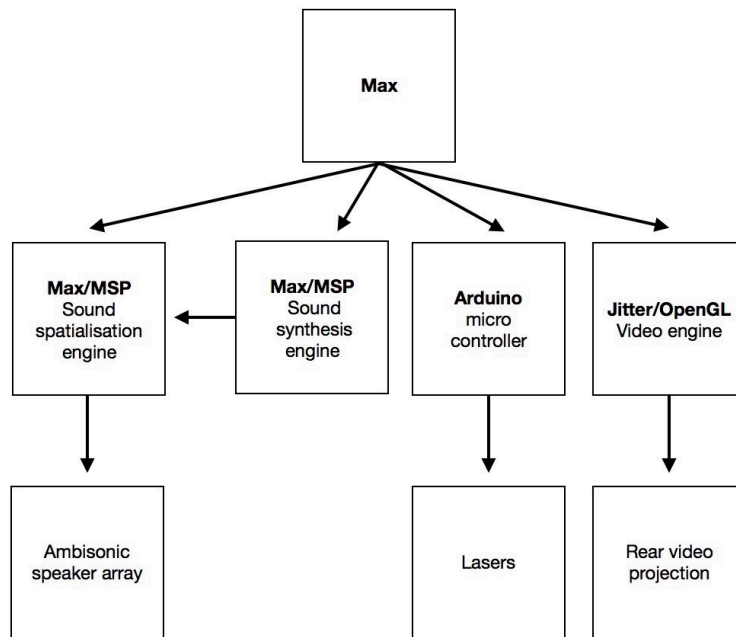


Figure 18: Configuration of apparatus forming the compositional and presentational environments for *Hybrid Spaces*, and *Compound Terrains*.

4.4 COMPOUND TERRAINS 2017-2019

Year	Exhibition	Funding	Partners	Collaborators
2018	Spatial Sound Institute Budapest	Arts Council England	Spatial Sound Institute Budapest	Jeremy Keenan
2019	MONOM Berlin	Transmediale	Spatial Sound Institute Budapest	Jeremy Keenan

Compound Terrains was the second work to be completed during my research practice and was completed in 2019 at Spatial Sound Institute (SSI) in Budapest².

By bringing forward the technological hermeneutics of spatial perception highlighted in *Hybrid Spaces*, *Compound Terrains* foregrounds a second contributing element in the pilot-drone relationship, offering a spatial perception that moves between embodied

² I acknowledge the contribution of my long-time friend and collaborator Jeremy Keenan in the creation of *Compound Terrains* as he authored the Arduino code that manages the newly built laser distribution box.

and disembodied realms. *Compound Terrains* therefore contributes to the research question by communicating how the idea that the technological ecosystem of the drone functions as a portal or boundary between real and virtual space. This idea is experienced and felt by the audience as they are immersed in rapid oscillations between lasers and surround sound in the gallery space and projected computer animations and virtual sound sources that create the illusion of a space beyond the gallery. The vantage point of the audience which places them inside of this artwork elicits the essence of extreme ontological spatial ambiguity that drone pilots report when operating machines at a great distance.

4.4.1 Audiovisual Design in *Compound Terrains*

The audio synthesis engine in *Compound Terrains* was built with similar concerns in mind as those in *Hybrid Spaces*. The audio was structured around a harmonic rich waveshaping approach with a minimal use of fundamental pitch structure. Given the expanded spatial field of the work, short envelope sounds with high transient content were predominant throughout the composition. This more fully exploited the high accuracy of the 4D sound system in defining point sources, in addition to enhancing the audiovisual coupling of laser emission to sound source in the space. The sound profile was adjusted to maximise the 4D sound system's ability to define sound sources perceived as far outside the actual space of audition, with high frequency rolloff as a characteristic of distance being particularly effective to that end. In faster passages, the crossfading envelopes of each voice create a comb filtering effect which was intended to increase the perception of coupling a given shape had as it crossed back and forth between its laser and onscreen manifestations. The pitch structure, much like that of *Hybrid Spaces*, was chosen to differentiate between the presented geometric elements, as well as sometimes representing scales of spatial distance in the audiovisual field.

4.4.2 Conceptual Context in *Compound Terrains*

Drone operators can spend up to twelve hours at a time on flying missions. This means that they become cognitively and psychologically immersed in the distant space that is reconstructed by sensor equipment and fed back to them via their computer screens. At

the same time, however, they are physically present in another space entirely – the cockpit which is thousands of miles away. The pilot’s relationship with the drone’s sensors, the datalink and ultimately the cockpit screen is therefore an essential feature of how the pilots interpret their bodies into distant spaces. These accounts reveal oscillating senses of remoteness and presence as they describe themselves as being displaced into the drone and watching from a great height and then returning to the drone’s grounded control facility many times over (see Section 3.3 of this thesis). Through their relationship with the drone technology the pilots’ spatial perception moves back and forth between embodied and disembodied realms. This oscillation of dis/embodied spaces is embedded into the compositional strategy of *Compound Terrains* and is communicated to the audience via the rapid chasing motion of real and virtual laser arrays. A large screen functions as the portal or boundary between real (gallery) and virtual (computer animated) spaces. At times, the virtual animated lasers are indistinguishable from the real lasers and distance encoded sound sources appear to emanate from outside of the gallery space. The audience focus on the screen as the perspectival source of motion which emerges from the video scope into the real space of the work is emblematic of this cognitive reconstruction. In this way, the more distant objects on screen take precedence over their more proximal counterparts rendered in kinetic motion and laser light. This affords an audience experience that, at its core, contains the same oscillating spatial perceptions between embodied and disembodied spaces. Figure 19 below shows how *Compound Terrains* provides a metaphorical framework for audiences to empirically understand how pilot-drone relations produce experiences of space that move between embodied and disembodied realms.

Audience experience	Drone pilot experience
<p>In the case of the audience’s experience of <i>Compound Terrains</i> the lasers and surround sound draw perceptions of space quickly back and forth between the embodied gallery space and disembodied space away from the gallery space.</p>	<p>In the case of the drone pilot’s experience the instruments in the cockpit and the screen rendering of the drone’s camera feed draw perceptions of space quickly back and forth between the embodied cockpit space and disembodied space away from the cockpit space.</p>

Figure 19 *Compound Terrains* metaphorical framework

My theory of dis/embodied space emerges from a type of human interaction with drone technologies that produces a high frequency – and mostly uncontrollable – modulation between a sense of embodied and disembodied space. Although the geometrical ambiguities of *Hybrid Spaces* successfully communicate the idea of multistable states, I felt that the sense of modulation between embodied and disembodied space needed to be foregrounded and rendered into a felt experience. *Compound Terrains*, the second artwork in the series, focuses on the audience’s sense of dis/embodied space by offering an experiential, audiovisual rendering that would both demonstrate and evoke this essential movement between virtual and real space.

John W Clark’s term “telecheric machines”, which describes the technology of manipulation at a distance, (see Section 3.6 of this thesis), and was a point of departure for the compositional and design principles behind *Compound Terrain*’s fast oscillations between virtual space (3D geometry rendered as onscreen computer graphics) and real space (3D geometry rendered as intersecting laser beams). Lacking the living flesh of the human body, the mechanical body of the telecheric machine is invulnerable to the hostilities of the environment in which it operates. This idea of removing humans from harm’s way and replacing/augmenting their actions with a machine predates the US drone programme by some 50 years. It does however imply exactly the same mode of conceptualising and organising space; a specific topography for which Clark (1964) devised his basic schema of *hostile and safe zones*. This pertinence emerges as central to *Compound Terrains* and the innate dichotomy of its situation between screen and space. If the border between onscreen representational spaces and their embodied counterparts were purely perceptual, this tension would be less remarkable. However, as we have seen, there is an adversarial relationship between these zones, with a clear asymmetry of consequences affording an advantage to the disembodied.

This asymmetricality is fundamental to the way that *Compound Terrains* presents the reorganisation of space in a reversal of visual representation as it is conventionally idealised; instead of the subjugation of mediatised forms to those of the ‘real’, wherein the projected image is parasitic in relation to its subject, here the disembodied form

dismantles the power of its subject through the very consequences of that representation. This 'primacy of the virtual' is most noticeable in the tendency of the image and sound to escape the site of experience into ubiquity, as the audiovisual horizon expands beyond the capability of the space to contain it.

For the purposes of this thesis submission, the sonic components of all *Compound Terrains* are decoded via third-order ambisonics to a periphonic speaker array. This allowed me to place sound sources in real space at the location of each loudspeaker, create phantom sonic images between loudspeakers and distance-encode the sound source into the same virtual space occupied by the projected screen-based graphics. Thus, in classic one-point perspective, the vanishing points of both the visual and sonic components were scaled to the same point in virtual space – a capability exploited more fully in *Compound Terrains* than in either of the other two artworks.

A different approach to the synchronisation of laser and sound was taken in *Compound Terrains*. The illusion was created of a sound source moving through the embodied space of the gallery, travelling unencumbered across the portal that is the screen and into the disembodied three-dimensional space of OpenGL, screen-based graphics, before finally disappearing over the same virtual horizon as the projected pixels. *Hybrid Spaces* was most successful at synchronising sound, graphics, and laser at the surface of the screen and beyond into the disembodied space of OpenGL graphics. Due to the fixed nature of the lasers and their perpendicular orientation to the screen, the movement of sound in the embodied exhibition space could not be synchronised along the beam of the laser itself. When composing *Compound Terrains*, I overcame this limitation by building a new laser control unit (Figure 20) that increased the number of control channels from six to twenty-four. I further added a servo motor mount (Figure 21) to each laser, also integrated into the new control unit, to enable the beams to move and create a greater array of shapes in composition. The servo-mounted lasers were then positioned parallel to the screen and at regular intervals over two planes of height (Figure 21).

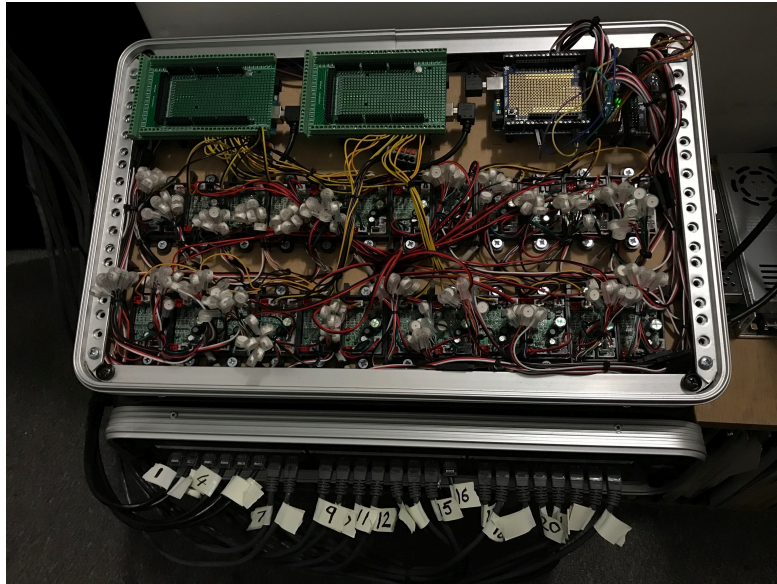


Figure 20: New laser and servo control unit.

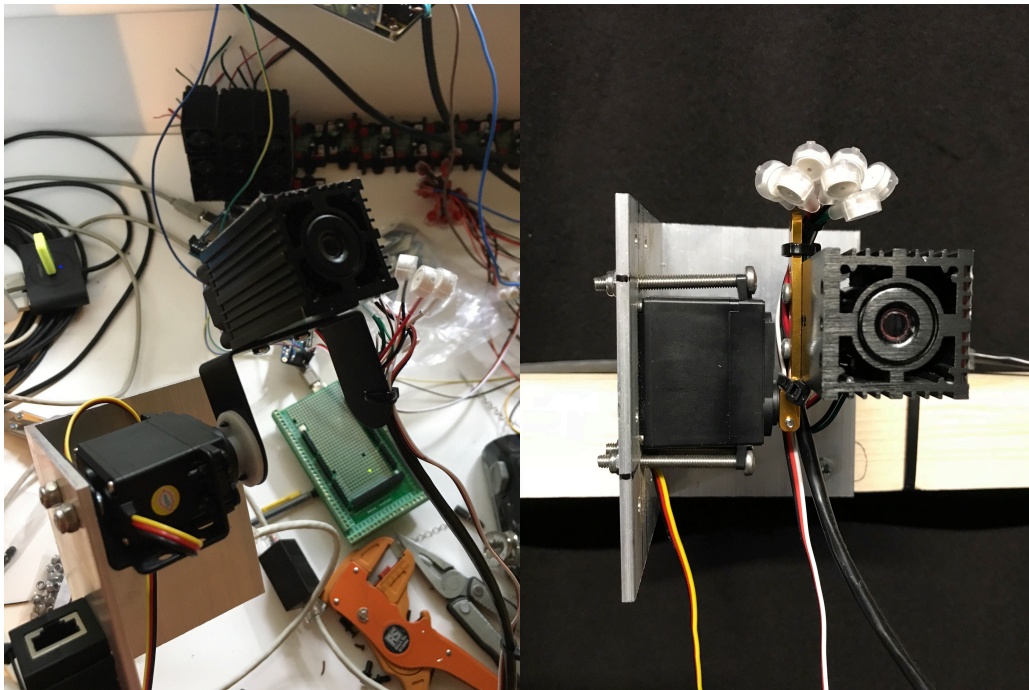


Figure 21 Servo-mounted lasers.



Figures 22 Laser array and screen positioning.

The software component of this system uses a 48-voice polyphonic synthesiser and the same third-order ambisonic spatialisation engine as *Hybrid Spaces* and *Conjured Spaces*. The first 24 voices of the synthesiser were mapped to the physical Cartesian coordinates of the servo-mounted lasers; the remaining voices – 25 to 48 – were similarly mapped to the respective Cartesian coordinates of an array of 24 virtual lasers. The virtual lasers were positioned in the virtual three-dimensional OpenGL space using the same scale and distancing pattern as the real lasers and were also enabled with the same range of movement and pivot points as their real-life counterparts (Figure 23). Thus, the virtual elements possessed the same compositional possibilities as the real elements.

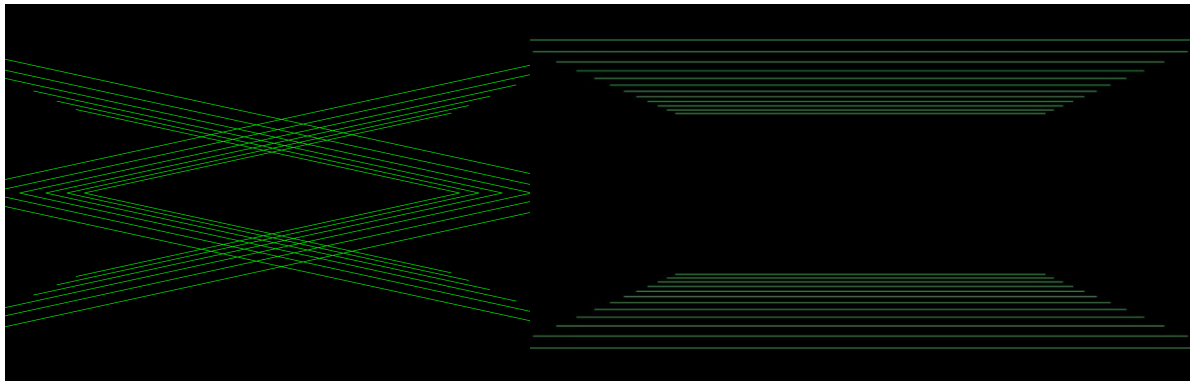
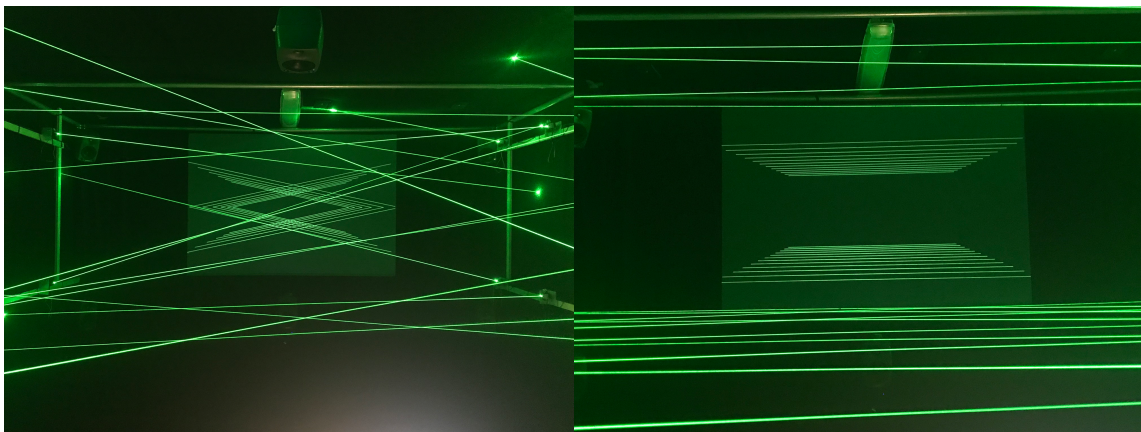


Figure 23 Virtual laser array.



Figures 24 Real and virtual laser arrays.

The final layer of audiovisual synchronisation was the mapping of an envelope follower to the brightness of both the real and virtual lasers. This allowed a tight compositional relationship between the amplitude envelope of each synthesiser voice and the brightness of its corresponding laser. The simultaneous manipulation of and interaction

between the real and virtual lasers and synthesiser voices was the single most important feature of this compositional configuration of the apparatus, with each element responsible for the production of virtual and/or real space. The ease and naturalness with which our perceptual state moves between real and virtual elements are made clear to the senses through the experience of *Compound Terrains*. An audiovisual chasing or panning effect was created by rapidly turning each laser and corresponding voice on and off in sequence. This created the illusion that a single audiovisual element had a range of movement that spanned the outermost limits of the embodied gallery space and the outermost limits of the disembodied virtual space of the screen. *Compound Terrains* creates a tangible sense of modulation to and from embodied and disembodied space. In its most successful moments, the technologies of its production become transparent, allowing the synchronised sound and visuals to become a single audiovisual protagonist, moving freely and quickly between embodied and disembodied space.

4.5 CONJURED SPACES 2021

Year	Exhibition	Funding	Partners	Collaborators
2021	NA	NA	NA	NA

Conjured Spaces was the fourth and final work to be completed which and was undertaken during the resubmission period of research practice. The third artwork to be completed, *Illusory Contours* is detailed in the appendix of this thesis. *Conjured Spaces* is an audiovisual work that is designed to be either independently of a gallery situation - through a web browser or file download - or as a larger-scale projection with multichannel sound system. The latter option has not yet been exhibited, not least because opportunities to use appropriately sized spaces for large-scale immersive audiovisual works have not been available to me throughout the 2020-2021 COVID-19 pandemic. When considering the presentation of *Conjured Spaces*, it was important to me that I could create something that would communicate the central themes of pilot-drone relations and multistable dis/embodied spaces without the need for audiences to be in a determined space. Although the video documentation of *Hybrid Spaces* and

Compound Terrains demonstrates the immersion of the audience in light and sound, the feeling of this immersion must be assumed through the documentation unless spectators are able to attend the installations themselves.

4.5.1 Audiovisual Design in *Conjured Spaces*

The rationale driving the aural aesthetic behind these three works strongly diverges from standard compositional modalities at play in the majority of electroacoustic and audiovisual work, and certainly those of conventional music practice. This divergence is fundamental and twofold. Firstly, from a technical standpoint the methods of synthesis differ from most extant compositional practice. Secondly, the creative decisions that shape the sonic experience of the work deviate from those at play in audiovisual composition, with a different set of values at their core. The sonic profile of *Conjured Spaces*, for example, derives entirely from the pixel data of the visual field. This technique differs from the more common ‘audio-reactive’ approach, where the visual aspect of a work is structured from a real-time musical analysis of the ‘soundtrack’, with features like rhythmic onset, frequency, and audio amplitude mapped to colour, position, brightness, and other visual features. This approach, common to products like Apple’s iTunes visualiser and frequently used to create visuals for dance music for example, while effective, is less so for an examination of multistable potentials in audiovisual work given the essentially staged formal derivation of the visual from audio modes. The approach taken in *Conjured Spaces*, which treats the audio and visual as deriving from the same source, presents its sensory output as a continuous multistable space. The synthesis uses a wavetable constructed directly from a real-time frame by frame transposition of a given frame’s pixel by pixel RGB content from a 2D X/Y matrix into a constantly changing cyclical waveform. As opposed to conventional audiovisual approaches which create a visual output from audio analysis of an image, where timbral choices are freely made according to extrinsic compositional logic, the audio in *Conjured Spaces* is entirely data driven.

4.5.2 Conceptual Context in *Conjured Spaces*

The other two works follow a similar rationale in their construction; in *Compound Terrains* and *Hybrid Spaces*, the sound and visual aspects emerge from a single amodal data source, the permutations of which serve to demonstrate the unstable relationship between states of dis/embodiment, shifting back and forth between different levels of proximal and distal perceiving bodies. One example of this structural choice can be experienced in *Compound Terrains* around 05'28" in the documentation video, where over the course of several minutes the tempo rises and falls, merging multiple events into a single stream of sensory information, blending the audiovisual field over physical distance. This trajectory demonstrates the experience of peripheral spaces between material and virtual, proximal and distal, exploring the kinds of constantly shifting conjunctions of bodily presence afforded by drone technologies.

While aesthetic choices were made around timbre, frequency and envelope, a decidedly non-compositional approach to their implementation in all three works informs their sound. In some sense, the process can be understood as an obverse to that of music concrete. Instead of recorded sonic material reduced to a timbral object, the audio signal resembles more an abstract representation of physical data that might be pertinent to the operation of a drone. Similarly, while the sounds used are not specifically designated to indicate real-world quantities, there is no 'erasure' of the signified source as per musique concrete; instead, there is the implication through resemblance that these sounds strongly represent the material relations of involved objects, namely drones and human bodies. For this reason, the sonic profile of all three works eschew strictly musical concerns, and are instead intentionally modelled after the operational schemes of auditory displays, alarm systems, data sonification and everyday machines such as household electronics.

My approach to the presentation of *Conjured Spaces* differs significantly to those of *Hybrid Spaces* and *Compound Terrains*. The green wireframe geometry and similarities in synth timbres create continuity between the three works. However, I took the decision not to include laser projection in *Conjured Spaces* and instead focus attention

on the dis/embodiment of space as figuratively depicted through aerial imagery. My approach to the production of *Conjured Spaces* was also a departure from the compositional tools and environments used for *Hybrid Spaces* and *Compound Terrains*. These two works essentially used the same laser control system, software environments (Max/MSP Jitter) and ambisonic encoder/decoder (ICST). When planning the production of *Conjured Spaces* the same macro approach was taken as in the preceding two works. Authoring was done in two parts; one the creation of a bespoke software environment, and two, the creation of the artwork within that environment.

A Touch Designer network was built that would enable me to draw and animate wireframe geometry and place images of terrain within this geometry. The images were sourced from EarthView (Shah 2020), a Google project that has archived thousands of high resolution aerial images from all over the world. The choices to use Touch Designer instead of Max and Jitter lay in its superior video rendering performance and geometry instancing capabilities. It is, for example, not possible using Jitter to make multiple instances of geometries to create larger macro shapes whilst maintaining high resolution graphics rendering and CPU performance.

Sound was generated and synchronised in Touch Designer by creating a bespoke pixel synth. This technique resamples the output of the graphics renderer at 60 samples per second – the same frame rate as the video is rendered. This 60Hz base sample rate then references a wavetable and is routed to an internal digital oscillator. The sound is, therefore, largely generative, with some minor interventions in the form of filtering and oscillator frequency adjustment. Once the animated graphics sequences were finalised I then internally recorded the output of the Touch Designer video render and routed the output of the pixel synth into Reaper. This process yielded synced video and stereo audio sound files that were then imported into Reaper for final editing. The stereo sound was encoded into third order ambisonics which allowed spatial placement to match the onscreen three dimensional geometry in terms of both cartesian space and size and shape of the visual objects. The audio was then decoded to binaural and multiplexed with the video to produce the final piece. An un decoded third order ambisonic mix was

also produced which will allow for future decoding to a multichannel speaker array if exhibitions with live audiences become possible in the future.

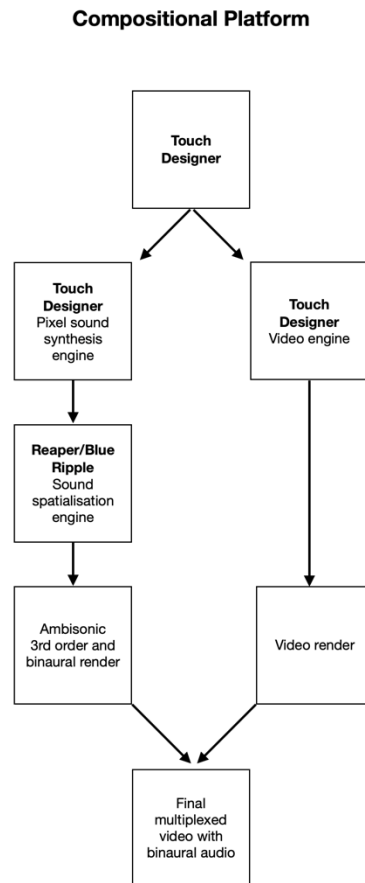
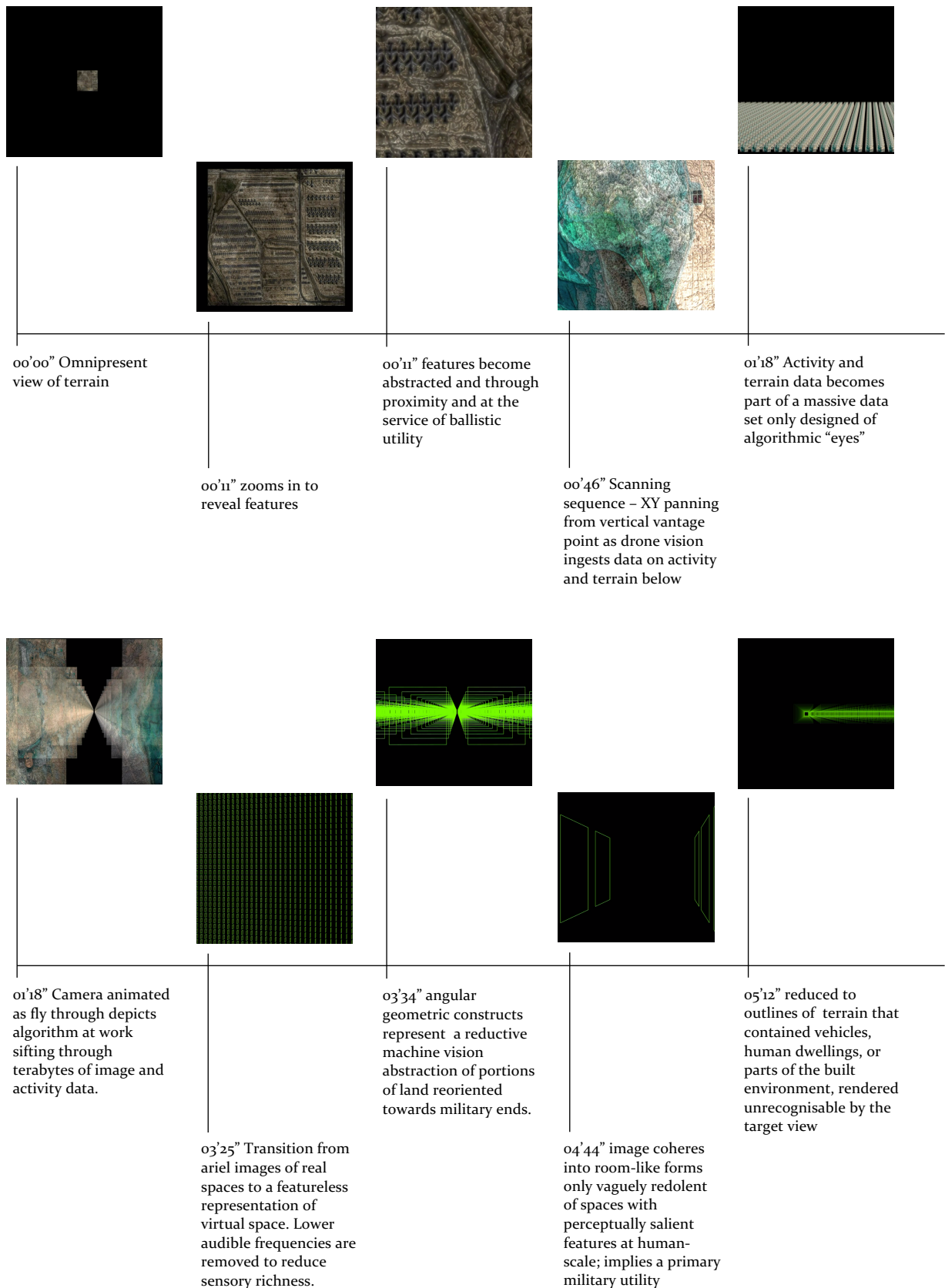


Figure 25 Configuration of software environments forming the compositional platform for Conjured Spaces.

Throughout this section conceptual references are made to time points in *Conjured Spaces*. Some of these time points are also displayed along with still images from the video in figure 26



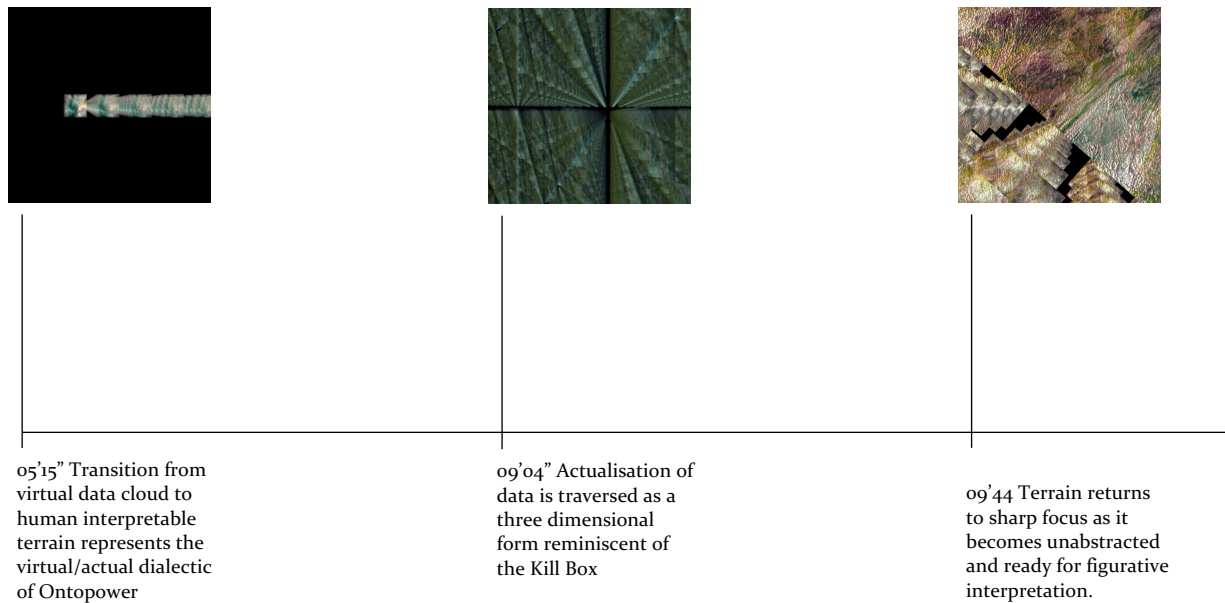


Figure 26 *Conjured Spaces* timeline

Conjured Spaces is the final artwork to be produced as part of my practice research and it is built on the research outcomes of my written discourse and the preceding artworks in my portfolio. Firstly, *Hybrid Spaces* both explores and foregrounds the research themes of multistability inherent in audiovisual art practises and uses them to highlight the cultural parallel of the pilot-drone relation through the mapping of sound to the morphing of two- and three-dimensional geometries. Secondly, *Compound Terrains* effectively delivers a felt experience of dis/embodyed space in the spectatorship of the artwork by oscillating light and sound back and forth between virtual and real space. Thirdly, *Illusory Contours* (see appendix), which functions as a bridging work between the themes, technology and compositional approaches used for *Hybrid Spaces* and *Compound Terrains*, and the conceptual, technical, and aesthetic approaches taken in the production of *Conjured Spaces*.

By introducing a further variation of spatial perception *Conjured Spaces* takes a vertical perspective of the animated graphical subject displayed on the screen. This creates a sense that the vantage point of the audience has shifted away from that of a grounded human and towards a God's eye view that is experienced by drone operators as they visually interpret the battle spaces that are beamed to their cockpits via satellite link. The Gorgon Stare and Ubiquitous Surveillance Imaging System (ARGUS-IS) systems are

examined as an alterity relation (see Section 3.4 of this thesis) in terms of a pilot-drone relation and from within Ihde's human-technology relation schema, as they epitomise a combination of new visual perspectives and data collection that is unique to military drone technology.

With city-wide surveillance capability, the Gorgon stare system ingests decades worth of real time video footage within the space of one year (Chamayou 2015, 40). Unable to process such large amounts of data with only human resources the US military uses ARGUS-IS to process several terabytes of data per minute as it functions as an "integrated cognitive systems for automatised video-surveillance" (BAE Systems, 2019). This "cognitive system" or AI is designed to generate kill lists via its machine learning algorithms. Human behaviour is abstracted through the formation of vectors and vertices that represent connections between potentially threatening human behaviours. This automated form of threat identification is termed Ontopower by Brian Massumi (Section 2.3 of this thesis) and is explained as a new type of power that is characterised by emergency and is manifest through soft power (surveillance) and hard power (military interventions).

In *Conjured Spaces*, this emergent possibility of power in response to an operational need that already always exists is taken to its logical conclusion: in everything and everywhere, there is always a potential target for surveillance and offensive tactical activities. The implication of Ontopower as an overarching strategic rationale and its attendant affective states are seen as inseparable forces. *Conjured Spaces* begins by the zooming in on territorial images that flood the viewscreen to the point of abstraction; morphing, flashing in and out of view, multiplying and reconfiguring their spatial relationships, their identities fluid, indistinct, interchangeable. The extent of *Conjured Spaces* is a latent expanse of imagined targets, wherein surveillance generates preconditions for the application of force. Here, the vaunted schism between virtual and embodied worlds is examined outside its usual framing of relations between the domain of the material and its perceived opposite, whereby the virtual is understood to be parasitic upon its tangible real-world subject. Instead, the scope of *Conjured Spaces* recognises in the context of Ontopower that the virtual is the architect of the real: with

the possibility for material consequences to emerge from a virtual milieu that can endlessly manufacture pre-emptive targets through its 'affective logic of potential', the possible domain of military force is always already omnipresent.

This new way of batch processing huge data sets of imagery is now pervasive, although we are mostly unaware of it. Inside many modern machines pass countless images, parsed for information and soon discarded (Saucer 2010: 9). This is part of a range of automated processes performed by automated actors that are essential in the functionality of seeing machines, from drones to speed cameras to real-time navigation systems. (see Section 2.7 of this thesis).

The attendant audio in *Conjured Spaces* follows this transformational primacy of data over direct perception both in its underlying structure and its timbral presentation. Most notably, the auditory component of the work has no perceptual corollary to any kind of naturally-occurring environmental sound. Importantly, its monotone hum, never reaching crescendo or release, remains abstract to the territory of its subject, the surveilled ground target and its embodied life. Instead, the sonic profile of *Conjured Spaces* most closely resembles alert tones, sonified data, encrypted digital radio broadcasts, the auditory display of medical devices, in other words, data.

One key difference in the perspective of *Conjured Spaces* from that of *Hybrid Spaces* and *Compound Terrains* is the implication that the Z axis is frequently in rotation and as a result becomes an axis on which the screen-based graphics move in an upwards and downwards orientation rather than a back-and-forth orientation as in *Hybrid Spaces* and *Compound Terrains*. This places the disembodied eye of the audience vertically above instead of horizontally in front of the objects of focus. Our traditional sense of orientation is based on the stable line of the horizon. The stability of the horizon relies on the stability of the observer, who is thought to be located on a surface or ground that can be imagined as stable even if in fact it is not. As Erwin Panofsky argued in his now classic 1927 text *Die Perspektive als 'symbolische form'* (English translation: *Perspective as 'symbolic form'*), the construction of linear perspective assumes the view of a one-eyed and immobile spectator as the norm - and this view in itself is assumed to be

natural, scientific and objective. Linear perspective, thus, is based on an abstraction and does not correlate to subjective perception; instead, it employs a mathematical and homogeneous interpretation of spatial reality. Panofsky's analysis of pictorial visualisations of space and spatiality covers different cultural and historical contexts, examining their cultural codification as symbolic forms which are commonly understood as synonymous with one point linear perspective. (Bawden et al. 2016, 526).

Through the production of *Conjured Spaces* I have explored and poetically rendered a state of transition in terms of the spatial orientation of visual culture caused by a seeping of military drone footage into the collective consciousness. For example, between 05'50" – 07' 47" I composed a search-like sequence that scrolls through aerial footage evoking the cognitive image dataset processing of the ARGUS-IS. Our sense of spatial orientation has dramatically changed in recent years as a result of our interactions with the drone technologies of surveillance, tracking and targeting. One of the manifestations of this transformation is our increasing exposure to aerial views: leaked military drone footage posted on YouTube, Google Maps, satellite views and the use of drone footage in commercial film production. Humans are growing increasingly used to a God's eye view. On the other hand, we also notice the decreasing importance of a paradigm of visuality that has long dominated our vision: linear perspective. Its stable and single point of view is being supplanted (and often replaced) by multiple perspectives, overlapping windows, distorted flatlines and divergent vanishing points.

Conjured Spaces situates vertical perspectives and the technologies that produce them within the specific cultural and political context of military drone operation. Instead of advancing a rhetoric that situates vertical perspective as a penetrating machine gaze which creates the omniscience of an all-powerful surveillance, *Conjured Spaces* offers a perspective within the context of a human's relation to technology as embodied, vulnerable, and partial. In this way, the specific forms of vertical perspective are made pertinent in relation to a way of seeing inherent in the pilot-drone relation. Drones do not see and cannot gaze; they do, however, have advanced optical instruments through which light is converted into data and fed through a satellite link for processing via AI

algorithms, and to be made available for a human operator's, interpretation and embodiment by a human operator.

Paul Virilio's idea of omnipresence (see Section 2.1 of this thesis) was used as a conceptual underpinning for the sequential animated decision taken in the composition of *Conjured Spaces*; As the video begins, the scale between the kind of omnipresence afforded by UAV operations and their targets is effortlessly traversed. As the viewer zooms in, a quantised square of land consisting of clear natural features is nonetheless presented as an abstracted and anonymised block as it is viewed up close, its borders apportioned according to the logic of ballistic utility. Further, at 3'25" in the video the intimate relationship between military technologies and the organisation of space is foregrounded by the transition from framed aerial photographs of target territories into the square green border reminiscent of the drone's target scope. It is also at this point that the low frequencies of the accompanying audio are filtered out to reduce sensory richness and enforce the sense of transition from an image of a territory that is designed to be interpreted by a human, to a green wireframe image that is designed to represent the digital residue of the operative image. This represents the moment where the inhabited terrain of a marked military zone is entirely subsumed by this wholly depersonalised, virtual and disembodied 'military space'.

The fact of the drone pilot's physical body being disconnected from the battlefield is a fact of the pilot-drone relation; "a virtual battle over an actual war" (Section 3.5 of this thesis) and the disembodiment of military technologies of Paul Virilio's military space (Section 2.1 of this thesis) bring us back to Don Ihde's concept of *here-body*, *there-body* (Section 3.5 of this thesis) revealing the distinction between a sensorially complete experience in the drone operator's *here-body*, which sits in the drone cockpit, and of the visual objectification of a presumed out-there in the battlefield body which is experienced through the hermeneutic relation of the datalink.

The multistability of Ihde's *here-body*, there body provides an abstracted and useful lens through which to further explore multistability through may art practice and the drone operator's dis/embodied spatial experiences. This lies at the heart of what I have tried

to express through the aesthetics of my practice research. Between 1.55 and 2.17 in *Conjured Spaces*, we see this multistable relationship represented as a conjunction of audiovisual flows; at 2.02, this conjunction maintains a seeming moment of stability at the apex of constant shifts between dis/embodied states. The view then quickly transforms back into a direction of characterised by the presence of this multistability; the perspective returns to its ever transforming flow of proximal and distal bodies, where multiple forms of presence exist in unstable tension. The precarious and mercurial multistable nature of the relationship between these contrary conceptions of space and their disorientating effect on embodied states can be felt in the staccato audiovisual glitching effect starting at 02'27" and distributed throughout the video. This refusal to stabilise into a coherent synergy is a tension that persists as a central theme in *Conjured Spaces*, in accordance with this spatial and perceptual disjuncture.

Throughout my research practice and the production of *Hybrid Spaces*, *Compound Terrains* and *Conjured Spaces* I have made use of animated lines in both virtual (with computer animation) and real (with laser light) spaces. The interplay and oscillation between virtual and real space in these works is felt by spectators through the animation of perceptually multistable three-dimensional geometry in *Hybrid Spaces*, and the rapid movement of geometry between the screen (virtual) and gallery space (real) in *Compound Terrains*. Both of these works capture my idea of the dis/embodied spaces afforded by the drone-pilot relation and communicate it through immersive experiences that place the audience within the work. *Conjured Spaces* brings forward these conceptual themes and design aesthetics to complete a closer examination of the Deleuzian ontological understanding that favours the virtual/actual over the virtual/real dialectic. This philosophical reading of the virtual pertains to force and the potential to be forceful, rather than something that is simulated or illusory (see Section 2.3 of this thesis). By returning to Massumi's idea of Ontopower we can again provide cultural context to the abstract Deleuzian concept of the virtual and the actual by framing Ontopower as a mode of power embodying the logic of pre-emption across the full spectrum of the U.S. Military force, from the hard to the soft. Ontopower is the power to bring into being, and in practice describes the nebulous and virtual cloud of surveillance data and data processing algorithms that are actualised into kill lists and

ultimately missile strikes. This virtual to actual transition is again a consistent theme throughout this thesis, in both written and practice research.

My idea of dis/embodied space relies upon the virtual/real, virtual/actual ontological oscillations of the pilot-drone relation and these have served as inspiration for both the macro compositional structure and micro arrangements of aerial footage in *Conjured Spaces*. The transitions at 03'27" from a matrix comprised of squares of terrain to empty green wireframe borders, which return to recognisable terrain at 05'15" are expressions of an operational space that is not regarded as continuous and homogenous as it is in our daily lived experience. It is rather a dynamic mosaic where tactics vary in relation to mission objectives. Drone commanders and operators use the concept of Kill Boxes to carry out operations and they see the world beneath their drones as a patchwork of squares of colour, each of which corresponds to specific rules of engagement and "people of interest" (Chamayou 2015: 59). These squares are represented within the three dimensional matrix of *Conjured Spaces* which at 08'02" coalesce to form a cube. This is central to the concept of kill boxes which are graphically portrayed as a theatre of operations that can be divided into a series of cubes or boxes.

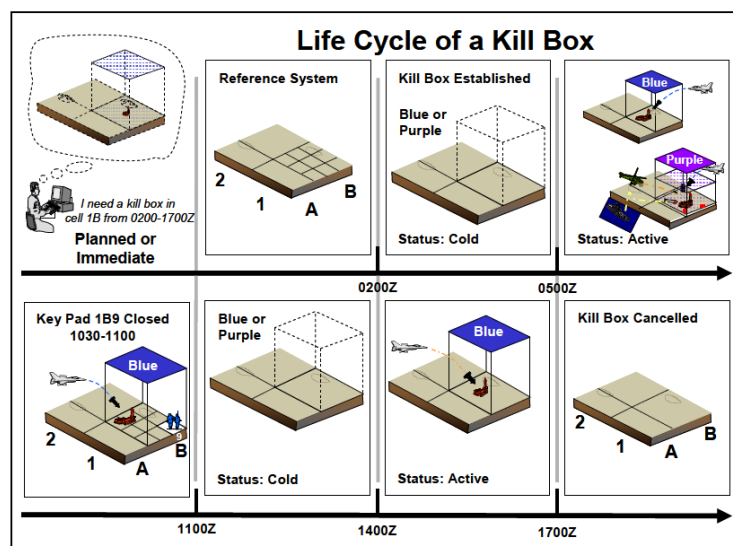


Figure 27 Life Cycle of a Kill Box

These kill boxes have life cycles through which they are opened activated and change colour as they are used. At 05'30" and 08'45", *Conjured Spaces* depicts them through the

scrolling of terrain imagery contained within their square boundaries. Once established a kill box becomes a space in which drone pilots can fire missiles at surface targets without any further coordination with, or authorisation from their senior officers. Each cube becomes “an autonomous zone of operations” (Chamayou 2015: 62) for the drone pilots assigned to it. Kill boxes are also dimensionally dynamic and they are scaled for open terrain or urban warfare as needed and can be opened or closed quickly in response to a military situation. This scalar modulation is depicted at 0’53” and 08’09” in *Conjured Spaces* as the number of rows and columns in the matrix expand and the distance between each square increase to form a macro structure. Like kill boxes, *Conjured Spaces* uses vectors, to create outlines which are ephemeral and spatially multistable as they lie over the terrain and temporarily define space as an incomplete digital image.

The engagement of the kill box, and its seemingly detached arbitrariness from the perspective of its potential target, becomes apparent at 06’19” in *Conjured Spaces*. As the shifting audiovisual texture freezes in time, the viewfinder fixates on a single square ‘box’ of land. Reflecting the fatally reductionist data-reconstructed caricature of the target within this kill box, the visual component relays a feature-poor rendition of the landscape, stripped of identity and life. The audio settles into a frozen tone, its harmonic content being derived from the already abstracted image, characterising this doubly opaque rendering of a given lived environment, nonetheless determining the ‘fate of the real’ not despite, but because of this opacity. The sound’s frozen timbral signature pauses momentarily with no acknowledgement of any weaponry engagement, destruction, aftermath or ‘collateral damage’, an inert hum, a non-place, a numb inverse of the target’s situation. *Conjured Spaces* foregrounds a third contributing element of the pilot-drone relationship that affords spatial perception that moves between embodied and disembodied realms. *Conjured Spaces* therefore contributes to the research question by communicating the idea that the pilot-drone relation effectively reorganises spatial embodiment through the actualisation of virtual data into squares of physical terrain that become perceptible aerial footage. Figure 28 below shows how *Conjured Spaces* provides a metaphorical framework for audiences to empirically

understand how pilot-drone relations produce experiences of space that move between embodied and disembodied realms.

Audience experience	Drone pilot experience
<p>In the case of the audience's experience of <i>Conjured Spaces</i> the matrix of wireframe geometry depicts a virtual cloud of potential spatial perspectives that are then actualised and made available to perception as both three-dimensional cubes and arial perspectives of spatial terrain.</p>	<p>In the case of the drone pilot's experience; data ingested from Gorgon Stare exists as a virtual cloud of potential spatial perspectives that are then actualised and made available to cognition as kill boxes and to perception as arial perspectives of spatial terrain.</p>

Figure 28 *Conjured Spaces* metaphorical framework

5 – SECTION 5: CONCLUSION

The research question, aims and objectives of this thesis set out to generate new insights through my audiovisual art into how human relationships and interactions with military drone technology can impact on perspectives of spatial embodiment and disembodiment. By exploring multistability within audiovisual art practice I have generated and communicated new insights into oscillating experiences of embodied and disembodied space and, moreover how I could use practice research, i.e., the combination of immersive audiovisual art installation and text-based research, as a vehicle to both generate and communicate these new insights. In the authoring of this thesis, I have produced a series of immersive audiovisual artworks and an accompanying discourse that uses the pilot-drone relationship as an example that helps contribute to our understanding of multistability within audiovisual art practices and resulting perspectives of dis/embodiment as alternating stable states. I explain how our perceptions of space can be mediated through the specifics of the military drone's technological ecosystem and, how this can be communicated through immersive audiovisual art installation. This practice research has been applied with the purpose of addressing the question posed in the introduction to this thesis:

What new insights can immersive audiovisual art installation create into the embodied and disembodied spaces that result from the human operation of military drones?

The methodology applied to addressing this question has been a cycle of writing, art-making and art spectatorship that has generated new insights into the subject of immersive audiovisual technologies and spatial embodiment. These insights have been communicated through the interlacing of, the spectatorship of three new immersive audiovisual artworks and the accompanying written discourse on pilot-drone relations. My coining of the term dis/embodied space has served throughout this thesis to communicate underpinning concepts and invariant perceptual features that are present in immersive audiovisual art installation and mirrored in the pilot-drone relationship.

The making of the first artwork *Hybrid Spaces*, and the reading of Don Ihde's concepts of multistability and human-technology relations were completed in parallel. This led me to the idea that I could abstract an invariant feature of HTR and introduce it to an art experience to affect it throughout. Therefore, spatial multistability, an elemental feature of immersive audiovisual art became the first new insight along with drone related dis/embodied spaces. These new insight were imbued within *Hybrid Spaces* as it communicates technological hermeneutics that afford a dis/embodied and multistable spatial perspective of the embodied and disembodied experienced by both the artwork audience and drone pilots. Driven by research objectives one and two, (page 3 of this thesis) this interlacing or imbricating of reading and artmaking, of theory and practice became possible for me as I began to follow the post/phenomenological logic of reducing an experience to a set of invariant features. Through this exploration of multistability through audiovisual art practice I was able to first connect idea with experience and more importantly to find singular invariant features that were common to both a drone pilot's and the audience's multiple perspectives and spatial dis/embodiment. It remained then for me to realise objectives three and four (ibid) through the creative production of each artwork and to communicate the new insights as audience experiences (Sections 4.3, 4.4 and 4.5 of this thesis).

Throughout the production of *Compound Terrains* and *Conjured Spaces* I continued to explore multistability by extracting and then imbuing the artworks with invariant features of drone-pilot relations. These invariant features were teased out through a close study of both the specific technological and cultural ecosystems of drone warfare (sections 3.6 and 3.7 of this thesis) and the more abstract schemas of Ihde's human-technology relations (section 3 of this thesis), Clark's *Telechiric Machines*, Suchman's *Problematic of Separation*, Virilio's *Military Space* and Massumi's *Ontopower* (Sections 2.1, 2.3, 3.1 and 3.6 of this thesis). The second new insight was how invariant features of Multistable spaces emerged during the production of *Compound Terrains*. These were realised in concept and practice by developing the idea that the physical apparatus of both immersive audiovisual art work and drone as *Telechiric Machines* do indeed act as interfaces, boundaries or portals between embodied and disembodied spaces. Suchman's *Problematics of Separation* and Ihde's *here-body, there-body* became the invariant features that would be imbued within *Compound Terrains* and communicated to audiences through the rapid oscillations of sound and light between real and virtual spaces.

Throughout the production of *Conjured Spaces* I returned to the Deleuzian philosophical tradition of virtual/actual (rather than virtual/real) and to the Latin etymological roots of virtual and virtuality that I explored early in my text-based research (Section 2.3 of this thesis). The working in of virtuality from the philosophical tradition as "potentiality" allowed me to philosophically explore the city-wide surveillance system Gorgon Stare, the ingesting massive data sets and how these are processed and actualised into Kill Boxes and targeted strikes. This revealed a third new insight and invariant feature of the pilot -drone relation; that the pilot drone relation is one of a virtual/actual dichotomies. Whilst experimenting with the oscillations between animated wireframe geometry that I used in *Hybrid Spaces* and *Compound Terrains* to represent virtual space, and the figurative depictions of aerial terrain footage in *Conjured Spaces* I began to draw these conceptual threads together and imbue them within the artwork. The wireframe as visual theme and representation of virtuality has been constant through all three artworks. The figurative depiction of aerial terrain footage is unique to *Conjured Spaces* and the transition between the two communicates

the actualisation of virtual data into arial footage that is made available to the drone pilot.

In summary, and in direct response to the research question: the new insights that my immersive audiovisual art practice can create into the multistable, embodied and disembodied spaces that result from the human operation of military drones are a new understanding of the pilot-drone relation as:

1. spatially multistable
2. a portal between embodied and disembodied space
3. a virtual/actual dichotomy

The themes explored and methods described in Section One of this thesis have involved a broad discussion of spatial embodiment and disembodiment, notions of virtuality and physicality, immersive and networked audiovisual technologies, telepresence, virtual communities, MR systems, our relationships with these technologies and our associated hopes and fears for and of them. Throughout, my argument – which is routed in the post-phenomenological thought experiments of Don Ihde – maintains that human relationships with immersive and networked audiovisual technologies produce experiences of space that are inherently multistable. By focusing on the relationship between a drone and its operator as a specific body–technology coupling, I have shown how this human-technology relationship generates particular, contextual and located perceptual variations of space as multiple stabilities of embodiment and disembodiment. Through this understanding of the interpretive and perceptual variations of space experienced by drone pilots, I have also described the non-neutral and transformative effects of the pilot’s complex and profound relationships with the drone’s technological ecosystem. From this, it follows that the ontological ambiguities associated with the drone technologies that humans use to grasp – or literally take hold of – the physical spaces beneath their drones reveal the impossibility of objectivity in spatial perception, or indeed any knowledge.

My proposition throughout this thesis has been that we consider the spaces that are created through the production of my artworks as multistable. As Ihde puts it, “no

technology is ‘one thing,’ nor is it incapable of belonging to multiple contexts” (Ihde 1990: 156). Therefore, perceptions of our bodies in space are as specific as the technologies which mediate them. At the same time, however, we should also understand that no specific technology can simply be appropriated for any purpose, just as technology cannot be meaningful in any way conceivable. The specifics of a drone’s technological ecosystem as a concrete morphology imposes limitations on the uses, and therefore meanings, which are possible. Considered in this way, only some human-technology relations make for stable experiences. That is to say, a human’s experience of the world through technology is open to multiple stabilities.

The challenge of producing a thesis comprised of artworks and text that results in new knowledge, maintains a continuity of ideas across text and artworks and creates media to convey this new knowledge has been met through a systematic approach to practice-based research. As set out in my methodology statement (Section 1.4 of this thesis), the Norms of Creative Production (Scrivener 2002) have been observed throughout the production of this thesis. I have, as evidenced by my written discourse along with both the documentation and direct experience of the three artworks, produced these works as high-quality and original manifestations of my response to a set of issues, concerns and interests which reflect a cultural, social, political and aesthetic preoccupation with the way in which technology can mediate our understanding of space and reality.

As I reach the end of this thesis, I have come to agree with the position that this form of practice as research is legitimised if we accept the claim that art-making and art spectatorship enable a unique and distinctive way of knowing that is not accessible through more traditional modes of exploration (Scrivener 2002; Pakes 2004). The artworks in this thesis have, I believe, produced, and made available the new concept of dis/embodied space. This knowledge has been produced through a studio-based process and disseminated via the direct experience and documentation of the artworks. It has been generated through a synthesis of making, manifestation and reflection on the process which has led to new insights through the artworks’ epistemological primacy: they are the vehicle making that insight available to a wider community. In this explanation of my practice-based research, each artwork has an inherent coherence as

it is underpinned by the logic that emerged through the activities of making and spectatorship. This perspective characterises my practice-based research as a rational process, and as a mode of knowledge with its own distinctive logic.

In Section Two, I provided a general context to this discussion by exploring the cultural milieu of immersive and networked audiovisual technologies. By outlining the history of our relationships with such technologies in the context of popular culture, and the various ways that communities have formed through and around these technologies, I have highlighted a persistent and intimate bond between technology and notions of reality, artifice, simulation and virtuality. Within these notions exists a similarly permanent interpretational tension of how humans relate to technologies. The utopian tradition of interpretation manifests through a set of desires and fantasies which see these technologies as a means to escape the limitations of the human mind and body, by creating machines that give us previously unobtainable, but long-coveted powers. The opposing force in this tension is dystopian in form and is manifested through concerns over what effect technologies might have on us, and fears that humans are destined to reach beyond their powers and endanger their very existence. From Icarus flying too close to the sun (Ovid 2015), to Skynet's Terminator (Cameron 1984), stories of technologies that become our enemy or endanger us are deeply embedded within our culture. Although these persistent tropes evolve over time, they preserve existential themes which resonate with our hopes, fears and desires of technology. If we invent technologies that challenge the gods or exceed our humanity, we tempt fate. Here, our technologies are cast in a dystopian light, and we fear being overcome by our own creations. Conversely, we ceaselessly develop our technologies to overcome our limitations - fuelled by the utopian hope that our technologies will give us what we think we lack.

Utopian/dystopian tensions are indeed clearly present within the artistic and scholarly discourse that surrounds both the multistability of audiovisual artworks and the use of military drones. They share equally persistent notions of reality, artifice, simulation and virtuality. What is clear from this discourse is the invariant nature of the

utopian/dystopian tension and the intimate relationship that these poles have with notions of reality and virtuality, physical and digital, embodied and disembodied.

In Section Three, I have explained that – although this utopian/dystopian dialectic provides an essential contextual and analytical framework, within which I have explored human-technology relations – it does not form the primary focus of this thesis. The focus has been the specifics of how spatial multistability is created through my audiovisual arts practice and how it can function as a means to explore human-technology relations. To provide conceptual context to this relationship, I turned generally to the classic phenomenology of Husserl and Merleau-Ponty and, more specifically, to the post-phenomenology of Don Ihde. Both branches of phenomenology recognise that spatial embodiment is highly complex, perceptually rich and located in the intentionality of motility; moreover, the motile body is a necessary condition for our intelligent grasping of the world. By focusing on the post-phenomenological theories of Ihde and others, I have been able to incorporate the technological dimensions which transform and translate our embodiment into our reach-out through instruments, machines and infrastructures. In the case of the comparable multistabilities explored through my artworks and of the operator-drone discourse; sensing, imaging and simulation instruments have been discussed as devices through which audiences and drone operators embody, disembody and reembody the world. The very intentionality of reaching out across space, the extension of the senses through technology the first phenomenology of how this human-technology relation shapes our understanding of space, embodiment and reality. By using the artworks to explore multistability and the specific example of the operator-drone relation in terms of Ihde's human-technology schema, I have revealed an invariant feature of this phenomenon and called it dis/embodied space. I have then explained how this might be inserted into the discourse around our wider relationships with immersive and networked audiovisual technologies.

In Section Four, I describe the production methods of my art practice and the function of my artworks within this thesis. Although I have not attempted to answer why humans are so fascinated with simulations, I may have provided – by the method and outcomes

of my practical research in particular – an alternative to the utopian or dystopian positions. Technologies allow us to embody space but never totally; an element of our sensory system always remains disembodied in a mediated perception of space which is the very way in which technologies allow us to overcome the limitations of our bodies. By becoming the invariant features of the relation itself, the abstracted and suggestive nature of the artworks in this thesis go beyond any figurative representation of embodied and disembodied pilot-drone interactions, or indeed any other human-technology relation. The artworks – as immersive audiovisual apparatus – mediate perceptions of space by affording an alternating sense of embodiment and disembodiment. The abstraction in each artwork means that both I and the spectators of the works are able to draw away from the cultural subject and question the value of what has been left behind. The abstracted wireframe animation, the single beam of the laser’s light and the corresponding synthesised voices have left the cultural complexity of drone warfare, virtual communities and cyber culture behind. My hope is that the felt experience of these artworks as abstractions leaves behind many of the vagaries and contingencies that may be associated with our relationships with immersive and networked audiovisual technologies. My use of abstraction in creating these works is an attempt to uncover the essence of a thing, and to arrive at this essence by removing what is peculiar to a particular instance of human-technology relation within a particular moment of time, leaving only the essential, universal properties of the phenomena – spatial dis/embodiment via technological interaction.

5.1 Future Work

The research I have undertaken here suggests future avenues of exploration. As a matter of course, my methodological approach to the production of artworks has evolved considerably, not least as a synthesis of the two domains of text and practice-based research, the latter a natural outcome of this process. The most ambitious artwork in this thesis, *Compound Terrains*, exemplifies this clearly through its concern with the abstraction of multistable spatial embodiment, and the deconstruction of the cultural contexts which surround it. In hindsight, both *Hybrid Spaces* and *Illusory Contours* now feel like supporting works, with *Conjured Spaces* as the culmination of ideas and aesthetics, rather than technical and compositional approaches. That is not to say that

I do not consider each a major works, as they stand alone. However, as part of the triptych of submitted works, the scale and site-specificity of the production and presentation of *Compound Terrains* make it stand out as a primary piece.

In subsequent research, I aim to explore further the specifics of HTR. While I have identified many of the elements at play in the notion of embodied and disembodied space as a complex, sensation-involving cognition and culture, a more detailed analysis of these structural relationships could be undertaken by examining the effects of groups or clusters of human experience on my idea of dis/embodied space. Similarly, my proposal of dis/embodied space suggests the need to further elaborate the details of these relationships, particularly within the context of embodied cognition. By extension, my future research will involve the production of practical work that encompasses these areas of inquiry. I am interested in developing further works that incorporate perceptual links between patterns of human experience and technologies that enable telepresence. I would also like to continue to expand the self-reflexive methodology already developed in the production of this thesis about the reception of immersive audiovisual installations as an aesthetic form.

The conceptual and technical approaches developed over the course of this PhD suggest various possibilities for the development of new audiovisual artworks. Beyond the specific focus of pilot/drone/target relations at play in the submitted artworks, there emerges a more general concern with the increasingly entrenched relationship between the real and the virtual in systems attending everyday life. The conceptual scope of future artworks will be broadened to include situations of asymmetrical dis/embodiment that exist in more general forms of commercially-driven data surveillance, working the boundaries and thresholds which mediate between forms of information and the bodies which they inevitably act upon.

In *Conjured Spaces*, one planned area of development is the use of machine learning or 'AI' technologies to develop the database of maps used throughout the work. While images used in the composition of the work were selected with the intention of presenting highly depersonalised, delocalised images of target terrain, these images are

still garnered from real photographs. Using Nvidia's machine learning library, StyleGAN2, a model could be trained using several thousand aerial photographs, producing a latent space of all input terrains. From this model new terrains can be generated, which though appearing to be authentic aerial photographs, would be images of terrestrial spaces which do not exist in real life. This would open avenues for further exposition of the ways in which military drone technologies create potential targets through the very fact of deployability, by its ubiquity becoming a latent space of imagined threat responses through its asymmetrical Ontopower. Similarly, the use of 'AI' technologies in military applications strongly suggests an exploration of computer vision libraries, these being the basis for automated target acquisition and identification systems. Emotion detection, threat evaluation, activity recognition and face recognition technologies all contain possibilities for examining the growing infrastructure of machine learning applications in civilian and military contexts.

Another avenue of development is the interactive juxtaposition of 3D models with tangible, material counterparts. The three-dimensional animation in the submitted works has been intentionally spare to describe the highly abstracted, depersonalised relationships at play in situations specific to drone/pilot/target relations. In different contexts, more elaborate simulated three-dimensional worlds could be integrated with kinetic elements, rendering more intricate relationships possible. This could take the form of three-dimensional models which morph according to the changing shape and orientation of their 'embodied' form, or more complex three-dimensional immersivity connected to spatialised audio that is structured according to changing real-time data affecting both domains.

The technical and conceptual frameworks employed in the submitted works afford more general possibilities to produce audiovisual art. While the use of laser light in artworks is well documented, the interaction between onscreen animation, spatial sound and kinetic laser fixtures is an unexplored technique, and both *Hybrid Spaces* and *Compound Terrains* exemplify this novel relationship. In both works, the treatment of the screen as a permeable threshold, while again a potent theme in media art, lends new forms of possibility. In *Conjured Spaces*, undeveloped forms of audiovisual synthesis

were developed that expand the nascent explorations of using pixel data to simultaneously drive timbral articulation and visual image, allowing the intuitive synaesthetic creation of audiovisual textures.

INDEXED ARTWORKS

The three artworks that represent the practical outcome of this thesis are stored on the accompanying USB drive. For the purposes of this submission, each artwork is presented in the following forms:

Hybrid Spaces:

1. The work authored in the Max/MSP and Arduino programming environments.
2. Video documentation of the work physically installed and as intended to be experienced by an audience.
3. A Reaper DAW session containing a third-order ambisonic master recording and screen recording of the single-channel video projection.

Compound Terrains:

1. The work authored in the Max/MSP and Arduino programming environments.
2. Video documentation of the work physically installed and as intended to be experienced by an audience.
3. A Reaper DAW session containing a third-order ambisonic master recording and screen recording of the single-channel video projection.

Conjured Spaces:

1. The work authored in the Touch Designer programming environment.
2. The finished audiovisual piece
3. A Reaper DAW session containing a third-order ambisonic master recording and finished video piece.

Illusory Contours (appendix):

1. The work authored in the Max/MSP and Arduino programming environments.
2. Video documentation of the work in a studio setting.
3. A Reaper DAW session containing a third-order ambisonic master recording and screen recording of the single-channel video projection.

The Reaper sessions can be used to experience the synced audio and video. The audio can be decoded from the third-order master to an arbitrary speaker array. The decoder is currently set to stereo binaural.

REFERENCES

- Aceti, L. (2013). Not Here, Not There: An Analysis of an International Collaboration to Survey Augmented Reality Art. *Leonardo Electronic Almanac*, 19(1).
- Achterhuis, H. (Ed.). (2001). *American philosophy of technology: The empirical turn*. Indiana University Press.
- Allinson, J. (2015). The necropolitics of drones. *International Political Sociology*, 9(2), pp.113–127.
- Andersen, C. (2014). Games of Drones: The Uneasy Future of the Soldier-Hero in Call of Duty: Black Ops II. *Surveillance & Society*, 12(3), p.360.
- Antin, D. (1986) Video: The distinctive features of the medium. *Video art* 57.
- Baudrillard, J. (1994). *Simulacra and simulation*. University of Michigan press.
- Benford, S. and Giannachi, G., 2011. *Performing mixed reality*. Mit Press.
- Benjamin, W. (2008). The work of art in the age of mechanical reproduction. Penguin UK.
- Bernstein, J. M. (1992). *The Fate of Art: Aesthetic Alienation from Kant to Derrida and Adorno*. Pennsylvania State University Press.
- Biggs, M. (ed.) (2000). *Editorial Working Papers in Art and Design*, 1.
- Brown, H. (1990). Perspective Realism, in *Studies in the History and Philosophy of Science*.

Buchanan, R., Doordan, D., Justice, L. and Margolin, V. (eds.) (1999). *Doctoral Education in Design*. Carnegie Mellon University Press.

Candy, L. (2006) *Practice Based Research: A Guide*. University of Technology, Sydney

Candy, L., 2019. The creative reflective practitioner: Research through making and practice. Routledge.

Castells, M. (2007). Communication, power and counter-power in the network society. *International Journal of Communication*, 1(1), 29.

Chamayou, G. (2015). *Drone theory*. Penguin UK.

Chandler, D. (2014). Think the NSA Is Bad? Games Are Masters of Surveillance. Available online at <http://killscreendaily.com/articles/think-nsa-bad-how-games-have-their-eyes-you/> [Accessed 21 July 2014]

Clark, J. (1964). Remote Control in Hostile Environments (pp.300–312) *New Scientist*

Crimp, D. (1980). The photographic activity of postmodernism. *October*, 91–101.

Daniels, D. & Naumann, S. (eds.) (2011). *See this Sound: Audiovisuology Essays 2: Histories and Theories of Audiovisual Media and Art*. Walter König.

Davies, C. (2002). *Osmose: notes on being in immersive virtual space* (pp. 101-110). Lisse, The Netherlands: Swets & Zeitlinger.

Davies, C. (2003). Landscape, earth, body, being, space and time in the immersive virtual environments osmose and ephémère. *Women, Art, and Technology*, 322-337.

Davies, C. & Harrison, J. (1996). Osmose: towards broadening the aesthetics of virtual reality. *ACM SIGGRAPH Computer Graphics*, 30(4), 25–28.

De Souza e Silva, A. (2006). From Cyber to Hybrid Mobile Technologies as Interfaces of Hybrid Spaces. *Space and Culture*, 9(3), 261–278.

Durling, D. and Friedman, K. (eds.) (2000). *Doctoral Education in Design: Foundations for the Future*. Staffordshire University Press.

Dyson, F. (2009). *Sounding new media: Immersion and embodiment in the arts and culture*. University of California Press.

Edney-Browne, A., 2019. The Psychosocial Effects of Drone Violence: Social Isolation, Self-Objectification, and Depoliticization. *Political Psychology*.

Panofsky, E., 2020. *Perspective as symbolic form*. Princeton University Press.

Foster, H. (ed.) (1983). *The anti-aesthetic: Essays on postmodern culture* (p. ix). Port Townsend WA: Bay Press.

Geroimenko, V. (ed.) (2014). *Augmented Reality Art*. Springer.

Gertz, N. (2014). Drone Operators, Cyber Warriors, and Prosthetic Gods. In *The Philosophy of War and Exile* (pp. 92–117). Palgrave Macmillan, London.

Gibson, W. (2010). Google's Earth. *The New York Times*.

Godzinski, R. (2005) (En) Framing Heidegger's Philosophy of Technology. *Essays in Philosophy* 6.1: 9.

Grau, O. (2004). *Virtual Art: from illusion to immersion*. MIT Press.

Grayson, K. and Mawdsley, J., 2019. Scopic regimes and the visual turn in International Relations: Seeing world politics through the drone. *European Journal of International Relations*, 25(2), pp.431-457.

Gregory, D. (2011). From a view to a kill: Drones and late modern war. *Theory, culture & society*, 28(7-8), pp.188–215.

Grimshaw, M. (ed.) (2013). *The Oxford handbook of virtuality*. Oxford University Press.

Grosz, E. & Eisenman, P. (2001). *Architecture from the outside: Essays on virtual and real space*. MIT Press.

Guignon, C. B. (ed.) (1993). *The Cambridge Companion to Heidegger*. Cambridge University Press.

Gusterson, H. (2016). *Drone: remote control warfare*. MIT Press.

Hacking, I. (1983). *Representing and intervening: Introductory topics in the philosophy of natural science* (Vol. 5, No. 1). Cambridge: Cambridge University Press.

Hamilton, E.T. 2016. *Death From Above: Art Contemplates Drone Warfare* (Doctoral dissertation, University of Southern California).

Heidegger, M. (1962). *Being and Time*. Trans. J. Macquarrie & E. Robinson. Blackwell Publishing Ltd.

Heidegger, M. (1977). *The question concerning technology and other essays*. 1955. Trans. W. Lovitt. Harper Row.

Heim, M. (1993). *The metaphysics of virtual reality*. Oxford University Press.

Heim, M. R. (2014). *The paradox of virtuality* (pp. 111–125). Oxford University Press.

Husserl, E. (2012). *Ideas: General introduction to pure phenomenology*. Routledge.

Ihde, D. (1986). *Experimental phenomenology: An introduction*. SUNY Press.

Ihde, D. (1990). *Technology and the lifeworld: From garden to earth* (No. 560). Indiana University Press.

Ihde, D. (2002). *Bodies in technology* (Vol. 5). University of Minnesota Press.

Ihde, D. (2009). *Post-phenomenology and technoscience: The Peking university lectures*. SUNY Press.

Kant, I. (2007). *Critique of Judgement*. Oxford University Press.

Korvenmaa, P. (ed.) (1999) *Useful and Critical: the Position of Research in Design*. University of Art and Design Helsinki.

Krauss, R. (1998). Sculpture in the Expanded Field, in J. Kastner & B. Wallis (eds.), *Land and environmental art*, pp.233–234. London: Phaidon Press Limited.

Lanier, J. (2001). Virtually there. *Scientific American* 284.4: 66–75.

Lunenfeld, P. (ed.) (2000). *The digital dialectic: New essays on new media*. MIT Press.

McCarthy, K. F. & Ondaatje, E. H. (2002). *From celluloid to cyberspace: The media arts and the changing arts world*. Rand Corporation.

Manovich, L. (2001). *The language of new media*. MIT Press.

Merleau-Ponty, M. (1968). *The visible and the invisible: followed by working notes*. Northwestern University Press.

Merleau-Ponty, M. (1996). *Phenomenology of perception*. Motilal Banarsidass Publishers.

Milgram, P. & Kishino, F. (1994). A taxonomy of mixed reality visual displays. *IEICE TRANSACTIONS on Information and Systems*, 77(12), 1321–1329.

Miller, J. (2014). The fourth screen: Mediatization and the smartphone. *Mobile Media & Communication*, 2(2), 209–226.

Moran, D. (2005). *Edmund Husserl: founder of phenomenology*. Polity.

Nakashima, E. & Whitlock, C. (2011). With Air Force's Gorgon Drone 'we can see everything'. *Washington Post*, 2.

Natanson, M. (1974). *Edmund Husserl: Philosopher of infinite tasks*. Northwestern University Press.

Nelson, R. (2013). *Practice as research in the arts: Principles, protocols, pedagogies, resistances*. Springer.

Nāsō, P O. (2015) *The Fall of Icarus*. Penguin Classics.

Parks, L. & Kaplan, C. (2017). *Life in the Age of Drone Warfare*.

Pizzocaro, S., Arrunda, A. & De Moreas, D. (eds.). (2000) *Design Plus Research: Proceedings of the Politecnico di Milano Conference*. May 18–20, Milan.

Power, M., 2013. Confessions of a drone warrior. *GQ*, October.

Renan, S. (1967). *An introduction to the American underground film* (Vol. 207). New York: Dutton.

Richardson, I. (2012). *Touching the screen: A phenomenology of mobile gaming and the iPhone*. Routledge.

Ross, A. (2007). *The aesthetic paths of philosophy: presentation in Kant, Heidegger, Lacoue-Labarthe, and Nancy*. Stanford University Press.

Scrivener, S. (2002). Characterising creative-production doctoral projects in art and design. *International Journal of Design Sciences and Technology*, 10(2), 25–44.

Scrivener, S. (2002). The art object does not embody a form of knowledge. *Working papers in art and design*, 2.

Scrivener, S. & Chapman, P. (2004). The practical implications of applying a theory of practice based research: a case study. *Working papers in art and design*, 3, 3.

Selinger, E. (2012). *Post-phenomenology: A critical companion to Ihde*. SUNY Press.

Sharits, P. (1978). Hearing: Seeing. *Film Culture*, 6566, 70.

Strawser, B. (2010). Moral predators: The duty to employ uninhabited aerial vehicles. *Journal of Military Ethics* 9.4: 342–68.

Strawser, B., Hajjar, L., Levine, S., Naqvi, F. & Witt, J. (2014). *Opposing perspectives on the drone debate*. Springer.

Suchman, L. (2015). Situational awareness: Deadly bioconvergence at the boundaries of bodies and machines. *MediaTropes Test Journal*, 5(1), pp.1–24.

Tuchman, M. (1971). *Art & technology: a report on the Art & Technology Program of the Los Angeles County Museum of Art, 1967–1971*. Los Angeles County Museum of Art; dist. Viking Press New York.

Vasulka, W. & Weibel, P. (eds.) (2008). *Buffalo heads: media study, media practice, media pioneers, 1973–1990*. MIT Press.

von Uchtrup, M. (1999). Conjuring New Muses. *Art Papers*, 23.

Waite, S., 2018. Networks of Liveness in Singer-Songwriting: A practice-based enquiry into developing audio-visual interactive systems and creative strategies for composition and performance.

Wall, T. & Torin M. (2011). Surveillance and violence from afar: The politics of drones and liminal security-scapes. *Theoretical Criminology* 15.3: 239–254.

Whitson, J. & Simon, B. (2014). Game Studies meets Surveillance Studies at the Edge of Digital Culture: An Introduction to a special issue on Surveillance, Games and Play. *Surveillance & Society*, 12(3), 309–319.

Wilcox, L. (2017). Embodying algorithmic war: Gender, race, and the posthuman in drone warfare. *Security Dialogue*, 48(1), 11–28.

Zaner, R. M. (1977). Interdisciplinary phenomenology.

Ziarek, K. (1997). After Aesthetics. *Philosophy Today*, 41(1), 199–208.

Zics, B. (2009). *Buffalo Heads: Media Study, Media Practice, Media Pioneers, 1973–1990* edited by Woody Vasulka and Peter Weibel. MIT Press, Cambridge, MA, USA, 2008. *Leonardo*, 42(5), 463–465.

Zimmerman, T., Lanier, J., Blanchard, C., Bryson, S. & Harvill, Y. (1987). A hand gesture interface device. *ACM SIGCHI Bulletin*, 18(4) 189–192.

Zimmerman, T. G. & Lanier, J. (1991). U.S. Patent No. 4,988,981. Washington, DC: US Patent and Trademark Office.

WEB REFERENCES

Since the date of access many of the websites listed below have ceased to host the articles and information used in this thesis. These are noted after each reference.

Brekwell (2016). <https://www.vice.com/en/article/wd4bnm/drone-video-games-documentary-203> [Accessed June 2016 - page no longer available]

Harris (2008). <http://www.govtech.com/dc/articles/420596> [Accessed January 2019 - page no longer available].

Mother Jones <http://www.motherjones.com/politics/2013/06/drone-pilots-reaper-photo-essay> [Retrieved June 2016 - page no longer available].

Rheingold, H. (2000). The Virtual Community.
http://www.caracci.net/dispense_enna/The%20Virtual%20Community%20oby%20Howard%20Rheingold_%20Table%20of%20Contents.pdf [Accessed January 2019].

Orland (2012). <http://arstechnica.com/gaming/2012/02/unmanned-presents-a-nuanced-psychological-perspective-on-modern-warfare/> [Accessed June 2016 – page no longer available].

Radu (2018). <https://www.usnews.com/news/best-countries/articles/2018-03-20/the-us-military-wants-to-lead-the-innovation-game-in-vr> Accessed January 2019].

Shah, G. (2020) <https://earthview.withgoogle.com/>

Unnamed recruitment officer, promotional video
<https://www.youtube.com/watch?v=mWxFc> [accessed July 2017 - page no longer available]

http://wiki.secondlife.com/wiki/Military_Lands [accessed January 2019- page no longer available]

<https://militarymetaverse.org/> [accessed January 2019 - page no longer available]

<http://www.govtech.com/dc/articles/420596> [accessed January 2019 - page no longer available]

APPENDIX

During the resubmission process of this thesis *Illusory Contours* has become a bridging work that has led to the creation of a new major audiovisual work *Conjured Spaces*. *Illusory Contours* was created using the same laser and servo control unit as *Compound Terrains* and the same compositional framework of OpenGL graphics and third order ambisonics inside the Max/MSP and Jitter programming environments. *Hybrid Spaces* successfully foregrounds multistability through the mapping of sound to morphing two and three dimensional geometries. *Compound Terrains* effectively focuses on a felt experience by inducing a sense of dis/embodied space in the spectatorship of the artwork. *Illusory Contours* introduces a further variation of spatial perception by taking a vertical perspective of the animated graphical subject displayed on the screen. This is an attempt to create a sense that the vantage point of the audience has shifted away from that of a grounded human and towards to God's eye view that is experienced by drone operators as they visually interpret the battle spaces that are beamed to their cockpits via satellite link.

The audiovisual composition of *Illusory Contours* is centred around a rectangular grid shape, the length of which has two lines that form the longest two external edges of the shape and the width has six lines, two of which form the outer external edges with the remaining four forming equally spaced internally dividing edges. The strategy for the synthesis of a close audiovisual relationship in relation to the laser, video and audio projection was the same in this artwork as it was in the previous two: the point source of a sound is mapped to the location of both screen-based graphics and laser projection. In this case each line in the grid shape is considered to have two points - one at each. A sound source is mapped to the same position of each point and moves through ambisonic space in direct relation to the movements of each point of each line. The grid shape (Fig 26) is composed of eight lines each with two points, therefore the on-screen graphics are accompanied by a sixteen voice synthesiser with each voice mapped to the cartesian coordinates of each separate line point. There are twenty four laser mounted to the rear of the exhibition space in much the same way as *Hybrid Spaces*. They are focused down the length of the space and are trained at fixed points on the screen that

connect with the twelve intersecting vertices of the grid shape as it rests positions 0. and -6. along its Z axis.

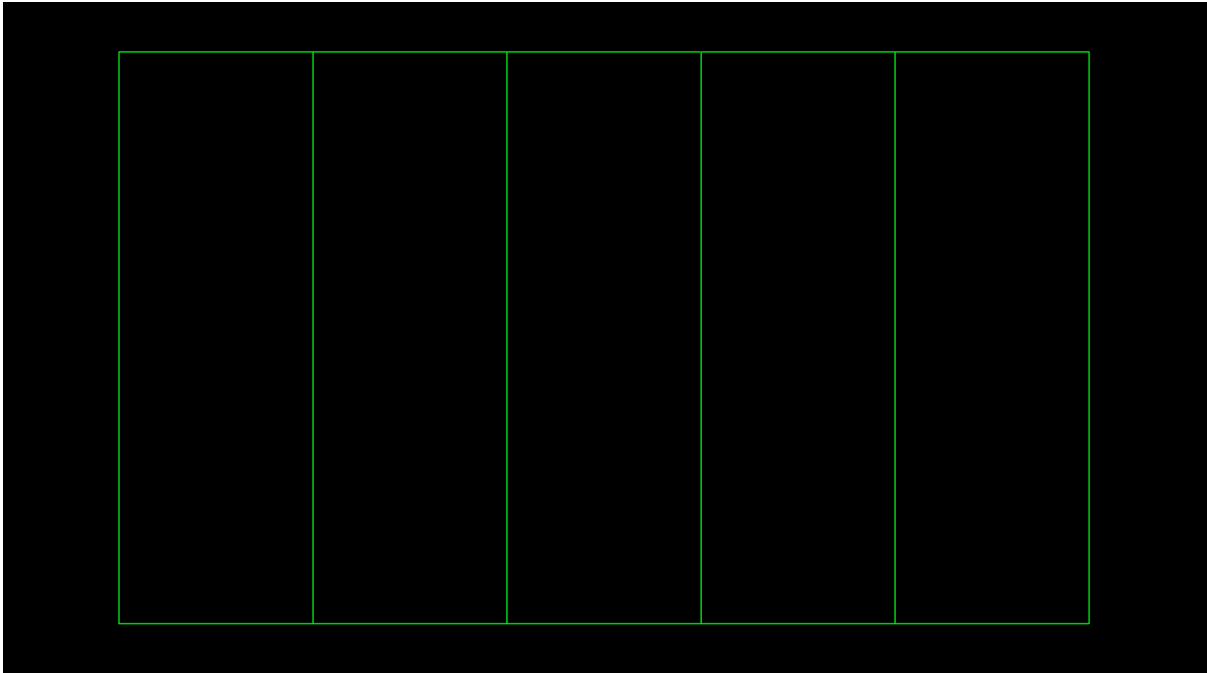


Figure 29 Sixteen-point grid shape in position 0. along Z axis.

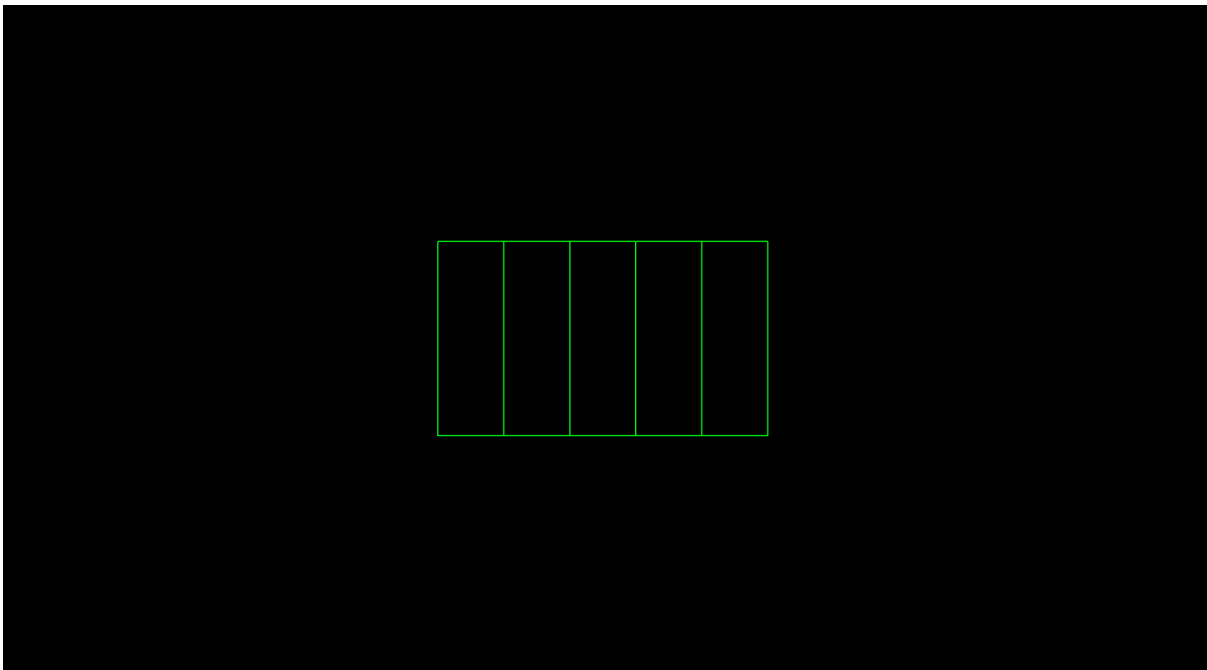


Figure 30 Sixteen-point grid shape in position -6. along Z axis.

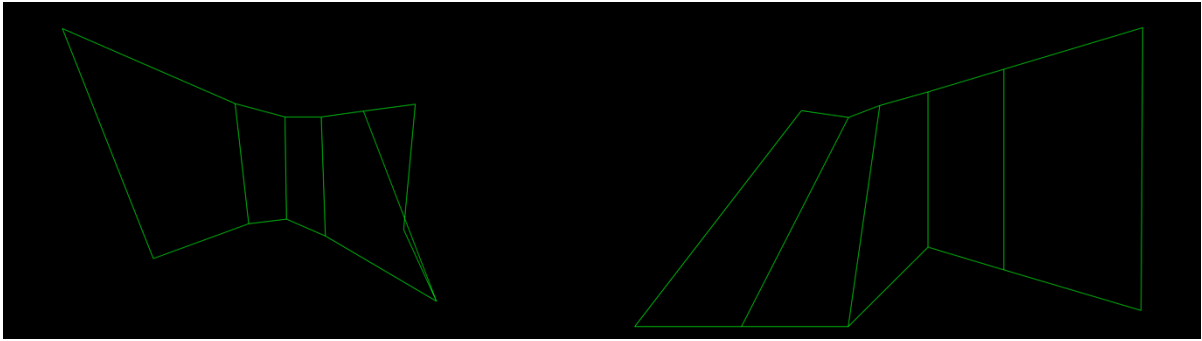


Figure 31 Sixteen-point grid shape in various positions between 0. and -6. along Z axis.

The viewing mode of all four artworks use a perspective projection called one point perspective, which is the most common way of visually representing space from the three-dimensional world we inhabit. This implication that the Z axis is rotated lies at the centre of aesthetic development from *Illusory Contours* to *Conjured Spaces* (see section 4.5 of this thesis).