Soft(ware) Sculpture:

Spatial and Temporal Interventions in Audio-Visual Media.

By

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Declaration

I hereby declare that I am the legitimate author of this thesis and that it is my original work.

No portion of this work has been submitted in support of an application for another degree or qualification of this or any other university or institution of learning.

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Abstract

'Soft(ware) Sculpture' is a re-articulation of the notion of sculpture developed in this thesis to reflect sculpture's new relationship with software and the consequent emergence of new forms of sculptural practice and sculptural artefacts, which through digital technology are able to sense their environment and become reactive to it. 'Soft(ware) Sculpture' is therefore composed of a multitude of fluid relationships in constant motion across time, dimensions and realities. The notion of 'Soft(ware) Sculpture' was developed by the author from a re-articulation of expanded arts practices that emerged in the 1960s and 1970s. Contextualised through research that was conducted in sculptural and media arts histories across multiple artistic disciplines, these practices were re-evaluated and extended upon through the application of current digital technologies overlaid on the author's existing sculptural practice, thus connecting material, time and space in order to explore possibilities previously beyond the remit of sculpture. Conceptual, historical and technological precedents were identified and utilised as foundations for the development of the frameworks that lead the software sculpture fusion. This study re-examines the relationships and the roles of sculpture with and within a constantly changing, technologically oriented society through the emergence of software as a mono-medium, more precisely, as a medium that has grown to encompass most of the technology that preceded it. The practical body of work that accompanies this thesis advocates the fusion of the conventional sculptural 'object' and the digital medium to create both a 'sculptural ecology' and a 'sculptural situation', read within this study as macro and micro-states of a new breed of sculptural artefacts that are fluid in both appearance and behaviour and that in themselves are also capable of creating artistic artefacts.

Dedication

This thesis is dedicated to Jack

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1. Introduction

> The computer's most profound aesthetic implication is that we are being forced to dismiss the classical view of art and reality which insists that man stand outside of reality in order to observe it, and, in art, requires the presence of the picture frame and the sculpture pedestal. The notion that art can be separated from its everyday environment is a cultural fixation [in other words, a mythic structure] as is the ideal of objectivity in science. It may be that the computer will negate the need for such an illusion by fusing both observer and observed, "inside" and "outside." It has already been observed that the everyday world is rapidly assuming identity with the condition of art. (Burnham, 1969b, p. 103)

Software and sculpture have an interesting relationship. As shall be discussed in this thesis, software and sculpture behave in the same manner, essentially (re)shaping or (re)arranging information, be it in the form of physical matter, sound or data, and organising it in a way that is meaningful. Both software and sculpture are processes of remediation, and whilst they more often work on different levels, at times in separate dimensions also, this research focuses on how the two work together.

Soft(ware) Sculpture is not an artistic genre or a movement. Through technology, humankind now also resides in virtual and augmented spatial and temporal dimensions and Soft(ware) Sculpture can be understood as a natural expansion of sculptural practice into these dimensions. More importantly, Soft(ware) Sculpture is not being proposed as an alternative to, nor a replacement of the more traditional formats of sculpture. Both shall continue to exist in parallel for at least as long as these fall within the parameters of what

society understands by sculpture. Eventually Soft(ware) Sculpture might become a defining parameter of sculpture, extending sculpture's forms into other evolutions and iterations in the future.

Sculpture as an act, an act of shaping and manipulating the environment is not so much about objects or things but rather the act of making these things. Through shaping matter sculpture shapes the way that we relate to it. Sculpture is first and foremost an intervention in society, it is an act of adding and removing relationships between objects, humans and their environment. Software behaves in the same manner, it shapes information in a manner that we can relate to, it organises data by collecting it in libraries then connects these libraries to other libraries, and then to images, text, numbers, coordinates, which are then processed and remediated through software in a manner that we as humans can understand.

1.1 Aims and Motivations

This research looks into the combination of software and sculpture into what shall be referred to as a 'sculptural ecology', a collection of 'sculptural situations' that are less concerned about the 'final' outcome, than the creation of the outcome itself. As a series of interconnected relationships, the outcomes of a sculptural situation are multiple and simultaneous across many levels. As humans we become part of the situation itself, receiving and transmitting information, whilst filtering it through our own bodies and minds. The structural framework that the act of sculpture provides together with the capability that software has of translating data between a multitude of modalities and formats allows for the sculptural situation's capabilities to exceed beyond the conventional ideas and roles of

sculpture. A sculptural situation allows us to distort, or rather manipulate the very fabric of reality. Every element, every component that makes up the sculptural situation, emerges from the situation transformed. A sculptural situation creates new information, new knowledge, new ideas, new ways of understanding and new ways of seeing, listening and feeling.

The way that this research is structured attempts to address a number of questions with regards to the roles, the nature and the future directions of sculpture in the twenty-first century. Whilst sculpture has a long historical tradition, dating back several thousands of years, its relationship with technology, within a technologically oriented society, has significantly altered the way that sculpture behaves, the way that it looks and the way we relate to it. This thesis starts by looking at the idea of sculpture and how this has changed since Modernism. Focusing on concepts developed from the 1960s onwards, where an interest in technology, the conception of interconnected cybernetic systems and the idea of the expanded arts together with postulation about the dematerialisation of the art object and the nature of media, have had a significant impact upon the visual arts. This research shall trace the relationships between sculpture and the notion of software and how this has evolved, and indeed is continuously evolving, through an acceleration in the rate of new digital technology that we make use of today.

It is important at this point to clarify that this thesis and the practice that has been developed together with it, is, due to the nature of technology, potentially always in an open-ended state and as such can be considered a perpetual work in progress. Although the concepts developed in this thesis have taken future technological advances into consideration, the practical body of work remains limited by the currently available technology. As the relationship between theory and practice has been instrumental in the thesis and the rate at which technology advances makes it challenging to keep up with, this thesis should be

considered a snapshot of the potential marriage of software and sculpture in the light of current technological possibilities. As a result of this, the thesis is subject to future revisions and expansions in order to accommodate for any shifts brought about by future emergent technologies and to be able to retain its significance within a contemporary artistic paradigm.

Jack Burnham in the introduction to the 1970 exhibition entitled *Software* recognises the challenges and changes that a cultural shift brought about through advancements in technology brings with it and the unique opportunities that this presents in the process of art-making.

> Software is not technological art; rather it points to the information technologies as a pervasive environment badly in need of the sensitivity traditionally associated with art. Since people will continue to make poems and paintings without computers, Software focuses on modes of creativity and creative assistance which are more or less unique to the electronic age…it becomes apparent that machines can only handle the ideas given to them by human beings. What machines do is to telescope and edit experiences in a way that printed materials cannot. (Burnham, 1970, p. 14)

Within this thesis, the first step has been to reconsider the very nature of the sculptural artwork and the position that sculpture has in relation to itself, to the socio-cultural framework it operates in and in relation to new digital media that in this research have been approached as sculptural matter, or rather material to make sculpture with, or explore through the act of sculpture.

Audio-visual media and the manner that these operate within a visual arts context shall be explored throughout this research. More specifically, through this thesis, sound shall be explored in the manner that it relates both to software and to sculpture. Sound introduces

elements of time, the notion of performance, of something happening across time and the concept of improvisation. This introduces within sculpture elements that were previously outside of its concerns, or rather outside of its domains.

1.2 A Sculptural Approach

This thesis is approached primarily from a sculptural standpoint. As a sculptor my understanding of the environment and the socio-cultural structures that I operate with and within are, in no small part, dependent on an inherent affinity with materials and their nature: their tactile, spatial, textural and aesthetic characteristics. To these, one may also include the processes for handling and manipulating materials. As shall be discussed further on (section 7.4), I come to sculpture primarily from steel-working. I am drawn to the efficiency with which steel allows one to arrive to form as well as its resonant, sonic qualities. Other facets of my sculptural practice, imparted by working on a small island with limited natural resources inevitably filter down and colour my understanding in a very particular manner. These elements cross over into the digital realm and are in themselves reinforced through it. I collect discarded metal objects which I later rebuild and rearrange into larger more complicated structures. Applying this approach to software allows for a very physical understanding of signal chains and flows of information. Whilst I am not fluent in code, this process developed from an understanding of physical materials and media allows me to assemble and construct within a digital space, in the very same manner that I construct within a physical space through adding and removing information. This creates the opportunity for a rapture of demarcation lines between the digital and the physical within my practice, as essentially the motions and logic behind my process remain unchanged.

As a practitioner within the field of sculpture, I have exhibited consistently for the past decade both locally as well as internationally. My practice has always been carried out in tandem with my studies, from my undergraduate years in Fine Arts, later moving onto an MFA in Digital Arts, where my focus has always been primarily sculpture. As a result of this my research and practice have been developing together and I have always considered these a natural extension of each other. Throughout this thesis, my practice has been instrumental in developing an understanding of sculpture that goes beyond the studio-galley scenario that artists traditionally operate within, by borrowing element and notions from other artistic disciplines, as well as spaces and dimensions that go beyond the materiality and physicality that sculptors are accustomed to working within. This has allowed me to explore the nature, roles, and meaning of sculpture and hypothesise of its future direction(s).

1.3 Overview of the Study

Through an integration with software the practice of sculpture extends beyond its traditional borders and as explored and demonstrated through the practical body of work developed in parallel with this thesis, new modalities of art-making can be developed. Through empirical research, a number of experimental artworks have been created that challenge the conventional formats of both sculpture as well as other modalities of art-making.

Shanken (2015) remarks on the phenomenon of interconnected relationships within the artwork becoming so ingrained within an artistic practice that they became almost invisible. However, it is not the nature of art that has changed, but rather the nature of society, the manner in which society relates to art. Ascott (1983) remarked how the vision of our time is ultimately cybernetic. This notion is echoed in the writings of Capra (1988) who adopted

Kuhn's (1962) vision of a scientific paradigm as a constellation into what Capra (1988) calls a 'social paradigm' that through mankind's relationship with technology has shifted in to what Capra (1988) defines as: "a constellation of concepts, values, perceptions and practices shared by a community, which form a particular vision of reality that is the basis of the way the community organises itself" (Capra, 1988, p. 22). Throughout this research, an emphasis is placed on the role of both human and non-human agency as part of the artwork itself. Beyond the idea of a participating audience, within this research, the human element, both from the artist's and from the audience's end is seen and considered as part of the artwork itself (section 2.2). Concepts and ideologies deriving from cybernetics and systems theory have essentially refocused society into adopting the practice of viewing things in a holistic manner, rather than by viewing things separately. Capra (1988) describes this as an 'ecological worldview' which recognises the interdependence between humankind, their environment and other non-human elements which are engaged in a cyclical relationship that creates society's own vision of reality and through which we extract knowledge and meaning (Capra, 1988, p. 23). In sculpture this causes and indeed to a certain degree has already caused a paradigm shift; from understanding artworks as parts, into understanding them as a whole; from the idea of an art object to that of an artistic situation that is based on more than just the artefact as it sits on a pedestal, and of its formal values. The way that knowledge is created and accessed has also significantly changed from the linearity of a process of building, block upon block, to one that considers the connectivity of a network, a web of sources and resources through which knowledge aided by the hypermediated nature of the internet is accessed and more importantly created. Knowledge is now understood as a dynamic set of relationships between one idea and another which in turn destabilises the notion of compartmentalised disciplines within the art world and promotes one of inter, multi

and trans-disciplinary practices. This is echoed within my practice where sculpture crosses over and overlaps with multiple disciplines that come both from the arts as well as from other areas of research. The way that knowledge is created and how this in turn impacts the process of art-making shall be discussed further on in this research (Chapter 7).

Capra (1988) makes an interesting remark that can be applied to the concept of a sculptural situation and is ultimately what makes it fall within the socio-cultural expectation of sculpture and aligns it with its historical predecessors (section 7.26). When discussing a systems approach to society Capra refers to the idea of an 'object' which he views as created through a specific pattern of relationships as identified by the human observer, which is dependent on the process of knowledge. Sculpture is the manner in which such patterns are generated and focused, where the intervention happens on a socio-cultural level. In this research concepts such as that of the 'writer' and the 'reader', Grau's (2016) notion of 'aggregate images' and the idea that no image can be read without previous knowledge of reading images, shall be explored as these are fundamental to understanding the role that sculpture plays in society and the manner in which it functions within it (section 7.3).

Von Foerster (1979) argues that things are never really discovered but rather invented. It is the way we position ourselves within our environment and how we relate to everything around us that creates reality as we know and understand it as well as the nature of objects. Gravity, for instance, has always existed, we have been subject to its laws way before it's 'discovery'. Von Foester (1979) argues that essentially mankind, or rather Newton to be more specific, invented it by giving it a name. The pattern has been identified, and from then on we relate to it and understand it in a different manner. The way that gravity behaves however, remains unchanged irrespective of its name. Maturana and Varela (1984) refer to this as 'distinction'. We as humans are the fabricators of our own reality, which we extract from the

information generated through the dynamics of how things relate to each other and to ourselves. Bateson (1972) goes further by stating that in order to understand the dynamics of what is going on inside of ourselves as human beings, we need to have the same degree of diversity within ourselves, putting the human being as his own metaphor.

The conceptual framework of a sculptural situation, of an interlaced network of connections, as shall be discussed in Chapter 2, shifts the location of the artwork from a physical space to a space which flows (Larsen, 2014). The idea of a space that is constantly shifting, within physical and virtual dimensions is held together by the structure imparted by networks. Networks are what connect systems to other systems between the macro and micro levels, what enables the transfer of information and the creation of knowledge within the networks. In Chapter 6 the theoretical implications of a fluid space shall be examined in the light of how it connects to sculpture, to technology and to sound and shall be utilised to create and sustain these sculptural situations. The relationship between space and time shall also be examined in the light of linear and sequential narrative structures that are prevalent in most modalities of audio-visual media, which however break down within a sculptural context which can be described as non-linear and non-sequential.

A sculptural situation has bearing to and references the space or rather the place in which the situation occurs. In this research a dialectic between the idea of a 'literal site' and that of a 'functional site' as proposed by Mayer (1995) shall be reflected upon within the context of the body of work developed with this thesis and how the specifics of a space, or rather, the place relate, or not, to the sculptural situation. For the most part, no works have been developed for a specific place, what Irwin (1985) refers to as 'site-specific' however most sculptural situations developed for this research have relationships with the place in a manner that Irwin (1985) would define as 'site-adjusted' or 'site-conditioned'. Alternately,

some of the artworks developed have no real physical presence and only exist in virtual space, while others have existed physically but have always been exhibited in the form of documentation (section 7.8).

In the final part of this thesis my practice as a sculptor, how this has developed and its relationship to the concept of a sculptural situation within a contemporary visual arts framework shall be reflected upon in order to speculate about the future direction of sculpture, both from a personal standpoint as a practitioner, as well as from a broader context where the possibilities of future roles, responsibilities and evolutions of sculpture shall be discussed (Chapter 8). Sculpture and its relationship to technology has evolved considerably and shall continue to evolve in line with the creation, proliferation and use of emerging technologies and their influence on new cultural trends. Future technology and the manner in which this has the potential to alter the very nature and the essence of humanity shall inevitably alter the way that sculpture is perceived by us. Software and sculpture look at the idea of transformation, achieved through a (re)organisation of information, however, one may argue that the transformation is not simply an aesthetic or material one, nor is this solely expressed in terms of technology but rather in the manner that society looks at itself and the reality that it constructs, around itself. The same reality that software and sculpture inhabit, and through the manner in which these shape information, have the capability to change.

2. Sculpture

2.1 Reconsidering The Artefact

Through its presence in both space and time, the audio-visual media lend themselves well to the idea of a polymedia and multimodal sculptural intervention detached from the rigid definitions of specific process, media and materials. The concept of software as a universal engine (Manovich, 2001) and a metamedium (Manovich, 2013) that can act as a universal denominator and bridge various components in multiple formats together, however, is not enough, by itself in order to make an intervention necessarily artistic, nor easily identifiable as such. Spatial and temporal intervention in audio-visual media through the process of sculpture which is extended and augmented through digital means creates a different kind of artefact than what the visual arts and its audience are traditionally accustomed to. Such an approach requires a reconsideration of the artefact, the artist's role and intention and their relationship with the audience. This study proposes the artefact as a relational system rather than a traditional static object, irrespective if materialised or dematerialised. The artefact produced through sculptural intervention in audio-visual media is a series of relationships between the various parts that create the artefact system.

The forms of audio-visual media that this research addresses goes beyond the traditional or conventional notion of the media. What is meant by audio-visual sculpture, in the context of this research, is primarily concerned with aural and visual material and how these can be manipulated in time and in space. The term audio-visual media does not imply that a specific modality such as for instance video shall be investigated exclusively. The conventional notion of audio-visual material such as video, cinema, computer-based

animation and computer/web interfaces shall be looked at extensively, however it is not excluded that new modes, and/or blends between the auditory and the visual components shall be created and explored. More specifically the grey areas between the auditory and the visual in terms of how these are perceived, engaged with and articulated shall be the prime focus of this research. The introduction of sculpture, and from sculpture the spatial element, offers an increasing number of combinations between the aural and the visual. The shift brought about by the idea of introducing a spatial dimension in the audio-visual media and the introduction of a temporal element in sculpture brought about by digital mediation fuses the two components together into a potentially new territory.

The idea of sculptural interventions in audio-visual media through software also brings to the table the baggage that comes part and parcel with the above-mentioned processes and media. Sculpture's role in the creation and remediation of meaning, in relation to space, place and the socio-cultural structures that constitute reality may have similar functions to the audio-visual media, but these are achieved in distinctly different manners. The concept of narrative is traditionally more prevalent in the audio-visual media where there is also a distinction between the aural and the visual elements of the narrative; most times the idea of an aural narrative takes a secondary role in relation to its visual counterpart (Anderson, 2012). The notion of space is more associated to sculpture rather than to the audio-visual media, even though sound is in itself intrinsically spatial, whilst on the other hand, that of a place is perhaps better (re)constructed through audio-visual material, or at least traditionally so.

This prompts a number of questions on the definitions of both sculpture and audio-visual media. An attempt at merging the two together, aided by the digital elements raises and

justifiably so, questions as to how far can one stretch the fundamental tenets of sculpture and respectively that of audio-visual media. Does a meeting of the two always happen within a grey area that would allow for a total integration, or would their fusion always create a hybrid structure, producing an uncomfortable, yet functional relationship? As explored by video artists in the early 1970s and possibly even before, if one takes into account Nam June Paik's TV sculptures, the nature of, or rather the relationship between the audio-visual media and the screen, be it a television or a monitor, makes the audio-visual media always present in space, in the form of an object that in itself could be considered sculptural. The same can be said about the projected rectangle and the projection itself as explored by the expanded cinema interventions of the early 1970s. Is the audio-visual medium intrinsically sculptural, or is the relationship between the audio-visual media and sculpture an inevitable working partnership? On the other hand what about sculpture's audio-visual properties? There is no doubting that sculpture is visual, or at least for the most part, but sculpture is also, and in more recent times even more so becoming increasingly aural. Could, for instance, Harry Bertoia's "Sonambient" sculptures of the 1970s be identified as audio-visual? Could one speak of sculpture as an audio-visual medium, and would that make sculpture therefore both a medium and an act, a vehicle and a process simultaneously?

The introduction of software into this equation and the proposition of its role as a metamedium makes to a certain extent, the idea of separate media redundant as they all converge to, or rather stem from a single point, supported by the same platform. Software apart from bringing to the table its own set of characteristics also seems to make redundant the same concept of identifying the said grey area, between audio-visual media and sculpture

by creating an access point between the two through software's ability to create space on-demand - digital space.

The digital space and its potential extension into the notion of a digital dimension opens an interesting set of possibilities. The relationship between the digital space and the physical space, makes each dimension an extension of the other.

2.2 Extending Sculpture

No medium today, and certainly no single media event, seems to do its cultural

work in isolation from other media, any more than it works in isolation from

other social and economic forces. What is new about new media comes from

the particular ways in which they refashion older media and the ways in which

older media refashion themselves to answer the challenges of new media.

(Bolter & Grusin, 2000, p. 15)

Although readily dismissed by many, what digital technologies such as 3D printing are doing to sculpture can be likened to what photography has done to painting in the early twentieth century. Most argue that an analogy of this kind could never be drawn as the contexts are totally different. On one hand whilst true that the skills acquired and the processes involved in sculpture in its conventional form cannot really be translated into the digital world, since technology is still far from making this happen at this point in time, perhaps the future can hold such a reality. One would say that the skill sets needed to create digital models have nothing to do with sculpture and thus the two shall always remain distinct and separate streams. Whilst objectively there is no difference in a 3D printed replica of an object to a reproduction of an image in Benjaminian terms, technology in itself, and what can currently

be achieved in terms of resolution makes the desktop 3D printer look too underdeveloped to perhaps threaten the very existence of sculpture as photography initially did to painting.

Sculpture works within a human scale. As described by Penny (1999), sculpture is 'tangible power' - anything that is too large or too small to fit within human perception, it can be argued, cannot be experienced in sculptural terms, even though conceptually, a sculptural intervention can be indeed initiated outside of the human range of sensitivity. Penny (1999) points at other turbulent forces that technology in itself brings to sculpture. Extending upon Burnham (1968), Penny argues how technology and its integration with sculpture is no longer a question of making the object, or of replicating it and its associated process. Sculpture, in relation to technology, is no longer only confined to the spatial dimension but also to the temporal, fluid and interactive dimensions. One has to appreciate that both the work of Burnham (1968) and Penny were written at a time where the technology we have access to today was both unavailable and also perhaps to a certain degree unimaginable.

Burnham's ideas of sculpture as a system, as a microsystem of relationships that mirrors society itself, predicts a "transition from an object-oriented to a system oriented culture" (Burnham 1968, p. 11). Like Judd, (1965) Burnham predicted the dissolution of the significance of the sculptural object and the object itself, where Burnham goes further than Judd is by predicting the development of a "systems aesthetic" (Penny, 1999).

Art as a clear reflection of the economic, technical and social relationships

which form any society. (Burnham 1968, p. viii)

Herbert Read's seminal text *Modern Sculpture* (1964) points at a radical shift in sculpture, that had to a certain extent remained unchanged in its significance, intents and purposes for millennia. In *Modern Sculpture,* Read (1964) suggests that sculpture in the 20th Century departed from its original conception as "…an art of solid form, of mass, and its

virtues were related to spatial occupancy" (Read, 1964, p. 250). and shifted into an art form that is:

> Essentially open in form, dynamic in intention, seeks to disguise its mass and ponderability. It is not cohesive but cursive - a scribble in the air. Far from seeking a point of rest and stability on a horizontal plane, it takes off the ground seeking an ideal movement in space. (Read, 1964, p. 253)

This shift Burnham (1968) argues, is the result of a complex web of relationships that society forms with technology which has permeated every aspect of one's life. Sculpture had morphed into an art form that departs from its original intentions to represent life into one that encompasses anything three-dimensional (Judd, 1965). The relationship between art and science, which now perhaps more than in Burnham's and Read's time, share surprisingly similar goals, has taken sculpture beyond what Burnham (1968) refers to as the archaic form of sculpture, that is, sculpture before Modernism, based on the Jungian premise of the pre-logical and the logical man. These distinctions were first proposed by Levy Bruhl in *How Natives Think* (1910) and adopted, expanded and arguably misinterpreted by Jung in his essay *The Archaic Man* (1913) (Read, Fordham, & Alder, 2014, pp. 4354-4377; Segal, 2007, pp. 635-636). Perhaps what was happening in the 1960s could be described as an age of new enlightenment, a realisation that the sculptor and the scientist could very well be the same person, their motivations perhaps more similar than they themselves realise, driven by the need to discover and create, to control matter and their environment in their totality.

> A point in human evolution when the sculptor begins to imitate the machine maker and the creator of scientific models, unaware that the artifacts of technology are meant to do the same things as his own forms, and that they do them more successfully. The drive that finally prompted the sculptor to forsake

naturalism and the human figure was not that of the desire to destroy the biological replica, but the realization that if he was serious in his quest to bring inert matter to life anthropomorphism would not accomplish it. The machine, he intuitively realized, as unsubtle and inefficient as it was, remained the only means by which man would eventually reconstruct intelligent life, or what might be called life-bearing artifacts. As a result, much modern sculpture has been concerned with the creation of pseudomachines which haphazardly approximate the life impulse. (Burnham, 1968, p. 5)

Since the eighteenth century, Burnham explains, through the creation of the automaton, mankind has attempted to "concede a soul or indwelling vitality inanimate objects" (1968, p. 16). Today artificial intelligence seeks to expand upon this, an endeavour that for centuries has been both artistic and scientific in nature. An interesting observation by Burnham places the role of art as a means, that is shared with other disciplines of controlling the environment,

 If we remember the joint origins of art, magic, religion, and science, it seems possible that each was part of a common goal which could only be ascertained as one of the four disciplines to achieve some degree of irremeable [sic] control over the environment. (Burnham, 1968, p. 5)

Societies and environments, form an integral part of how sculpture is understood and experienced in the present day. We have witnessed a shift from an idealistic ideology where objects were imbued with representational, sometimes spiritual attributes, to a materialistic one where sculpture is primarily relating to its location and occupation with and within space

and the physical matter that constitutes it. This materialistic ideology evolved and further engaged into a relational ideology, where sculpture takes the role of a system of dynamic relationships that in itself becomes a miniature model of the world. These relational systems, through technology attempt to replicate or perhaps synthesise life itself through the use of new and continuously evolving technologies which in themselves also add new and alternative ways of experiencing and negotiating our realities. These shifts can be perhaps attributed to society's use and assimilation of technology and how society itself is viewing itself through this new lens. Sculpture traditionally has almost invariably been on a human scale and made in man's own image. This image that humankind has of itself has shifted through the centuries. Humankind's goals, aspirations and relationship(s) with its environment and its constant fixation with dominating every instance and aspect of it ultimately find their way expressed through sculpture. In more ways than one, understood in this manner, as 'power', as described by Burnham (1968) and Penny (1999) sculpture (as well as science) is essentially mankind playing 'God', asserting its dominance over the world through its ability to modify it, which is further strengthened by the new confidence that technology gives to humankind in order to achieve this. Mankind is an interesting being, but through sculpture one can discern the limitations of mankind as a creative 'God-like' creature. Man can contemplate the vastness of intergalactic space, and even ponder about himself contemplating about it, and to a certain degree even intervene sculpturally upon that, however, one may argue, mankind cannot really ever experience this as sculpture, at least in the conventional understanding of the word. No amount of technology, at least present technology, can overcome this, as even if man finds enough material and figures out the engineering problems to build, for instance, a structure large enough to have a presence in intergalactic space, the rate at which time moves billions of lightyears away, is beyond

humankind, not only in individual terms, but also perhaps as a species. Sculpture is almost invariably human-sized, and prior to Modernism has arguably always been created as a reflection of mankind's self-perceived greatness.

The shift from 'image-based aesthetic' into one of a 'system based aesthetic' that Burnham (1968) suggests, in sculpture whilst perhaps being an organic, and natural progression, creates a set of problems in terms of how sculpture is both understood and created. The arts, in their disciplines, are always to a certain extent self-referential, society itself is constantly referencing itself, creating a fluid set of cultural idioms and iconographies, that follow perhaps no logical or rational rules of how these are constructed. In more ways than one, system aesthetics are dependent on much more than the art that came before and the place that this was created in. Unlike the painting or the static form of sculpture, systems are dependent on multiple elements and seldom keep a specific form in traditional sculptural terms.

Burgin's (1969) observation on Situational Aesthetics, expands on how aesthetic objects of this nature exist partly in real and partly in perceptual space,

> 'Software', consists of sets of conditions, more or less closely defined, according to which particular concepts may be demonstrated. This is to say, aesthetic systems are designed, capable of generating objects, rather than individual objects themselves. Two consequences of this work are: the specific nature of any object formed is largely contingent upon the details of the situation for which it is designed; through attention to time, objects formed are

intentionally located partly in real, exterior, space and partly in psychological, interior, space. (Burgin, 1969, p. 895)

Burgin (1969) continues by pointing at Cage's idea of ridding one's self of ownership and substituting this with the concept of use. These concepts appear very interesting especially in the time that they were written in, as this particular point in history is characterised by the artefact detaching itself from its material existence. Whilst this was considered by Fluxus and Conceptual artists at the time, in terms of how an artistic intervention is idealised and conceptually formulated, in tangible terms, as described by Lippard (1973), this was never perhaps really fulfilled until video was assimilated as an art form. Elwes (2005) observes how:

> The dematerialisation of the art object had begun and artists looked for new forms of expression that reflected the urgency of their revolutionary ideas and the now direct relationship they were seeking with their audiences. They found video and performance art. (Elwes, 2005, p. 6)

and

In the early days of video art, the unreliability of video equipment gave the medium the reputation of being the only art form that was truly dematerialised. (Elwes, 2005, p. 18)

Similarly, Lippard (1973) quotes Beuys in stating that

> Objects aren't very important for me anymore…I am trying to reaffirm the concept of art and creativity in the face of Marxist doctrine…For me the

> formation of the thought is already sculpture. (Beuys, 1969, as cited in,
>
> Lippard, 1973, p. xvii)

Reification or the process of making something real or concrete, of bringing something into being, has been a primary mover in the step from idealism to materialism. Reification takes a slightly different meaning in Marxist ideologies where the objectification or the 'thingification' of social relations and those involved in these social relations are made visible, or rather, the subjects are turned into objects and the objects into subjects. Burnham (1968) expands upon this idea and proposes the consideration of reification as a means by which the world can be made anew, through the process of sculpture within a technologically or scientifically driven society.

> Thus the process of "thingification" which has given birth to modern sculpture
>
> is the constant resynchronization of artistic sensibility with a disclosed form-
>
> world of scientific theory. (Burnham, 1968, p. 6)

In more ways than one, this implies that sculpture is to a certain extent a process through which an idea, or better, a mental projection, is made visible or rather tangible in spatial terms, which is perhaps coherent with Read's (1964) views on Modernist sculpture. What Burnham does however and Read falls somewhat short of is the consideration of how this 'thingification' works within a broader, social context. In previous research I had observed the idea of sculpture as a tool with which one experiences and engages with the world, drawing similarities with how language is developed, through a tool making process (Galea, 2015). I had looked into the work of Andy Clark (2008) who speaks of language as a 'mind transforming cognitive scaffold', where Clark mentions that "It can productively transform people's cognitive capacities by simplifying the outer world" (Clark, 2008, p. 44)

and Arbib (2005, 2012) who remarks how the manual dexterity acquired through the use of tools and the increased gestural capacity that was automatically developed through this, was instrumental in the development of language, pointing at a direct link between physical and mental processes and how one can be used to expand the other.

'Thingification', therefore cannot be considered in isolation as a mental process, or a process that is dependent solely on the artist who extracts an idea and gives it physical or spatial substance, but perhaps as an ecology of numerous factors that have a direct influence on the process of reification itself. Much as in the same way as there are arguments on narrative and the process of meaning-making where Walsh (2006) argues how the medium plays a major role in how the narrative is transmitted and articulated, arguing against the idea of the narrative being constituted of 'medium independent content' (Walsh, 2006, p. 855). The process of transmitting an idea into a sculptural form cannot be considered in isolation. Walsh (2006) describes narrative as a cognitive process:

> Narrative processing, then, is a mode of articulation of the data of experience: "articulation" must be understood to mean the production of meaning, the creation of structure, rather than the expression of some mind-independent content. (Walsh, 2006, p. 860)

Walsh continues by stating that "It goes without saying that the meaning-producing act of articulation is also potentially a communicative, or meaning-transmitting act" (2006, p. 860). This in itself means, by default that if there is an act of transmitting, of communication, there should be obviously someone or something on the receiving end, thus creating a system of relationships, as not only the input and output are sending and receiving data and stimuli, but they in themselves are constantly receiving and outputting data, and stimuli from multiple

other sources. This creates a feedback loop, a system of interconnected relationships that are the result of, and also the force that drives these systems indefinitely.

The metamorphoses from an idealistic into a materialistic object-based sculpture where sculpture is considered as an object in itself, validating its own existence as put forward by Judd (1965) and the Minimalist movement, itself, is in essence, an attempt of de-idealising sculpture, devoiding it of any social, cultural and historical iconography and reference. This as Burnham (1968) argues is not the last stage before absolute 'thingification', as the human mind, can never free itself from its own social and cultural baggage. No matter how reified the actual object is, human perception is always tinted, the place in which the object is set in always exerts an influence on one's relationship with the object, which in turn becomes more problematic once the object itself is dematerialised and does not exist in the same dimensional plane that the audience exists in.

> Sculpture has increasingly become an art form addicted to ideas which threaten its material substantiality. Yet, by definition, it remains slavishly attached to the idea of physical mass. Driven on by the dynamic influences of science and technology, sculpture has ceased to be an art with a sense of traditional continuity, surviving only through constant threats to its own origins. (Burnham, 1968, p. 10)

Krauss (1979) takes a more radical view at sculpture and its transition from Modernist to Post Modernist ideologies. In her text *Sculpture in the Expanded Field* (1979), Krauss observes how in Modernism, sculpture was in a way robbed of its monumental function, perhaps a similar situation to that which happened to the photography-painting relationship at

the turn of the 20th century. Essentially sculpture had been replaced by nothing, however its apparent lack of function within society led to Barnett Neumann describing it in the 1950s as: *"Sculpture is what you bump into when you back up to see a painting,"* (Neumann, (n.d.) as cited in Krauss, 1979, pp. 35-36). Krauss goes on further to describe sculpture before the 1960s as a combination of exclusions; that which is not landscape and not architecture becomes by default sculpture, making use of what in her own words could be considered an inverted or "negative logic" (Krauss, 1979, p. 36). Krauss' text is significant as it presents an expansion of this negative logical binary. Krauss considers a move from this duality presenting a model similar to that employed in quantum computing where the options are not simply - is or is not, but rather, - is, is not, both or none, thus creating an expanded relational structure where sculpture becomes a component of this disciplinary playing field that she considers. The consideration of micro and macro models and the constant zooming in and out of these structures to view systems in their entirety whilst perhaps not system based in themselves produced some form of logical explanation to the problem of sculpture at the time and the shift from materialistic into relational aesthetics.

> This suspicion of a career that moves continually and erratically beyond the domain of sculpture obviously derives from the modernist demand for the purity and separateness of the various mediums (and thus the necessary specialisation of a practitioner within a given medium). But what appears as eclectic from one point of view can be seen as rigorously logical from another. For, within the situation of postmodernism, practice is not defined in relation to a given medium-sculpture but rather in relation to the logical operations on

a set of cultural terms, for which any medium - photography, books, lines on walls, mirrors, or sculpture itself-might be used. (Krauss, 1979, p. 42)

In order to understand sculpture in this manner and in order to observe sculptural systems in their entirety, one has to develop new ways of looking at these systems.

The shift to a systems view coincided with a growing recognition of the scientist as being a part of the "system" of observer and observed and thus not a neutral or objective factor in the research process. (Ostroff, 2000, p. 4)

The notion behind system based theories stems from the shift from looking at phenomena in isolation, to one that considers "…the nature of integrated wholes, and their complex patterns of organization" (Ostroff, 2000, p. 4). In sculpture to a certain extent there was no real need for this before Modernism, in more ways then one, sculpture that was idealistic in nature, sculpture that was a container, a vessel that was imbued with spiritual or metaphysical content (Judd, 1965) was more often than not anthropomorphic or zoomorphic in form. This was always considered as part of something larger, a physical illustration which the viewers at the time instantly recognised, as the imagery being utilised was an integral part of their social and cultural environments. In modernism when sculpture was 'reduced' to "a scribble in the air" as described by Read (1964) these links to society became more distant, perhaps even apparently non-existent. However, by taking a meta-perspective stance, simply based on the assumption that nothing exists in isolation, theorists such as Burnham (1968), Burgin (1969), Krauss (1979) and in cinema Youngblood (1970) sought how sculpture or rather the artefact fits in relation to the bigger picture within society.

Gaudenzi (2013a, p. 15), introduces the concept of a digital, interactive artefact as a relational entity rather than a static one. She explains how the term 'relational' implies that such artefacts are in themselves systems formed from incongruous entities such as humans, machines, protocols, technology, society and culture and how all these are interdependent. An interactive artefact within a digital space, therefore, can be understood as a series of systems, interconnected to one another which are in constant relation to each other. These interconnections are not only bound to the digital realm. The viewer, the observer, as a living, cognitive organism, is a system within him/herself, becoming inseparable from the system observed, where the results of observations would depend on the interaction between the observer and the observed.

Other ideologies that this approach challenges are the dialectic between the artist and the audience, of locating who and where is instigating or rather initiating the intervention. Active user input, due to the interactive nature of such artefacts, brings about questions of authorship or rather co-authorship. Landow (2006), speaks about the near merging of the roles between the writer and the user, or better, in this case, between the artist and his audience. Landow (2006), not unlike Gaudenzi (2013a), observes how interaction due to the nature of digital media, shifts the relationship between author and what he calls the "active, even intrusive reader" (Landow, 2006, p. 126). Within a digital space the phenomenological distance between separate objects is widened and narrowed by the active user's input, thus changing the relationship between the various components that constitute the artefact.

In sculptural terms, other shifts are necessary as a direct consequence of this approach. Similar to the 'problems' artists that work with ephemera face, the artefact, at least in terms of how it appears aesthetically is constantly shifting; each sculptural, spatio-temporal

montage is temporary. Another factor that goes beyond aesthetics and appearance is the dependence on the relationship between the audience and the other elements within the artefact. The behaviour of the artefact is also in a state of constant flux, and through the various relational distances between the elements in the artefact, as they shift through time, they might make the artefact completely unrecognisable from its state in another point in time. This may even go beyond or against the original intents and purposes of the artefact system when it was initiated. In a way, the artist is giving full control not only to the viewer but to the whole artefact to behave as it pleases. An artefact that is independent to an extent where it is capable of taking its own decisions, might raise concerns on the concealed dangers, that have until now belonged more to science fiction that academic research and that currently, one would find difficulties to rationalise upon.

Systems as artefacts present some interesting differences to the art object when viewed in isolation, however even in its isolated, static form, a sculptural artefact, might be understood or experienced differently when viewed on separate instances. Figal (2010) makes an interesting observation in this regard:

> One can think one knows an image; one has read a text several times or heard a musical piece countless times, and yet it will always again seem as if one encounters what is to be seen, read, or heard for the first time. Every experience that one has already had with the artwork thereby enters anew into the context of the present experience. (Figal, 2010, p. 10)

Whilst Figal explains this from a phenomenological stance, as a purely phenomenological problem, again he is taking a meta-perspective and considering the artwork beyond the object itself.

> Art is insight. It is a relation to the states of affairs and things of the world, and aims to make these accessible in a way that is different from the manner that we are accustomed to: it makes them accessible in the work alone. (Figal, 2010, p. 10)

2.3 Towards a Sculptural Ecology

One has to keep in mind that the systems created are themselves part of larger systems within themselves, which in themselves are part of other systems, and this keeps going on indefinitely, possibly ad eternum. Sculpture is a system, space is a system, even the very matter that constitutes the components within the relation system are systems of interrelated relations within themselves. Rather than talking about systems perhaps, it might be more suitable to talk about ecologies. The idea behind the term ecology can be interpreted as an interconnected series of systems that operate both interdependently and independently and have the ability or rather capability of sustaining both independent and interdependent relations within the same series of systems simultaneously, again bringing into consideration Krauss' (1979) - is, is not, or is both (or is none).

> Blood is necessary to lungs, so blood belongs to lungs. In the same way we can say lungs belong to heart, liver belongs to lungs, and so forth, and we see that every organ in the body implies the existence of all others. This is called, "the interdependence of all things," or "interbeing" in the Avatamsaka Sutra.

Cause and effect are no longer perceived as linear, but as a net, not a two-dimensional one, but a system of countless nets interwoven in all directions in multi-dimensional space. Not only do the organs contain in themselves the existence of all the other organs, but each cell contains in itself all the other cells. One is present in all and all are present in each one. This is expressed clearly in the Avatamsaka Sutra as, "One is all, all is one." (Hanh, 1988, p. 64)

Similarly, Burnham (1968) notes how:

When we buy an automobile we no longer buy an object in the old sense of the word, but instead we purchase a three-to-five-year lease for participation in the state-recognized private transportation system, a highway system, a traffic safety system, an industrial parts-replacement system, a costly insurance system, an outdoor advertising system, a state park recreation system, a drive-in eating and entertainment system and, not least of all, the general economic system. Granted, objects were always the means by which man participated in systematic social activities; still there has been a gradual shift of emphasis from the object to systems which make the object useful primarily as an economic instrument. (Burnham, 1968, p. 11)

The sculptural object traditionally was a concretisation of mankind's formalist ideologies. The object is immovable, it stays the same across time and in a way makes man's environment sub-dividable and transportable (Burnham, 1968). Whilst these objects could be lost or destroyed, in theory, they keep their form, meaning and perceived value for as long as they exist. Along the years, sculpture has also ventured into more unorthodox makeups such

as the collection of more impermanent and fluctuating characteristics that departs drastically from the traditional conventions of the sculptural object. The sculptural artefacts as an ecology composed of an interdependent series of systems that are sustained and generated through material, biological and technological components, perhaps reflect more accurately the social and cultural structures of contemporary times, and in more ways than one are more relatable and approachable, as they are constituted out of the same socio-cultural matter that humankind consumes on a daily basis. A sculptural ecology, therefore, reflects that current age as it consumes and produces the very same social and cultural structures that sustain it. This idea goes somewhat beyond the idea of cybernetics on which Burnham based his concepts, as whilst most of the artworks that this research is concerned with do create feedback loops as a means of how the various components of these systems interact, generate and sustain themselves, advances in digital technology, artificial intelligence and generative algorithms, together with human intervention, which is an integral structural part of these sculptural ecologies, take the idea of a system further than that of a casual circular loop. Elements such as interdependence, co-creation, co-evolution of both the artwork and its environment together with the viewer and the artist themselves create a more dynamic series of relationships that like the idea of quantum computing and in a way directly opposed to the idea of a feedback loop, the relationship between the components, or indeed the web of systems that constitute sculptural ecologies is more akin to an indefinite ripple effect in an indeterminedly shaped container. Ostroff (2000) suggests the integration or rather the amalgamation between systems theories and organismic theories in order to observe complex sets of relationships viewed from an elevated meta-perspective. This idea perhaps is more in line with what Burnham (1968) intends when he describes sculpture as taking the role of a quasi-living being. In this research, through software and digital processes, this organismic

relational sculptural system achieves lifelike qualities of self-awareness and the capability, or better the perceived capability for the artefact itself to take its own decisions.

The fluctuating states of relationships within the artefact system of a sculptural ecology result in a continuously changing set of stimuli that in turn may change or alter the appearance of the artefact both when viewed externally and internally. A dynamically active sculptural system struggles to keep itself in equilibrium, whilst realising that equilibrium may very well be the death of the system itself.

In systems theory, the sustainability of a system is achieved through the control of negative feedbacks in order to achieve a state of equilibrium (Amagoh, 2008). As systems theories began observing more complex systems and increasingly dynamically complex patterns started emerging, new models were sought in order to apply systems theory to an ever increasing set of disciplines that found value in the initial ideas developed by Bertalanffy (1950) who pioneered the idea of general systems theory (Wekowicz, 2000). The concept of entropy, initially developed in thermodynamic systems as a way of defining and measuring sustainability in a system, can be utilised as a model for an understanding of the mechanics involved in order for a system to reach a state of equilibrium, where entropy can remain constant or increase, but never decrease.

> As a preliminary definition, entropy can be described as the degree of disorder or uncertainty in a system. If the degree of disorder is too great (entropy is high), then the system lacks sustainability. If entropy is low, sustainability is easier. If entropy is increasing, future sustainability is threatened. The change in entropy is inversely related to the change in free energy. As energy is

expended to do work, entropy decreases. If no energy is available in the system, its entropy level will remain constant or increase. (Bailey, 1990, p. 2)

Thermodynamic equilibrium or maximum entropy, essentially the death of a system is achieved (as explained in thermodynamic physics), within a closed system, where new energy cannot be created, therefore the state of entropy will never decrease, resulting in the system constantly moving towards a slow (or fast) death. Other models for entropy have been developed to take into account further models of more complex systems such as Boltzmann's entropy, that take into account relationships between macro and micro-states, where new energy or data can be added into a system, resulting in a state of entropy that can shift both up and down. In social entropy theory as described by Bailey (2006), there are six key social systems variables:

The six key macro-sociological variables of SET are: population size (P), information (I), level of living (L), organization (O), technology (T) and space or territory (S). These PILOTS variables are key systems variables. Together, they determine the overall state of the system, including its entropy. (Bailey, 2006, p. 297)

These variables known as collectively as 'PILOT' are based on Miller's (1978) Living Systems Theory that is structured in 20 critical subsystems over 8 hierarchical levels (Miller, 1978). Burnham (1968) whose text predates Miller's (1978) and Bailey's (2006) looks at the work of the economist Kenneth Boulding when considering the role that entropy plays in his idea of systems aesthetics in relation to sculpture.

The universe then is seen to be like a man, who is spending his capital so that

his total capital in the form of potential continually diminishes, but who

continually builds up the diminishing capital into ever more elaborate works

of art. Thus when a sculptor makes a statue out of a piece of stone, there is

more organization in the statue than in the stone, in the sense that the shape of

the statue is much less probable than that of the stone. But if we look at the

whole system, the stone, the statue, the chips, and the sculptor himself, we

shall find that the organization of the statue has been bought at the cost of

disorganization in the chips and perhaps in a diminution of the potential of the

sculptor. (Boulding, 1964, p. 140)

Thus Burnham concludes,

Complex systems in all phases of modern life are the "ever more elaborate

works of art" which begin to approximate those of nature. Thus a pail of sand,

a spring-wound machine, a plant, and a human being represent systems of

decreasing entropy. In each succeeding case a level of structure and

complexity is bought only through the dissipation of greater amounts of

energy…Each in its own way moves toward a higher life form; each seeks to

lower its entropy rate at the expense of the general environment. (Burnham,

1968, p. 14)

In the same manner that systems theory has been adapted and adopted across multiple

disciplines through the development of modified models, a systems theory specifically for

sculpture could be developed in new directions in order to work better in a contemporary

technological age. The concept of the artwork as a system does have a few flaws which are inherent to the ideologies of systems theory in general. The macro and micro-systems and the meso and exosystemic relationships between these, the feedback loops, reciprocal transactions and the states of homeostasis and entropy would be hard to map, manage and understand in their entirety, and it would be perhaps far-fetched to believe that an artist considered, or is aware of his or her influence on all these factors whilst creating an artwork. The relationships between components, especially through the introduction of digital and software-based technology combined with the inclusion of both the audience and the artist in the structure, would create a whole cacophony of relationships across different spatial and dimensional as well as temporal planes. When one takes into consideration virtual spaces that could be both digital as well as mental spaces, their ephemeral and temporally inverted natures, or at least the possibility for this to occur, as time need not flow linearly and in the same direction (especially in digital spaces). Our conventional measures of time and space vary in relation to the dimensional planes that they exist in. One may also add the consideration that each state or dimension might have a totally different set or rate at which change (or the absence of it) is occurring. This makes it virtually impossible to rationalise or charter these relationships in a marionette kind of relationship that most systems theories seem to suggest. As sculpture is a creation of mankind, on a scale that humankind can handle and understand and inevitably in humankind's image, it might be perhaps useful to look for how these structures are ordered within humankind itself.

In the *Emperor's New Mind* (1989), Roger Penrose weighs the idea of consciousness in computers. If a computer is conscious, then human consciousness would be the result of complex calculations performed mechanically within the brain (Penrose, 1989). This would

mean that art rather than being a conscious or unconscious creation by the artist, is, in fact, a complex mechanical computation of the surrounding stimuli that the artist encounters. It therefore follows that it would become possible to turn computers into artists; into creators of thoughts, concepts and ideas, and that it would also be possible to reverse this turning the human being into a machine. This is, however, easier said than done. The human mind operates both logically and illogically, the ability to constantly create dynamic relationships between the ship it is steering (the human body) and the environment, animate and inanimate objects, abstract thought, as well as emotions, knowledge, memories and so on, and in real time, make it a formidable machine that is capable of operating on a level of complexity that as yet, in terms of technology is still unattainable. Links created between external and internal stimuli are constantly, negotiated and renegotiated, without the strings attached as in systems theories. In more ways than one links are created temporarily and destroyed, with only a portion of the information processed being consigned to memory, which in itself is also a somewhat destructive process.

Rather than considering the notion of constantly interconnected system, sculpture as a system can be understood as a set of temporary relationships where anything can be connected to anything, forming a kind of temporal montage that is destroyed as soon as it is consumed, as new sets of interconnections are instantly renegotiated. Imagine a large reservoir or pond of water that contains all the matter of the universe. If a drop of water is dropped in this pond it creates a ripple, that slowly makes its way across the pond temporarily altering the relationships between the individual water molecules in the pond. Two drops would create two instances of relational state changes between the water molecules and between the ripples in themselves. Also, these ripples need not be in sync, operating in the

same direction at the same speed, however, they would still cause a change of state in both the water molecules in the pond as well as on each other. Now imagine it raining, all the drops of water are creating temporary relationships between themselves and the molecules, whilst at the same time, the droplets are being absorbed into the pond becoming in themselves both the instigator and the receiver of change. When the sun comes out and shines upon the pond, water molecules evaporate, clouds are formed and the process starts all over again, albeit for different durations, at different rhythms and different intensities. This model would perhaps illustrate better the idea of a sculptural ecology. Whilst this analogy essentially describes a system, the major difference being discussed here is that it is not only the relationships between the individual components of the system that are changing but also the individual components within themselves are constantly being added and removed from the equation. More importantly, the components in themselves are being continuously transformed by interacting with each other.

The shift from a first-order cybernetic system as developed by Weiner in the 1940s to what is referred to as second order or second wave cybernetic system was a phenomenological one; rather than considering systems as closed loops observed externally, scientists realised that as observers, they are indeed part of the observed system and have a significant impact on it as previously discussed through the work of Ostroff (2000). Gaudenzi (2013a) describes this as:

> The observer and the observed system started to be seen as linked but also
> inseparable since the result of observations would depend on their interactions.
> The observer too became a cybernetic system, who is trying to construct a
> model of another cybernetic system. This circularity is typical of what has

been called in the 1970s Second Order, or Second Wave, Cybernetic - where cognitive processes are seen as constructing a reality via the interaction subject/environment. The world is seen as an active creation of our cognitive processes and this is why we cannot be neutral when observing it. (Gaudenzi, 2013a, p. 78)

Similarly, as living systems within themselves, human beings construct their own environment rather than just simply inhabit it. Gaudenzi built upon the ideas of Von Foerster (1982) when observing how "The environment contains no information. The environment is as it is" (Von Foerster, 1982, p. 256). concluding that "The environment is not given anymore, it is constructed by us" (Gaudenzi, 2013a, p. 78). As part of an interactive sculptural ecology the human actors which may be the artist or the audience or both in simultaneity, become key components, as systems within themselves engage or rather interact with other systems in order for the resulting artefact system to grow and develop and more importantly create.

Autopoiesis, that is the way that systems create, or rather auto create is a process of relational self-making that was originally developed by Maturana and Varela (1982) in order to study the way that cellular organisms self-maintain themselves. This theory has since then been adopted by various disciplines including systems theory and as described by Gaudenzi (2013a):

Any living organism materially self-constructs itself and by doing so distinguishes itself from its environment and acquires autonomy. Autonomy does not mean that the system does not need other systems to reproduce itself,

nor that it can survive alone, but that 'it can specify its own rules', what is proper to it. (Gaudenzi, 2013a, p. 79)

In a sculptural application, this theory could very well indicate how in a sculptural ecology, the various dynamic relationships between the systems and objects that make up the sculptural ecology do indeed create not only new content in terms of data and experience, but when combined with digital processes and the fluidity of the so-called new-media, (based on software) these have the ability to create anew, through the process of reordering. This goes beyond the traditional guise of sculpture simply as an act with which to modify or manipulate matter. Gaudenzi (2013a, 2013b) suggests that an interactive artefact system could be considered in itself a living being, which as she explains, occurs through the structural coupling that the components of the artefact system form between themselves, whereby through recurrent interaction the constituents of the system simultaneously take the role of both the shapers and the shaped within the system as explained by Maturana and Varela (1982, p. 75). Thus the components of the artefact system develop a set of circular relationships whereby the interactions within the system shapes the becoming of the system itself and as Gaudenzi concludes "if life is defined as self-organisation, adaptativity and change through interaction, then the interactive documentary can be seen as a living entity" (Gaudenzi, 2013a, p. 80).

The most significant difference however between Gaudenzi's relational artefacts in the form of interactive documentaries and the concept of a sculptural ecology, in itself, a relational artefact system is the difference in nature between the documentary and the act of sculpture itself. In a documentary, data, or rather content is always to some extent predetermined or pre-prepared. This comes obviously from the main objective of the

documentary, that is, as its name implies, to document. Sculpture, however, has the ability to behave differently. The act of sculpture need not be rooted in the past. Whilst sculpture has been used for centuries as a memorial of, a person, event or other, the main objective behind sculpture is to shape, to create; and the act of creation is capable of existing throughout the past, the present and the future. One cannot document the future, but one can create it. This difference, I would argue takes the idea of the sculptural ecology, or rather the model of this, beyond the mechanics of a circular loop. As discussed before, within a sculptural ecology the constituents have the ability to appear and disappear across time through different dimensional and spatial planes, where content is not pre-fabricated but rather continuously created, streamed, in real time.

2.4 Sculpture and its Position in the Audio-Visual Realm

Sculpture is a socio-cultural activity, it is a process through which one is able to manipulate, modify and distort the very fabric of reality, or at least the idea of a relative or personal (which could also be mass/collective) reality, which is dependent on one's experience of the world, and the position one takes when experiencing the world. Through socio-cultural structures, meaning is created, or more accurately, fabricated and new positions of relative reality are created. Sculpture is an act which intervenes directly on this meaning or sense making project, with which humankind engages with the world.

Sculpture is the creation of new scenarios running in parallel (or at times totally against) one's notion of reality. It is a process through which reality itself can be fabricated, modified or distorted. What perhaps makes sculpture so powerful is its physicality, its immediacy, its presence in space and traditionally its immunity to the effects of time. The idea of timelessness, of form transcending the ages.

The idea of timelessness, which has been for centuries one of the immovable virtues of sculpture, is also what has kept it in stasis for many centuries. This may or may not be a good thing, however, this is not the subject being discussed here. Sculpture through its impermeability or rather through its tradition of impermeability and immutability through time, suffers greatly in an age where the scaffolds of what constitutes our societies are constantly being modified and redefined, with social and cultural amalgams, absorption, tensions and collisions occurring daily and changing the world into an increasingly homogenous 'global village'. At times, one thing today takes on a totally different meaning tomorrow and work produced fifty or more years ago risks suddenly becoming 'politically incorrect' or 'culturally insensitive' or seen as decadent, frivolous, irrelevant or detached from current socio-cultural scenarios.

Sculpture's presence in time, although for long overlooked, is what makes sculpture 'human-sized', what makes sculpture relatable. Sculpture shares the same spatio-temporal realm with humankind in a manner that other arts do not, its presence in space and in time is the same as its audiences'. Sculpture is the concretisation of abstract thought, of metaphysical concepts, making the unseen not only seen but also physically present, in the here and now. What is even more significant is that sculpture has always been made in humankind's image, on a human scale and within human time. No matter how large or how small each sculptural artefact and irrespective of subject matter, or when it was done, sculpture has always been human in scale, and has always been a reflection of mankind.

Within the current socio-cultural scenario, and the rapid advances in technology, sculpture has changed significantly and dramatically. No longer bound by its stasis in time, sculpture is perhaps one of the processes within the arts that has been enjoying an increased level of sustained activity and progress. It is important to note how I am referring to sculpture

as a process, rather than a medium. Sculpture is an act, rather than an object. Unlike other media, sculpture has had the ability to dematerialise itself from the physical idea of medium and has recognised its position as a socio-cultural artefact, a process, an intervention in meaning and reality, rather than simply and solely an intervention in matter. This dematerialisation between the process and its medium is what makes sculpture a key processes in the arts, the break between sculpture and matter coincides perfectly with the emergence of a new mono or meta-medium: Software.

Software and digital technology can be thought of in terms of space rather than simply in terms of image, even though one usually interacts with software through images on a screen. This digital space extends beyond the reaches of the screen in both directions creating 'room-sized' artefacts shaped and formed depending on the space where they are located. Consequently, digital artefacts can be thought of as spatial objects that convert their container (the physical space), modifying their environment in real time and creating a modified and manipulatable 'place' in space and time, where a spatial conversation between the user, the space and the artefact occurs. The distance between the viewer and the artefact has been not only bridged by the 'digital space' but the audience is now essentially also capable of being within the artefact, becoming part of it.

Sculpture and its relationship to the digital space is an area that has been one may argue, underdeveloped and at times overlooked. Sculpture behaves somewhat differently from the other media. There is no 'sculpt' to sculpture in terms of material as there is paint to painting, photo to photography and film to film. In terms of linguistics, the verb doesn't point to a particular noun, it remains a verb, an act. Sculpture has always been about spaces and volumes; and whilst sculptors still do sculpt in the traditional manner through adding or removing material, as a process sculpture relies on the relationship between the object and its

environment. In the manner in which it is consumed by the audience, a sculpture is always an image made up of the artefact and its environment which may or may not be related. In terms of volume, this can be looked as the space that an object occupies in relation to the 'negative space' around it. The digital space adds a further dimension to sculpture, as within a digital space, the environment, the physical space around an object, is in itself the artefact, that in itself is in a state of constant flux, changing from one state to another, dependent on the relationship between the audience, the environment and the software running the digital element.

Like sculpture, software and digital media are social and cultural artefacts. Their lack of physical form and material attributes makes them fluid and endlessly mutable. Without any physical restraints, the digital media are positioned in a potential constant state of flux. This potential state of flux makes the digital media constantly reactive and responsive to changes happening within the digital space. A dematerialised sculptural process, a sculptural process that is not static, (medium based), but rather constantly evolving through interventions in both space and time, creates the perfect platform for integrating the digital and the physical space. In a manner sculpture has the ability to make software 'human sized'.

2.5 Polymedia Sculpture

One of the major advantages of software and digital media is the ability for a number of processes to run in simultaneity, communicate between each other and generate data for each other. Digital technology has the capability of converting virtually anything into anything, acting as a modern-day "Rosetta Stone", or perhaps even more fittingly, acting as the fabled "Philosopher's Stone". Through software, any input, be it image, moving image, animated

image, sound and so on, can be 'translated' into one another, of multiple iterations of each other. This works by first converting any input into computer language, binary, a succession of on-off pulses, which all of data being processed by the computer is made of, at least at a base level. This binary, becomes the first true universal language, a language that is capable of communication across a multitude of platforms, and processes. In terms of artistic practice, software offers possibilities beyond the traditional confines of the arts. Ideas such as Fischinger's "Raumlichtmusik" and Youngblood's (1984) prediction of an organic fusion between sound and image, performed by a single artist have now become very concrete possibilities.

The concept of a multi or polymedia art has been around for a considerable amount of time. In Baroque times there was the creation of the colour organ (also referred to as the Baroque light organ) that created colour changes according to the music. Later William Morris and the Arts and Crafts movement he pioneered, developed the idea of a 'total work of art'. Morris' idea is especially interesting as it deals not only with the idea of an individual artefact but also in how individual artefacts come together within space to create a single artefact, a place essentially.

As mentioned above Oscar Fischinger developed the idea of "Raumlichtmusik" (Keefer, 2009; Scoates, 2013) meaning 'space-light music' in the late 1920s and spoke about how an integration between vision and sound shall become the art of the future, with capabilities beyond individual media, art forms and processes.

Of this Art everything is new and yet ancient in its laws and forms. Plastic – Dance - Painting – Music become one. The Master of the new Art forms poetical work in four dimensions...Cinema was its beginning...

Raumlichtmusik will be its completion. (Fischinger, n.d. as cited in, Keefer, 2009, p. 2)

Youngblood (1984) predicted the VeeJay (Youngblood, 1984, as cited in Briffa, 2009. pp. 55-56), where disk jockeys utilise visuals to go with their musical performances in order to create multi-sensory experiences. Other artists such as Brian Eno and Bjork have worked with multi and polymedia approaches.

The notion of polymedia in relationship to a sculptural practice opens doors to new and exciting dimensions. This is brought about by an integration of software and sculpture where the digital media is being utilised to augment and extend the sculptural intervention and vice versa. Through digital technology, sculpture becomes an extension of the digital space whilst simultaneously occupying physical space-time locations. Through a polymediatic approach sculpture also becomes an interface between the various components or modes that make up the polymedia ensemble. Image, moving image, sound, and spatial elements running simultaneously become fused into a single component, a single intervention.

Manovich (2001), observes how "In hypermedia elements and structures are separate from each other" (Manovich, 2001, p. 41), unlike analogue technology where individual components were hardwired into "…a unique structure and can no longer maintain separate identities" (Manovich, 2001, p. 41). Digital media, by nature, is modular allowing each component within the system a distinct identity that can be moved around, thus altering its position and the relation between itself and the other elements of the system. The digital platform appears to have introduced space between the elements that make up the artefact,

resulting in a shift from traditional sequential media (video, documentary, audio) into a more fluid and continuously changeable form. The audio-visual medium as a sculptural medium becomes as described by Manovich (2001, p. 233) a "spatial montage" or "temporal montage", a construction in real time formed by the relationship between author, the active user, technology, subject matter, society and culture, occurring simultaneously within physical and digital space.

The development of the notion of polymedia within the visual arts comes from the dematerialisation of the art object, a direct consequence of visual art performances in the 1950-60s and later through video art from the late 1960s and the 1970s. This dematerialisation or rather detachment from the idea of having to create an object, whilst not new in any way (as can be found in many examples in music, theatre, literature) changed the visual arts profoundly. As a process, sculpture took more time to break with matter. Sculpture is an intervention in time and space, where apart from sculpture many other things reside including obviously matter, however, sculpture is not necessarily dependent only on matter. Through digital technology and the dematerialisation of the art object, sculpture is no longer spatial, present in space but static in time, but rather spatio-temporal. As stated earlier, this research approaches sculpture as a socio-cultural intervention, achieved traditionally through the manipulation of matter or its remediation, however when one extends sculpture to occupy or rather to cross-over into digital or virtual space, one can no longer talk about matter, or at least in the traditional understanding of the term.

Audio-visual media, on the other hand, have always been time-based but never really spatial, at least in terms of how the audience relates to them. Sound which is the audio part in audio-visual media is by default a spatial object, however, the limitations and confines of the

visual aspect, confined to the screen or the projected rectangle have to a certain extent flattened or restrained the spatial dimension of audio, at least in terms of how the audience perceives it. It is true that most audio-visual artefacts have been for a considerable amount of time produced in 'surround audio', however, the way that sound has been packaged together with the moving image, which tends to be the dominant aspect of audio-visual media, has put audio in a subservient position, its presence taken as a given, as if it were built into the image. This has, however, not always been the case. The first experiments with the moving image were silent, as was early cinema, and prior to the ascent of tape, and later digital media most film was recorded with no sound, where the sound was being recorded separately from the image. Celluloid film records light not sound, however when it came to video, the magnetic tape could record both light and sound simultaneously.

The moving image has been described as an act of movement and time (Deleuze, 1986), a succession of images moving linearly across time for a given duration. The moving image is not spatial, not only as it is bound to a two-dimensional plane, but also because its movement across time is linear and unidirectional. Whilst it is possible to run a moving image sequence backwards, it is impossible to have it run forwards and backwards simultaneously. When audio was added to the moving image, perhaps in an attempt to make the moving image more 'realistic', or perhaps more complete by introducing a spatial element (that would not interfere with the picture plane), the result, whilst satisfactory for the masses that the medium has been entertaining for the past century, leaves most forms of audio-visual media, feeling, to a certain degree, unresolved.

The transition in media due to technological advancements brought about by the digital age plays a major role in the understanding of the relationship between the audio-

visual medium and its location in space, which has been extended into digital and online territories. Manovich (2013) remarks in passing how the jump between the analogue and a digital software-based platform that most audio-visual media now run on, happened quickly and extremely abruptly. He indicates that perhaps most media formats we use nowadays are, or rather were developed as "computer simulations of older kinds of media" (2013, pp. 44-48), which might not have used all the potential that the digital space could offer. Manovich (2013) describes the computer, or more specifically the software that the computer runs on as a 'metamedium' "…software has replaced a vast array of physical, mechanical and electronic technologies used before the twenty-first century to create, store, distribute and access cultural artefacts" (Manovich, 2013, p. 2).

2.6 Software and Sculpture

> Welcome to the world of permanent change—the world that is now defined
>
> not by heavy industrial machines that change infrequently, but by software
>
> that is always in flux. (Manovich, 2013, p. 2)

Hester (2007) discusses sculpture in the light of the idea of post-mediumality citing the work of Krauss (1999) in the area of photography and film, who describes film as a "compound apparatus", the most 'non' of media (Hester, 2007, p. 7). These 'compound apparatus' cannot be reduced down to a singular specific medium or in Krauss' own words "…a single instance that would provide a formal unity for the whole" (Krauss, 1999, p. 31), but rather as described by Hester "They are instead more like composites, especially in the case of film, which is contingent upon a combination of heterogeneous activities, materials, gestures and

forms of organisation and technique" (Hester, 2007, p. 7). Applied to sculpture, Hester (2007) concludes

> Engaged in this fashion, the focus shifts from sculpture approached as an object or outcome, to sculpture regarded as an expanded practice in motion, irreducible to a single instance providing a formal unity. This turns the term 'sculpture' from a designation into a verb. It is saturated by many activities and becomes an event. (Hester, 2007, p. 7)

This idea is further substantiated by the observations of Bourriaud, (2005) who similarly notes how:

> The contemporary work of art does not position itself as the termination point
> of the 'creative process' (a 'finished product' to be contemplated) but as a site
> of navigation, a portal, a generator of activities. (Bourriaud, 2005, p. 19)

Hester's concept of sculpture turning from a designation into a verb resonates profoundly with the current age. Krauss' idea of the post-medium is only one of the threads that weave the contemporary discourse around sculpture and the arts in general "The current situation is a convergence of ideas relating to situational practices, relational aesthetics and notions of 'post-production'." (Hester, 2007, p. 7) Extending perhaps further on this would be Silver's (2006) and Manovich's (2013) idea of software as a mono or metamedium, which perhaps equally pushes the idea of mediumality down the hierarchy of relevance in contemporary artistic discourse whilst simultaneously opening up a whole pandora's box of how artistic disciplines or designations fit within a software controlled world.

Sculpture taken as a verb, as an act, is perhaps the central focus of this thesis. To sculpt is not only a creative act but also an act of creation, to shape, to form, which was traditionally, reserved for matter but has grown to also encompass environments and social structures. During and especially after Modernism, sculpture was 'robbed' of its base, its pedestal, (Burnham, 1968; Krauss, 1979), the idea of post-mediumality has to a certain extent, 'robbed it of its matter' and software as a mono-medium also threatens to 'rob' sculpture of its relationship with space. This would perhaps be correct if sculpture is only considered in its traditional guise as a discipline within the arts that is concerned with matter and volumes in space. When one considers interactive artefacts as living systems within themselves as described by Gaudenzi (2013a), sculpture is not only the act of creating these systems but also the force that keeps these systems together, the interdependence and the relations between the elements of the system, that keep the system in tension, structurally supporting it from (a premature) collapse. This, however, is by no means being proposed as the metric with which to measure all contemporary sculpture, or as a single theoretical framework that supports sculpture in the twenty-first century. Sculpture still continues to exist in its myriad of forms and configurations and this particular framework perhaps only applies in its totality to my current practice as a sculptor (Chapter 7). Sculpture to this day continues to exist in what Read (1964) and Burnham (1968) would call its 'archaic' or 'totemic' form, as a vessel or container imbued with meaning, as Judd (1965) describes all sculpture prior to Minimalism. It exists in its Duchampian form as the intangible but observable relationship between the object and its relationship with a particular place, or context, and as an object that validates its own existence. Sculpture also exists, as described by Krauss prior to her ideas in *Sculpture in the Expanded Field* (1979) as not landscape and not architecture, whilst simultaneously as developed by Krauss (1999) herself, as a

compound apparatus that goes beyond the idea of a medium. These forms of sculpture may also shift in the same artwork, as the understanding of sculpture, ultimately lies within the viewer, and certain artworks could perhaps be considered amalgams of the various forms of historical and theoretical understandings of sculpture. A dynamic relationship between what can be considered the various forms of sculpture can be thought of as similar to the dynamic relationship that a human being has with the world around him or her. One can be simultaneously a child and a parent, a friend and an enemy, an employee and an employer, a stranger and a sibling, and as one relationship does not exclude the other, so can sculpture exist in multiple levels that can be in direct opposition to one another whilst still remaining true to its nature.

As remarked by Morris when discussing the problematics that conceptual art had brought with it, which perhaps are still valid to this very day

"The problem has been for sometime one of ideas - those most admired are the ones with the most incisive ideas & biggest, (e.g., Cage, Duchamp). I think that today art is a form of art history." (Morris, 1962, as cited in Buchloh, 1990 p. 115)

In Morris's own work as observed by Buchloh (1990) "Morris's approach to Duchamp, in the early 1960s, had already been based on reading the readymade in analogy with a Saussurean model of language: a model where meaning is generated by structural relationships" (p. 115).

Structuralist ideologies such as the ones laid down by de Saussure (1983) in linguistics look at language as a series of interconnected relationships within a closed system

(Radford & Radford, 2004). When considering the Duchampian model, the relationship between the ready-made and the gallery does constitute a closed system, which supports itself through its self-referential relationship with art history and the institution and that which has been previously established, even though in doing so, this turns the whole idea of art history on its head in the manner, or in the spirit of the 'détournement' as described by Debord (1967), hijacking the institution and using its own mechanisms 'against itself' creating a situation and perhaps even a precedent, which is itself re-absorbed back into art history and acts as a point of reference for new forms or ideas of art to spring from. Language, like art, cannot be considered a closed system, and though inevitably self-referencing, can perhaps never be thought of as self-sustaining without external influences. It is the encounter of new situations and experiences, new connections and ideologies that spur the growth of both the arts and language. If new experiences and situations are not encountered, there would be no need to develop new ways of understanding, naming and expressing these encounters. The arts, at least in the contemporary idiom, are not about self-preservation but rather the creation of new knowledge, new things, the acquisition and the articulation of knowledge, knowledge that has and is becoming increasingly accessible in a technological and online society. This relationship between art and the way that we acquire knowledge has been radically altered due to the nature of being online. The way that knowledge is apprehended has become on one end increasingly facilitated, and on the other increasingly eclectic and unstructured. While more often than not we may understand advanced concepts through a simple Google search, the basics, or the foundation of what these more 'advanced' concepts are built upon remains obscure. This 'part understanding' is not necessarily a negative thing. From a purist stance on subjects and disciplines, this newly found, freely available knowledge becomes problematic, however in the name of growth and progress these incomplete montages of knowledge that

we are increasingly developing also allow for the considering and formation of new sets of structures that become inherently interdisciplinary, potentially ripe for the creation of new knowledge and the exploration of new directions.

In philosophy and art history there is a tendency for successive movements and ideologies to be a reaction to its predecessor(s) and for one ideology to exclude the other in a diametrically opposed stance. The way that an online society is changing the way that knowledge is apprehended and articulated, might perhaps organically shift this into a re-evaluation of the situation where one ideology need not exclude the other, and where the possibility for these to exist simultaneously within the same object/subject/system is created.

The relationship that humankind has developed with technology, and the software that most current technology runs on has permeated multiple levels of what it means to be human. Software has changed our relationship with practically everything. It has altered the relationship we have with our own selves (Bridle, 2011), with other individuals, with our environment and the objects that inhabit it, and also with our relationship with space and time and how distances in both the latter and the former can be compressed and extended in manners that our predecessors would have never imagined possible, but to us have become normal, everyday occurrences.

> Like the alphabet, mathematics, printing press, combustion engine, electricity,
> and integrated circuits, software re-adjusts and re-shapes everything it is
> applied to—or at least, it has a potential to do this. Just as adding a new
> dimension adds a new coordinate to every point in space, "adding" software to

culture changes the identity of everything that a culture is made from. (Manovich, 2013, pp. 32-33)

This observation echoes an earlier one by McLuhan (1964) who remarked "For the 'message' of any medium or technology is the change of scale or pace or pattern that it introduces into human affairs" (1964, p. 6). McLuhan continues by using a very fitting analogy to illustrate this point:

> The railway did not introduce movement or transportation or wheel or road into human society, but it accelerated and enlarged the scale of previous human functions, creating totally new kinds of cities and new kinds of work and leisure. (McLuhan, 1964, p. 6)

Software as previously observed has altered our relationship with knowledge and education as well as the creation of culture and cultural artefacts. Within the arts, and of course, sculpture is no exception, the way that we engage with and understand media has been radically altered, modifying, or perhaps, creating a concurrent (to the natural progression of) form of sculpture.

It might be beneficial at this point to define the role of digital technology in an artwork. In her introduction to *A Companion to Digital Art*, Christiane Paul (2016) suggests that:

> Works that involve digital technologies as a production tool do not necessarily reflect on these technologies. The materiality and aesthetics of these digitally produced works are still radically different from those of an interactive website that could be presented as an installation or projection, or experienced

on a screen; or a sensor–based interactive installation that needs to be "performed" by the audience; or a work that takes a material form but involved and critically addresses digital technologies. One needs to distinguish between art that uses digital technologies as a tool for the production of a more traditional art object—such as a photograph, print, or sculpture; and the digital–born art that employs these technologies as a tool for the creation of a less material, software–based form that utilizes the digital medium's inherent characteristics, such as its participatory and generative features. (Paul, 2016, p. 2)

Media theorist and scholar Charles Gere (2008) point out how digital technology has become so embedded in our society that it becomes invisible, almost considered natural. Comparing this to the countryside, which we have come to understand as natural, Gere points out how:

Like conservative fantasies about the countryside, it ignores the complex human forces that determined its development and present importance. Despite the sentimental rhetoric it inspires, the English countryside is an entirely artificial creation and takes its present form as the result of human needs, labour and social antagonism. (Gere, 2008, p. 202)

Gere (2008) discusses the roots of the technology we use on a daily basis, which he locates in military application developed during and just after World War II, taking a more recognisable form to what we consume on a daily basis through the security concerns during the Cold War (2008, p. 203). As a result of this Gere makes a very interesting comment about

the very technology that we have come to see as a natural extension of our daily lives. "Underpinning the way we do business, produce media, entertain ourselves and communicate are technologies that bear all the trademarks of the Cold War paranoia that produced them" (2008, p. 203). At the same time, and still influenced by the same Cold War context, avant-garde artists and thinkers looked at these technologies beyond their original purposes and reacted to the same Cold War scenarios in a very different manner.

> In the 1960s artists and others involved with media began to realize such ideas in technological form, in video, computers and multimedia. Out of this developed much of the current way we understand and use digital media. Though emerging out of similar concerns and in a similar context to the Cold War technological developments described above, the avant-garde re-oriented interactive and multi-media in a more utopian direction. (Gere, 2008, pp. 203-204)

These scenarios have pushed the understanding of technology as something that can expand the potentials of humankind, leading to the rise of ideals of techno-utopianism within 1960s counter-culture. Gere (2008) is quick in noting how our current understanding of digital technology and the technological society that has developed from this is the result of an amalgam of various, sometimes opposing factors.

> …some of the main elements out of which our current digital culture has been assembled: Cold War defence technologies; avant-garde art practice; counter-cultural techno-utopianism; postmodernist critical theory; new wave

subcultural style. Though, as time goes on, their presence becomes harder to detect. (Gere, 2008, p. 205)

The danger with this assimilation with technology in a way where it becomes inseparable from our daily lives lies in the camouflaging of dangerous ideologies that have shaped and constructed the very fabric of reality as experienced today, which are now considered as the natural state of reality. The digitisation of the world, whilst in no doubt adding and extending humankind's potential and possibilities, also comes with the concealed danger, or rather a number of piggy-back additions of dubious nature. Examples of this can include an increase in surveillance, a shift in the location of power and the structures that this operates upon where the control of access to information within an information age is crucial, leading to a more controlled, homogenised and confined society.

The inseparability of technology and reality is imbricated to a degree where it is now taken as given that new terminologies such as "post-digital" and "post-internet" have been developed. (Paul, 2016, p. 2)

The main ideologies behind the terms "post-digital" and "post-internet" do not mean that society, or rather the arts have reached a state beyond, or have reverted back to an era before internet or digital technology, but rather that these have become so common-place, that their influence is taken as a given. Utilised in the same manner that Krauss (1999) utilised the prefix 'post' in the idea of the post-medium essentially meaning beyond, the post-digital and the post-internet describe a condition where new forms of materiality emerge through the convergence of social and cultural content which flows across a multitude of media and platforms, that go beyond the original intention of the media itself (Jenkins, 2006).

Other theoretical positions that have developed through humankind's recent consumption of technology is what Birdle (2011) refers to as 'New Aesthetic' that Paul (2016) describes as an idea that stems from new relationships that society has started forming with itself through viewing itself through technology creating to a certain degree a new level of self-awareness. "The New Aesthetic, in particular, captures the process of seeing like and being seen through digital devices" (Paul, 2016, p. 3).

To some extent, technology has also developed into an eternal loop with our socio-cultural structures creating a situation where one struggles to make out which one is mirroring the other. I remember vividly observing a project-specific performance class of undergraduate Theatre Studies students conducted by Frank Camilleri, where the performers were being led through their motions, step by step, in a manner that is virtually indistinguishable from the way code is written. The performers were being coded to behave in a certain manner within a particular space and context, for a pre-established duration. Camilleri, by his own admission, is not familiar with how code is written for computers, in the same manner, as I would assume, that most computer programmers would not know how to 'code' a group of performers, however, essentially they are doing the exact same thing and operating with very similar logic. Since the 1950s and even earlier if one considers DADA as instruction or rule-based artistic practice as suggested by Paul (2016), there has been an interesting reversal of function, where the arts have started behaving in a manner that is very similar to the ways that computers behave, whilst simultaneously scientists and computer developers have been trying to make technology more human.

Cage and his relationship with Cunningham in the performance arts, and the subsequent infiltration of certain ideas into the so-called 'visual' arts initially through the

Fluxus and later through an array of conceptual or concept based art movements, were instrumental in the development of instruction or rule-based practices. Whilst Cage's ideologies can be attributed to oriental influences, as previously discussed by Gere (2008), there was also a strong counter-movement within the avant-garde that reacted to the military developments in technology and appropriated them in search of a utopian technology-based society. The structuring and pattern development and the confines that a rule-based system imparts inevitably brings with it echoes of computer behaviour. As discussed by Paul (2016):

> This emphasis on instructions connects to the algorithms that form the basis of any software and computer operation—a procedure of formal instructions that accomplish a "result" in a finite number of steps. (Paul, 2016, p. 5)

This led to the development of new forms of artwork that considered notions of interactivity and participation, as well as the idea that artworks and artistic interventions can be both the result of compound events and elements, as well as temporary and fluctuating in appearance, making them additive in terms of duration, mainly cumulative, rather than finite in their aesthetic form, such as in the traditional notion of a painting or a sculpture, but behaving more like a book, a musical performance or a theatrical piece.

The continuous development of software, from its early inception based in military applications to the myriad of different uses and applications today, has taken the arts and the way that these behave in and relate to social and cultural structures into entirely new directions. The major and perhaps most significant paradigm shift that software has initiated occurred through its absorption of numerous analogue audio-visual media and platforms, all of which have been made accessible through a single interface: the computer. "Over the last

two decades, software has replaced most other media technologies that emerged in the nineteenth and twentieth centuries" (Manovich, 2013, p. 2).

3. Software

> Today software plays a central role in shaping both the material elements and
> many of the immaterial structures that together make up "culture". (Manovich,
> 2013, p. 33)

Software and the audio-visual media that have made software their home for the past decades are social and cultural artefacts. They are not tied down by their physical nature, and as such, are in theory, fluid and endlessly mutable. However, this has not always been the case. Most audio-visual media today carry with them a baggage inherited from their early form of electronic and analogue states. The television for instance, now completely digital, is still virtually unchanged, albeit larger and sleeker looking, from its first incarnations in the early 1920s. The same applies to cinema. Even though the media are now digital, the screen and the projected rectangle are still the major ways of experiencing film and video. Contemporary technology I believe, has the potential to go beyond that. Due to 'functional fixedness' (Vaesen, 2012), society appears to be limited in its capability to understand, experience and engage with media in alternate manners, or to understand audio-visual media in multiple, simultaneous modalities.

Society takes time to adopt and adjust to an alternative manner of experiencing and engaging with audio-visual media. The question of audio-visual media as spatial artefacts, together with the relationship between the screen and an active audience have been a rich area of artistic and theoretical inquiry since the early 1960s with the concept of the 'interactive and expanded cinema' (Youngblood, 1970; Hatfield, 2003; Uroskie, 2014). Similar ideas developed by Oscar Fischinger in the late 1920s (Keefer, 2009; Scoates, 2013)

suggest that the conception of an expanded audio-visual artefact might date back to the origins of the medium itself. Adopting a similar stance to that taken by Judd (1965) who spoke of the rectangle in painting as an unnatural limit, artists such as Steve Farrer challenged the idea of the projected rectangle and the screen, with works such as "The Machine" (1978-88) that consists of a mechanically revolving projector projecting in 360 degrees. Farrer's work looked at the relationship between the machine and the audio-visual medium and between the audio-visual medium and physical space (Tate, 2009).

Silver (2006) speaks of software as a universal when he observes how computers are universal machines:

> Unlike classical machines (clocks, steam engines and tin-openers) they can perform a wide variety of tasks without significant changes to their physical design. Through the writing of new programs, very different operations can be executed on a single device. (Silver, 2006, p. 9)

Silver continues by pointing out how this universality that software by its very nature allows for "supports difference in opposition to the sterile homogeneity commonly associated with rigid protocols and fixed procedures" (2006, p. 11). Similarly, Manovich (2013) remarks how software becomes "our interface to the world, to others, to our memory and our imagination - a universal language which the world speaks, and a universal engine on which the world runs" (Manovich, 2013, p. 2). More importantly, Manovich questions the notion of the 'medium' in contemporary culture and society.

> What happens to the idea of a 'medium' after previously media-specific tools have been simulated and extended in software? Is it still meaningful to talk

about different mediums at all? Or do we now find ourselves in a new brave world of one single monomedium, or a metamedium? (Manovich, 2013, p. 4)

As stated previously, an interactive, sculptural ecology that makes use of digital technology can be understood as a series of systems, interconnected to one another which are in constant relation to each other. As conceived in systems theories, especially those that look at living systems, these interactive interconnections are not only bound to the digital realm. As remarked by Guadenzi (2013a, 2013b), the viewer or observer, as a living, cognitive, organism, is a system within him/her self, becoming inseparable from the system observed, where the results of observations would depend on the interaction between the observer and the observed.

These observations are echoed in Deleuze (1986) who spoke of cinema as an art of movement and time where the viewer fuses with the artefact, essentially becoming part of it. Deleuze describes cinema as an 'externalisation' or as remarked by McLuhan (1964) an 'extension' of the human ability to mentally construct visual narratives through assembling with movement and image, and it's location in time. The image Deleuze states, is inseparable from a before and after, its past and its future, with the present only existing as a limit, a tension between the two states of the image.

What is in the present is what the image 'represents', but not the image itself, which, in cinema as in painting, is never to be confused with what it represents. The image itself is the system of relationships between its elements, that is, a set of relationships of time from which the variable present only flows. (Deleuze, 1989, p. xii)

Time in itself has no real significance. Meaning, sensation and intensity are what is given to time (pure duration) through the spatio-temporal montages we form with media.

The audio-visual medium as a sculptural medium hence becomes as described by Manovich (2001, p. 233) a series of "spatial montages" or "temporal montages", a construction in real time formed by the relationship between the author/artist, the active user, technology, subject matter, society and culture, occurring simultaneously within physical and digital space.

The nature of software itself is one of constant dynamic motion, like a living being it is constantly growing, changing, reflecting and affecting new trends in culture. Software becomes an integral part of and a shaper of culture which in turn shapes software to suit new emerging trends that reflect previous changes in the software that runs our daily technologically dependent life, creating a cybernetic feedback loop with society. As a result of this, software, like the human component within a sculptural ecology, is never stable, never 'finished', or at rest in the same manner that objects composed of physical matter traditionally are.

> Thanks to the practices pioneered by Google, the world is now used to running
>
> on web applications and services that have never been officially completed but
>
> remain forever in Beta stage. Since these applications and services run on the
>
> remote servers, they can be updated anytime without consumers having to do
>
> anything— and in fact, Google is updating its search algorithm code a few
>
> times a day. Similarly, Facebook is also updating its code daily, and sometimes
>
> it breaks. (Manovich, 2013, p. 1)

Software as described by Manovich (2013) increasingly acts as a glue that holds society together. The age that we are living in, often referred to as an information age, makes use of software at its core in order to connect together the multitude of daily engagements and interactions which humankind conducts within society itself on both macro and micro scales, as well as with the environment. Even though these daily interactions have different motivations and goals and make use of different metrics and units of measure, and in some instances are even conducted in different languages, the common core that all these transfers of data share, is the way that the data is structured in terms of software. Manovich (2013) describes these as "…the syntaxes of software: control statements "if then" and "while do," operators and data types (such as characters and floating point numbers), data structures such as lists, and interface conventions encompassing menus and dialog boxes" (2013, p. 8).

Manovich (2013) continues by highlighting how a large chunk of humankind, such as current key economic sectors not only run on, but would perhaps be inexistent without software. "The "knowledge workers," the "symbol analysts," the "creative industries," and the "service industries"—none of these key economic players of the information society can exist without software" (Manovich, 2013, p. 8).

The key to software's influence on practically everything within an information age, lies, unsurprisingly in its handling and processing of data, of information, and the facilitation, through software of transferring this information from one point to another whilst converting it in a manner that is accessible and understandable to each element within the information chain. Systems theories as previously discussed, place the transfer of information as a key structural component that essentially runs the system. Weiner (1948) as explained by Paul (2016) made information the centre of his original idea of cybernetic systems.

Weiner defined three central concepts which he maintains were crucial in any organism or system—communication, control, and feedback—and postulated that the guiding principle behind life and organization is information, the information contained in messages. (Paul, 2016, p. 4)

Essentially there is no real difference between the model of a sculptural ecology and a cybernetic system as described by Weiner (1948) and later applied to sculpture by Burnham (1968). Sculpture works both as an open and closed system, on macro and micro levels, behaving like living systems as suggested by Gaudenzi (2013a). One has to consider the possibility of sculpture existing not only as a singular process but also as compound aggregates of sculptural processes, that can have multiple roles and effects within a larger context, whilst also behaving differently and independently within the same ecology. Software is what makes sculpture capable of this - what makes it self-aware with the ability to create material and information independently.

In a way, the traditional relationship between a sculptural object and the viewer is perhaps not inverted but rather balanced. It is no longer the viewer who is looking at the artwork, but through cameras and a variety of other sensors, the artwork is also looking back. Through the transfer of information supported by the software/sculpture amalgam, content is created. It is perhaps important to mention that neither the audience nor the software is in control, or rather dictating/deciding the way that this content is being created. The two become intertwined in a classical positive feedback loop. What is perhaps different from the classical model of a feedback loop is that software can engage with multiple viewers at the same time forming unique and individual relationships that can have different dynamics and appear and disappear, affecting the generation of content, but not really the 'structural

integrity' of the system. As software behaves as a living system, but is non-living, at least in biological terms, the system, or rather the whole ecology can lie in a dormant state indefinitely without repercussion.

The role of the artist within a sculptural ecology is also a non-fixed, dynamic one that exists in multiple states on multiple levels. Whilst it is the artist who initially establishes the original elements, constructing the scenario, establishing the rules and boundaries, once the ecology has been established, the role of the artist, is taken up by the system itself - the created becomes the creator. The artist becomes part of the ecology as a member of the audience. In a way, the establishing of a sculptural ecology is similar to pushing a car off a cliff. One may choose the car model, colour and other specifications, one may choose the cliff to roll it off, the date, select a particular weather and time to initiate the process, but that is as far as one gets to control. Once the car reaches the tipping point there is little one can do to reverse the process and to control how far down the car will end, if it will explode upon impact, catch fire, or how many times it will roll, if at all, and where and when it will come to rest is everyone's guess.

The sculptor, shaper of ecologies rather than matter, develops what can be considered as a cumulative relationship with the sculptural artefact system. In more ways than one, this is akin to a parent-child relationship, where initially the creation is totally dependant on the creator. The two then start developing a relationship, where the creation is shaped by the creator until the creation is capable of taking the role of a creator itself. The creation may misbehave and let the creator down on occasion, or make the creator proud as growth is achieved. The process, the development, of this relationship shapes not only the artefact but

also the sculptor, perhaps at a different rate, however, through their encounter, both shall remain permanently changed.

Throughout my practice as a sculptor, I have been observing, perhaps through retrospective reflection brought by temporal distance, or detachment from the work and the relationships developed with my artworks, that my role in relation to my exhibited sculptural works has been changing significantly as my practice evolved, and continues to evolve the more it comes in contact with my own work. I have used the term 'exhibited' to refer to these artworks rather than the term 'finished' as these sculptural artefacts are never really in a finished state, in the same way that a painting or a bronze sculpture can be. In more ways than one, exhibiting these artworks is a starting point rather than an end point, an idea that is perhaps the total opposite of most traditional or conventional forms of not only sculpture, but for most artistic practices in general. To a certain extent, exhibiting these artworks means that the artworks come of age and are capable of supporting themselves. In relation to this my role has been anywhere from being non-present, to observing the audience engaging with the artwork externally, like a child looking at an aquarium, to a role similar to that of a salesperson in a trade-fair demonstrating a product and its capabilities to an audience, progressing into the role of a performer, totally engulfed and becoming a part of the artwork itself.

The fluid nature of sculptural artefacts that utilise software means that every time the same artwork is exhibited my role as a sculptor/performer/component of the system can (and does, more often than not) change between roles, or the roles can be all of the discussed or none at all. The work itself changes between one exhibition and another even if the system is established in an identical manner, as the relationship between the components of the

sculptural artwork and my role, the relationship with the artwork itself inevitably changes. A sculptural ecology, as a semi-sentient, living, hybrid organism/sculpture/set of relationships, is the product of a continuous transfer of information. Whilst this transfer of information is or may be in part composed of physical matter, this does not really have a physical form in the conventional sense of the word. Its form is to a certain extent defined through its presence and motions in space. Sculpture defined in this manner is a process of information shaping. It makes no difference if the information is fixed and non-changing across time; a series of relationships between points in space of a physical object, such as for instance, in Michelangelo's "David" (1504). On the other end of the scale, we might find work that makes use of a more complex series of relationships and transfers of information between physical objects (both tangible and intangible), digital technology, software and living organisms in multiple spaces, places and dimensional planes which may behave like multiple disciplines within the arts at the same time, such as the works developed as part of this research. What always remains the same, however, is the process of sculpture as an act of shaping information. Sculpture, through software, becomes a meta-process of shaping data and information, information that the process in itself is creating.

Software and sculpture in conjunction as a meta-process, take a position that generates, transfers and shapes information, which transcends the idea of denominations, disciplines and modalities within the arts as well as the boundaries between spaces and places, be they physical, digital or virtual, mental, actual or imaginary or any hybrid configuration of these. Soft(ware) Sculpture furthermore is never constrained by time and through its hybrid nature has the capability of expanding and contracting time, to freeze it and to travel through it at any speed and in any direction.

The fluid nature that allows sculpture to move across, in and out of time and space could be attributed to its now interdependent relationship with software, brought about by an information society of which both software and sculpture are products of. This relationship to a certain extent liberates sculpture from its material and spatial attachment, however, without limiting the possibility for sculpture's relationship with space and matter to keep proliferating. The physicality of sculpture is still one of its most important defining factors and what perhaps clearly distinguishes software from sculpture, and also what distinguished sculpture from other forms of artistic output. This is not to say, however, that sculpture merely acts as an interface to software, sculpture rather extends software, in the very same manner than software extends sculpture. Software itself is not simply composed of dematerialised information. As observed by Bratton (2015) the dematerialised data and information held in the perhaps even more abstract and dematerialised idea of the cloud is physically backed up as physical indentations on hard drives and silicon chips, on physical servers located in physical places.

3.1 Software = Sculpture

Software and sculpture can be considered equal on many levels. Software perhaps operates on a level that is outside of human scale. The way that both software and sculpture shape information and data in order to create new objects, knowledge, experiences and environments creates ample opportunities for overlap. At their base level, they both operate in similar manners. In software information is written, stored and modelled in 'machine language' in ones and zeros, pluses of on and off signals, whilst sculpture in its traditional form can be roughly and perhaps very crudely divided into additive and reductive processes

that add and remove information, most commonly in the form of physical matter, such as for instance, modelling with clay (additive) and carving in stone (reductive).

Sculpture in its meta-process state simply means that through the generation, manipulation and transmission of information, meaning can be created, altered and disseminated freely across multiple states, dimensions and modalities. For instance, data generated from an earthquake can be transformed into a musical score which may be performed in real time as a moving image composed of light built through sound, or perhaps the same information can be converted into a series of instructions for a stepper motor to execute that may result in the creation of an object through a 3D printer, or as a drawing in space executed by a drone quadcopter. The possibilities are indeed endless.

Software is the ground and as expressed by Fuller (Fuller, 2006 as cited in Manovich, 2013, p. 11) the "stuff" that media is made of. Similarly, Wardip-Fruin (2009) quoted in Manovich (2013) raises concerns on how:

> Almost all of these have focused on what the machines of digital media look
>
> from the outside: their output…regardless of perspective, writings on digital
>
> media almost all ignore something crucial: the actual processes that make
>
> digital media possible. (Wardip-Fruin, 2009, as cited in Manovich, 2013, p.
>
> 10)

Digital media or what is often referred to in the arts as 'new media' can be understood as artistic processes that make use of raw data, or information that is reconfigured through software in a way that we as humans can relate to and/or understand. Similar to the process of

sculpture, software is what gives meaning to information, through shaping it, through giving it structure.

Manovich (2013) mentions the work of Rheingold (1985) written at the time when the computer was being domesticated as fundamental in its proposition of software not only as a tool or a technology but rather as a medium in which and through which humankind can imagine differently. Manovich (2013, p. 10) goes on to describe software as *"…the medium where human intellectual creativity now dwells."*

Software, however, is capable of behaving beyond the conventional notion of media. It can act as a platform on which media runs, exists and is shared. It can create environments, objects and tools with which the same objects, environments and tools themselves are created. This co-existence between 'content creation' and access to the created content is according to Manovich one of the distinguishing features of software culture. Manovich (2013) also makes an important distinction between "media/content" and "data/information", which he views as the two faces of a coin within the same continuous dimension. Whilst a feature film and an Excel spreadsheet can be seen as clearly defined representations of both ends of the spectrum, such clearly defined examples are generally the exception rather than the rule. In the practical component of this thesis, the resulting artworks fit equally in both categories as data or information is being generated and converted in real time into content in the form of physical/digital media, creating new meaning in the process. Similarly, on this Manovich (2013) remarks:

It is still 'data' but data represented in a new way which allows us to arrive at insights and 'knowledge'. It also becomes a piece of visual media which

appeals to our senses in the same way that photographs or paintings do. (2013,

p. 30)

Manovich (2013) remarks how traditional media were absorbed into the digital world with little or no alteration to the original conventions. This could perhaps be attributed to the rather abrupt transfer from physical/analogue media into digital media that initially worked more in terms of emulation or simulation, rather than an exploration of what the digital realm could offer to the traditional media. Bolter and Grusin (2000) call this the process of 'remediation' which they define as "the representation of one medium in another" (2000, p. 45). Manovich (2013) also weighs in on this by observing how "…new media always remediate the old ones and therefore we should not expect that computers would function any differently…The only difference between computers and other media lies in how and what they remediate" (Manovich, 2013, p. 59).

Bolter and Grusin (2000) consider remediation, which they divide into 'immediacy' and 'hypermediacy' as the defining characteristics of digital media. Remediation, or the act of representing one medium into another, finds its roots in software studies through the writings of McLuhan (1964) who stated that "…the content of any medium is always another medium. The content of writing is speech, just as the written word is the content of print, and print is the content of the telegraph" (McLuhan, 1964, pp. 23-24).

Hypermediacy and immediacy function through what Bolter and Grusin (2000) call 'transparency' or the lack of it. By transparency Bolter and Grusin intend the aim for the medium itself to disappear, in order to focus on content, experience and immersion. This is a direct reference to the physical, mechanical and analogue roots of the media that is in itself

being remediated in another media. Immediacy is tactile, going beyond the computer screen and the computer's workings. Transparency is achieved, or rather varying degrees of, it through physical action, like, for instance, clicking on a menu button, mimicking an action in the 'real world', which gives what can be considered a low level of transparency in relation to physical action in the 'real world'. Other interactions such as gestural control, or sensor based 'clicking' can be considered as a higher level of transparency, or a more successful attempt at transparency as the medium itself practically disappears.

Hypermediacy works for the most part, in opposition to immediacy. Stemming from the idea of hypermedia, or rather the grouping together of a number of media, that through software are arranged through hyper-textual structures into larger structures that are linked to one another to create even larger structures of information that are fluid in appearance and behaviour. Manovich (2001, 2013) refers to this as hybridity, which is due to the very nature of digital technology and how this has remediated and absorbed within it practically all of its predecessors. Mitchell (1994) describes this as a phenomenon that "privileges fragmentation, indeterminacy and heterogeneity and… emphasises process on performance rather than the finished art object" (Mitchell, 1994, as cited in Bolter and Grusin, 2000, p. 31). Similarly, on hypermedia and the hypermediatic structures that these operate upon Colten and Oliver (1993) write

> An entirely new kind of media experience born from the marriage of TV and computer technologies. Its raw ingredients are sound, text, animation and video, which can be brought together in any combination. It is a medium that offers 'random access', it has no physical beginning, middle or end. (Colten and Oliver, 1993, as cited in Bolter and Grusin, 2000, p. 31)

Whilst Bolter and Grusin (2000) think of hypermediacy as a product of its age within a new technological society and as the opposite of transparent immediacy, as hypermediacy by nature, makes technology visible or perceivable, its function, one would argue goes beyond that of a state of opposition. Hypermediacy essentially enables media to remediate itself through other media, not only in a linear manner, such as writing into print, but also across and in multiple configurations, being that these media all run and function on the same platform. Through software, raw data and information can be structured and shaped in any fashion, allowing for images to make sound, and for sound to make writing. Any progress or technological advancement in one area is instantly applicable to the whole hypermedia cluster creating structures that are in constant growth and evolution.

In this thesis and the practice that accompanies it, these modes of remediating content and actions have been employed. Immediacy, or rather, transparent immediacy, where objects and processes are transformed in real time is balanced with hypermediacy, where the result of these transformations shift across predefined media constructs and understanding, essentially creating new forms of media and media compounds in continuity. The goal is to arrive at a state of remediation through which new meaning and knowledge are created and through which social and cultural structures can be (re)shaped. These states of remediation are integral components of the meta-process of sculpture.

The nature of media, together with the cultural baggage and associations that these bring with them enable sculpture to act directly upon the lower or base levels of the meaning-making project that humankind has engaged in and initiated with the world.

3.2 Audio-Visual Media in Contemporary Artistic Practices

Lund and Carvahlo (2015) identify the major contemporary audio-visual practices and their defining characteristics. Lund (2015) argues that the term audio-visual in itself implies intermedia relationships in the tradition of Fischinger and as later theorised by Higgins (1965). Lund (2015) states how the interest and the subsequent development of practices and modalities can be split into three major waves since the beginning of the twentieth century. The first wave is what Lund refers to as the 'period of synesthesia' at the beginning of the century, roughly between 1900 and 1930, where through film and the cinematic medium, modernist artists showed interest in the correlation between sound and image, such as in the works of Kandinsky, Fischinger and others. The second wave came around the 1960s, a period that Lund defines as the expanded arts period. During this time artists and theoreticians were looking beyond the limitations that were established and imposed on their medium. In this period there were ideas such as Younglood's (1970) idea of expanded cinema, Burnham (1968), Judd (1965) and Krauss' (1979) ideas in sculpture, as well as the work of Higgins (1965) who coined the term Intermedia. The third wave of audio-visual growth Lund places as starting from around the 1990s, a period which she calls the period of 'ongoing digitisation', a process that is still ongoing with no signs of slowing down to this very day. In this third wave computer and software, as discussed earlier, absorbed within themselves virtually all of the media that came before them, offering new possibilities and configurations with regards to the relationship between the aural and the visual. The digital era also put a greater emphasis on the real-time and live aspect of audio-visual media leading Lund and Carvahlo (2015) to list: Liveness; Intermediality; Performativity and Cinemacity as the four main characteristics of contemporary audio-visual practices.

Lund (2015) also revises the idea of intermediality which she argues is rooted in the discursive context of the 1960s and reframes it within a now prevalent digital focus. Like Manovich (2013), Lund comes to the conclusion that the digitisation of media turns single media and intermedia relations into the idea of a metamedium.

> It seems tempting to take up a concept which addresses more directly the relations of media under the sign of the digital: the 'metamedium', as the result of an 'active mix' of media as opposed to multimedia seen as a mere addition of media. (Lund, 2015, p. 37)

Lund and Carvahlo (2015) identify five major branches of contemporary audio-visual practices which they list as: Visual Music; Expanded Cinema; Live Cinema; VJing; and Live Audio-Visual Performance.

The term audio-visual and the nature of audio-visual media and practices lies in the combination of the two elements that make it up: the aural and the visual.

> By itself, 'audiovisuality' is not an artistic practice but describes a generic group of practices…the variety of work presented expresses the enormous possibilities within this combination. Consequently, part of the difficulties of working out stable definitions are the infinite technical, conceptual and aesthetic possibilities for using sound and image. (Lund, 2015, p. 13)

Lund's statement in this regard, which is later echoed in Carvahlo's essay on "Live Audio-Visual Performance" (2015) within the same publication, showcases a major problem in the theoretical and the majority of practice-based approaches to audio-visual media. For the most part audio-visual is taken as the relationship between sound and image. The problematics behind this lie in the lack of sustained research of other forms of visual expression other than the image, which in itself is perhaps inherently symptomatic of the

major areas of interest of these two theorists - visual music and live audio-visual performance, which shall be discussed later. With the notable exception of expanded cinema and some branches of live audio-visual performance, which as a term in itself can be used to describe practically anything, all current audio-visual practices and the theories behind them, consider the visual part to be purely image-based, or at least, one may say that there is a heavy bias towards the image. It might be argued that as humans, our sensory apparatus deals with vision in terms of images, stereoscopic images to be more precise, through which a virtual three-dimensional model of the environment is constructed, allowing for an understanding of three-dimensional form that aids in successfully navigating our environment. This might perhaps be the reason why for the most part the visual component is almost invariably considered in terms of image. There might, however, be other reasons for this, reasons that have to do with the media itself.

The 'problem' with most audio-visual work and discourse around this work is that, especially since the digitisation of the multitude of media elements that do not in themselves constitute the idea of audio-visuality, there has been a consolidated compression, or a flattening down of the layers that make up the audio-visual fusion as well as how the idea of audio-visuality itself is approached. The two-dimensional plane has been taken as arguably the only manner of initiating and experiencing the intermedia fusion between the aural and the visual. The screen and the projected rectangle have always acted as a sort of dimensional window through which this intermedia fusion between the aural and the visual can be created and accessed. These limitations had already been discussed by Youngblood (1970) through his ideas on expanded cinema, and consequently mirrored in painting and sculpture through the writings of Judd, (1965) however, again perhaps due to 'functional fixedness' (Vaesen, 2012), cultural selection (Appelbaum, 2003), or as observed by Grau (2009) the manner in

which the arts tend to be always referencing previous artworks, it appears that in terms of artistic practice, generally speaking, there is little concern from practitioners to go beyond this problem of a self-imposed limitation and as a result most audio-visual work is mainly made for the screen or the projector.

In the 'real world' after all one would be hard pressed to find examples where we experience a true separation between the aural and the visual, and these are generally always experienced as one. Consequently, there is very little on how audio-visual media relate to sculpture, however, this perhaps again boils down to a question of perspective. Is Harry Bertoia's "Sonambient" (1970s) not audio-visual? Can Alvin Lucier's "Music on a Long Thin Wire" (1977) be considered in audio-visual terms in the same manner that Anthony Mc Call's "Line Describing a Cone" (1973) is? The latter work was explained by Walley (2003) who describes McCall's piece as 'paracinema', similar to what Levi (2012) calls "cinema by other means". To take this further, perhaps to the point of triviality in order to illustrate the point, cannot an instrument, such as a guitar be potentially classified as an audio-visual sculpture or work? Similarly, why cannot we consider the mating display from some exotic birds as audio-visual (work, performance and so on)? Lund (2015) observes how audio-visuality need not involve technology or rather electronic/digital technology as shadow puppetry and theatre can be considered audio-visual. What happens when one applies this to sculpture? Cannot an artwork be simultaneously sculptural and audio-visual? Sculpture, after all, is for the most part visual, potentially aural and occasionally both.

The relationship between sculpture and audio-visual media has a close affinity with the concept behind expanded cinema practices as proposed in the late 1960s and the 1970s, and through its extension in the 1980s, through what Meigh-Andrews (2014) refers to as video sculpture. The elements of interaction, and performativity, as well as liveness and

immediality extend these audio-visual practices well into the 21st Century as well as into the contemporary discourse of sculpture.

On his work "Eau D'Artifice" (1990) Meigh-Andrews (2014) observes: "…the space between the monitors was of crucial importance to the experience" (2014, p. 301). Meigh-Andrews later adds "Video Sculpture although a sub-set of multi-channel video, is less cinematic and more sculptural" (Meigh-Andrews, 2014, p. 302). Meigh-Andrews (2014) quotes Rist (2001) in stating (written in 1993):

> The world in front of, behind, in between the window and TV is the biggest video installation imaginable. It is all just a question of point of view. Video is the synthesis of music, language, painting, mangy mean pictures, time, sexuality, lighting, action and technology. (Rist, 2001, as cited in Meigh-Andrews, 2014, p. 303)

Video, through this reasoning becomes sculptural, to be exact, sculptural through spatiality by default as the screen, monitor or television can be considered in themselves as sculptural objects and thus the artistic intervention can be considered 'in the round' or in how this relates in spatial terms as considered by Partridge (1976, as cited in Meigh-Andrews, 2014, pp. 172-173) and by Hall (1990, as cited in Meigh-Andrews, 2014, pp. 240-241). Such an approach to the screen can be seen in the works of Nam June Paik, an example of which is his piece "Family of Robot: Baby" (1986) & "Magnet TV" (1965) where the screen is considered as a physical object and the imagery is created through physical interaction. Tony Oursler considers the sculptural nature of video beyond the screen with his series of "Talking Dummies" such as "Crying Doll" (1989) and "Judy" (1994) which go beyond the notion of creating images, but rather attempt to create situations (Meigh-Andrews, 2014, p. 307) and

can be considered as precursors to the current projection mapping technology which will be discussed at a later stage (section 4.1).

Elwes (2005) comments on how "Nam June Paik believed that video most resembled life in its material mortality; video art imitates nature, not in its appearance or mass, but in its intimate 'time structure'" (Elwes, 2005, p. 15). In Chris Meigh-Andrew's "Streamline" (1991) the artist creates not an image of a stream or a representation but rather reconstructs a stream physically through video and the monitors themselves. The physical, spatial and temporal elements that make up a stream are all there, reconstructed physically through other media - moving image, sound and structured sculpturally within space and time.

Cinema emerged as one of the first real 'meta-mediums' - photography, sound, architecture, theatre and music all combined (Elwes, 2005; May 2015). What becomes interesting is that through digitisation software has engulfed cinema in its entirety, making it in turn virtually indistinguishable from video and television that are now produced in the same manner on the same platform, at least when one considers these in terms of the image produced (Wyver, 1991). What remains, up till now, until virtual reality technology figures how to get there convincingly, is the cinematic experience - the theatre, the lights out, the smells, the seating, the chatter, the intermission and so on. A question that obviously has no real answer in this regard is the classic 'what would be considered as cinema?'; Orson Wells' *Citizen Kane* (1941) viewed on a tablet, or the final of the FIFA World Cup viewed in a cinema theatre?

The idea of cinema as a metamedium becomes problematic considering that also software has been similarly identified as a metamedium. Perhaps software which like sculpture can also occupy the position of a meta-process, can also, in terms of how it relates

to media, be considered as a monomedium as also suggested by Manovich (2013). Software, like sculpture when considered as a process, behaves differently to cinema. Software has the capability of creating or rather synthesising the actual tools to build and modify itself, much in the same manner as with the sculptural process, where one is capable of building the tools to create sculpture itself, as well as a whole array of other things. Cinema, at least in its traditional format is not capable of this, as it depends on the specificity of the medium and the format of how it is consumed.

3.3 Expanded Cinema or Cinema by Other Means

Expanded cinema, on the other hand, behaves somewhat differently from the conventional modes of cinema, being somewhat of an oddity in the family of audio-visual practices. Expanded cinema has an affinity with sculpture on multiple levels and is considered as an important precursor to both installation art and video sculpture (May, 2015). Expanded Cinema is cinema from a meta-perspective, a cinematic approach that has the capability of zooming out and taking a look at itself from the exterior. The word 'expanded' in expanded cinema should not be taken as simply referring to expansion in the spatial dimension. Youngblood (1970) introduces the idea of expanded cinema in this manner:

> When we say expanded cinema we actually mean expanded consciousness…
> Expanded Cinema isn't a movie at all: like if it's a process of becoming, man's ongoing historical drive to manifest his consciousness outside of his mind, in front of his own eyes. One no longer can specialize in a single discipline and hope truthfully to express a clear picture of its relationship to the environment.
> (Youngblood, 1970, p. 41)

In this light, Youngblood's concept of expanded cinema goes beyond the cinematic medium itself and expresses the same concerns that all of the arts, especially sculpture as understood in this thesis, encounter when navigating an age where medium (and also process) specificity becomes problematic for the limitations that this imposes. The rise of technology and the acceleration of it through the ages has fused the arts in a dense cluster of interconnected disciplines and modalities. Whilst this has always been and shall always continue to be met with resistance, this fusion does not aim to destroy or extinguish any particular modality, or to eradicate the identity of disciplines or modalities of art-making, but rather to expand them beyond their original confines. This reflects and responds to society where we are now accustomed to accessing or engaging with different content and media through single devices, moving freely between one content and another. With a smartphone, for instance, one may make a movie, or watch it, make music, check the weather, send emails, read a book, play games or engage with others on social platforms. Whilst devices that do only one of these 'functions' do exist, and they will continue to exist in parallel to the smartphone, one has to acknowledge the coexistence of these two similar but distinct methods with which to access and create the same content.

Contemporary discourse on expanded cinema resonate with Youngblood's original ideology and repackage this within a contemporary context. The temporal and contextual distances with which these ideologies are now seen, together with the advancements in technology and the practice of expanded cinema itself, allows for a re-articulation of the cinematic medium, which places it at a position similar on many accounts to that of sculpture. May (2015) expands upon ideas as proposed by Walley (2003) and Levi (2012) in observing how cinema and what Levi (2012) calls "cinema by other means" have always coexisted. By 'cinema by other means' Levi understands the:

Conceptualization of cinema as itself a type of practice that, since the invention of the film apparatus has also (simultaneously) had a history of execution through other, often 'older', artistic media … The practice of posting cinema as a system of relations directly inspired through the workings of the film apparatus, but evoked through the material and technological properties of the original non filmic media (Levi, 2012, p. 27).

These observations, essentially re-frame Youngblood's words, where he states as quoted earlier, that expanded cinema is perhaps a tentative solution to "…man's ongoing historical drive to manifest his consciousness outside of his mind, in front of his eyes…" (Youngblood, 1970, p. 41).

It is through remediation, or perhaps in expanded cinema terms, an oscillation between (transparent) immediacy and hypermediacy as previously discussed through the work of Bolter and Grusin (2000), that expanded cinema proposes to achieve this externalised manifestation of consciousness. May (2015) expands upon Walley (2003) who uses the term 'para cinema', a term first used by artist Ken Jacobs (Hanlon, 1974; Huhtamo, 2016) to describe his cinematic/performative work that made use of shadow imagery rather than celluloid. By 'para cinema' Walley understands:

An array of phenomena that are considered 'cinematic' but are not embodied in the materials film as traditionally defined. This is, the film works I am addressing recognise cinematic properties outside the standard film apparatus, and therefore reject the medium-specific premise of most essentialist theory and practice that the art form of cinema is defined by the specific medium of film. (Walley, 2003 as cited in May, 2015, p. 51)

May (2015) argues that Walley's reasoning creates a clear distinction between cinema as an idea and 'its materials', thus following on Lippard's (1968; 1973) notion of the 'dematerialised art object' that brings 'para cinema' closer to the idea of conceptual art. May, however continues by quoting Baker (2000) in highlighting the potential pitfalls of these ideas which might lead to being read as "…a false and ultimately Platonic separation of 'matter and idea' that is one of the most common and banal of the misreadings to which so-called Conceptual art has been repeatedly subjected" (Baker, 2000, as cited in May, 2015, p. 53). May (2015) reasons that Walley's definition of 'para cinema' is a process of 'rematerialisation' rather than one of dematerialisation. "…a set of movements through which 'cinema' unfolds in the form of multiple materialities…" (May, 2015, p. 53).

These ideas when transposed to the arts in a broader context highlight the importance of the remediation process in contemporary artistic discourse and practice. Through a combination of software and remediation processes such as cinema, sculpture, music and other forms of performance, an artistic expression be it in the form of an idea, information or an intervention in society can be thought of and expressed by other and exchangeable means. Similarly, this could also work in reverse and the processes could themselves potentially behave like software. May (2015) toys with the idea of participation rather than belonging as proposed by Derrida (1980) who spoke of a literary genre that can participate in multiple genres without belonging to any of them. May (2015) however finds the application of these ideas as problematic:

> Indeed, while we would like to describe similar processes, these are to be found in the way such modalities of participation are (re-) mediated through apparatuses that distribute objects, discourses and technologies within specific spatial and temporal situations. (May, 2015, p. 44)

Whilst May hesitates on the idea of participation without belonging, this idea need not apply to objects, ideas or processes that exist within the same liner plane such as in literary genres as expressed by Derrida where all literary genres exist as a subset of literature. In my previous research (Galea, 2015) I had proposed the concept of hyperdisciplinarity to describe artworks that can be considered as interventions within multiple artistic disciplines simultaneously without effectively belonging to any particular one. Whilst I believe my practice to be a sculptural one, at least at its point of departure, there is nothing that can prevent it from behaving as and being read as musical, or performative, cinematic or painterly. What perhaps differentiates one's practice from another is the rate of remediation, a ratio of sorts between immediacy and hypermediacy which is dependant on the modality, media and processes of the artwork itself.

3.4 Ratios of Remediation in Contemporary Audio-Visual Media

The remediation ratio is what perhaps determines or distinguishes one practice from another, and what differentiates between one artwork and another. Expanded cinema's direct descendants out of the five major categories of contemporary audio-visual practices as defined by Lund and Carvahlo (2015) (Live Cinema, VJing and Live Audio-Visual Performance) could be primarily defined by the way that they remediate abstract thought, matter, human interaction and intermedia relationships. The other practice that Lund and Carvahlo (2015) list, Visual Music works a bit differently as most of the output in this direction tends to be considered in terms of image-making rather than meaning-making, with the resulting imagery being conceived through the intrinsic relationship that visual music has with musicology. Whilst there is a fascinating historical genealogy, especially in the regions

where visual music overlaps with video art, and whilst the practical body of work developed during this thesis has an inevitable relationship with musicology, as shall be discussed later on (section 5.3), visual music, understood as the production of visual compositions led by music tends to work in a series of confined systems that are mainly constructed out of relationships between colour and pitch and perhaps more abstractly through a series of arbitrary relationships between emotions and music. In a number of ways most of visual music output can be thought of as 'paracinematic' or as 'cinema through other means' as defined by Walley, (2003) Levi (2012) and May, (2015), as a form of moving image produced primarily through 'non-filmic' techniques, a tangential offshoot from the origins of expanded cinema that find its roots (in its current form) in early video production.

VJing coming from the words 'Visual' 'Jockey', which is sometimes also written as Vee Jay, in itself coming from the personality of the Disk Jockey, or DJ, which shares a number of commonalities with visual music, expanded cinema and live audio-visual performance. Predicted by Youngblood (1970) and finding its current roots in Fischinger's Raumlichtkunst, VJing is also directly related to the practice of Live Cinema, in itself perhaps a hypermediated progression of expanded cinema practices, that developed and remediated itself in reaction to advancements in technology.

The major differentiating factor between the practice of VJing and Live Cinema essentially lies in the location and therefore the contexts within which these practices are presented and executed. VJing is usually set in clubs, concerts and festivals whilst Live Cinema is usually set in museums and theatres (Mentotti, 2015). The manner in how the audience engages with these practices is also different. In a club scenario the audience is usually standing, dancing and drinking (or indulging in other substances) whilst in Live Cinema the audience is conventionally seated and watching attentively (Makela, 2008).

VJing also makes participation, reciprocity and interaction its major defining characteristics (Fischer, 2015), which are to a certain extent shared with Live Cinema, albeit, admittedly on different levels. VJing, unlike Live Cinema, is also by nature collaborative, where the VJ works in parallel to his/her aural counterpart, the DJ. Elements from musicology and musical performance such as improvisation are integral to the practice of VJing. Fisher (2015) remarks:

> The performative character of a VJ performance is closely connected to the sculptural and formal influences of music: composition, rhythm, the desire to create immersive spaces and the use of samples, loops, or patterns, all of which can be compared to the development of electronic music and DJing. (Fischer, 2015, p. 113)

> Where VJing differs significantly from Live Cinema, or at least in how they are perceived by both academics and the practitioners themselves is in their degree of autonomy. Both Fisher (2015) and Mentotti (2015) comment on how VJing is seen as part of a greater ensemble and is always in conjunction with a musician, sound artist or DJ. Real-time visual jamming to silence is a rare occurrence (Fischer, 2015, pp. 115-117) which has led to many VJ's joining forces with musicians to create collaborative collectives (Fischer 2015, p. 117) or moved altogether in the direction of Live Cinema, or as Live Audio-Visual Performers (Fischer, 2015, p. 119) which are usually more 'aesthetically autonomous' (Mentotti, 2015, p. 95).

> Even more than making one's own source material, performing live cinema means not falling into contingent collaborations with any DJ, lighting engineer or set producer that might be on that day's shift, as a VJ often has to do. In live cinema, the performer directs every aspect of the spectacle, never being

relegated to a secondary role, while the activity of other areas is aimed to create an experience for the audience. (Mentotti, 2015, p. 95)

Fischer (2015) also comments along these lines where VJ's have been feeling treated and perceived unfavourably compared to musicians (Fischer, 2015, p. 119). Bernard (2006) coined the term 'visual wallpaper' to describe the competitiveness between the VJ and the DJ in capturing the audiences' individual attention.

As in Live Cinema "The performers need to play their audience not their computers" (Harris, 2012, p.7), and because of the collaborative nature of VJing, this may result in having to play to someone else's drum, metaphorically (and occasionally literally) speaking. In my previous research (Galea, 2015) whilst collecting data through primary sources, during an interview with a dancer, she expressed similar concerns, where she felt that dance to a certain extent is perhaps always subservient to music. The dancer described how whilst a musician can play music without a dancer, a dancer can never really perform without music (although this is possible, and there are indeed multiple examples of this practice). These instances of the visual somehow playing second fiddle to the aural are intriguing, as usually one is accustomed to the contrary, to the primacy of the visual. In the same research (Galea, 2015) I had argued that music and musicology were perhaps more visual than aural. It is important to note how here I am not referring to the aural in terms of sound but in terms of music. The way that music is written, read, as well as visualised whilst performing, could make a sound argument for the consideration of music as a visual process, perhaps even more than it is an aural process.

Live Cinema, VJing, and Live Audio-Visual performance borrow heavily from the spatial and temporal structures of Western Musicology. Liveness and a degree of improvisation together with audience interaction and participation make these practices

dependent on their relationship with technology. "Realtime is a technological capacity that allies presence and the manipulation of sound or image source material" (Carvahlo, 2015, p. 133).

The physicality of music, itself intrinsic to the production of sound is also in itself a strong contributing factor to the 'visuality' of music. In VJing and Live Audio-Visual Performance, the musical legacy and the collaboration/coproduction creates what Bucksbarg (2009) defines as 'embodied performances'.

> VJ performances are embodied, in other words, they include interfaces and controllers that require the movement and gesture of the performer or participant for control, as well as the use of expressive movements of the 'body in space' that are translated into audio-visual material. (Bucksbarg, 2009)

This phenomenon also gave rise to the development of 'Controllerism', a (usually) musical genre that is defined by the performer's control of hardware interfaces. Manufacturers of audio products and software have responded to this trend, creating hardware products that are designed to be modular and user customisable, physical interfaces that control their software-based products such as Ableton's "Push" and "Push II", Native Instrument's "Maschine", Roli's "Blocks", Novation's "LaunchPad" and "Launchkeys" as well as Arturia's "Spark". This physical/digital relationship between the user and the software has also been extended into other areas where manufacturers have developed hardware interfaces that extend beyond the user/software immediacy but also extends to analogue/ electronic and mechanical devices. Arturia's "Beatstep Pro 2" and Korg's "SQ-1" not only remediate between the viewer and the software through physical knobs and buttons but also between other digital devices, (via USB and MIDI) analog devices (via control voltages and

gate outputs) and also, as in the case of the "SQ-1" through its "Little Bits" output, which makes the unit capable of communicating and controlling a whole array of electronic components and sensors as well as mechanical motors. These devices could be described as multi-dimensional devices or interfaces, nodes of modalities, that through the immediacy, understood as an action-reaction situation, generate transparent immediacy, as understood by Bolter and Grusin (2000) where the hypermedia elements and arrangement of hypermedia clusters become so stretched out, that technology itself disappears from immediate focus, creating a situation of transparent immediacy that remediates all the media processes into a physical process such as the turning of a knob.

The following chapter shall discuss technologies that were explored during this research and that have no real affiliation to specific audio-visual practices as previously discussed, like for instance the affiliation that video has with video art and celluloid with film (although these could fit comfortably within all previously discussed practices). These technologies ended up not being utilised in the final practical output of this thesis, however certain elements in terms of how media relates to specific processes, have definitely shaped the overall direction and outcome of this thesis.

Sound, which in itself features significantly in this thesis shall be discussed at length in a separate chapter dedicated to it.

4. Media as Sculptural Matter

In the process of the translation from physical and electronic media technologies to software, all individual techniques and tools that were previously unique to different media "met" within the same software environment. This meeting had fundamental consequences for human cultural development and for the media evolution. It disrupted and transformed the whole landscape of media technologies, the creative professions that use them, and the very concept of media itself.

Once they were simulated in a computer, previously incompatible techniques of different media begin to be combined in endless new ways, leading to new media hybrids, or, to use a biological metaphor, new "media species". (Manovich, 2013, p. 45)

A key aspect in the origins of video art was its development through ideas and technologies borrowed from audio practices that had preceded video by a couple of decades. Unlike in cinema where the film recorded no audio, the magnetic tape utilised by the early video artists recorded both sound and image. Experimental music and developments in sound recording had a very significant influence on video art.

It could be argued that unlike film, video is a combination of sound and image. The technical origins of video recording are derived from principles developed from sound recording and this relationship has been acknowledged

by a number of important video artists including Bill Viola, the Vasulkas, Robert Cahen and Peter Donebauer. (Meigh-Andrews, 2014, p. 105)

Early video art practitioners utilised the already established audio techniques that also made use of the electromagnetic tape. Through this the visual signal could be modified and manipulated by the very tools that were employed to manipulate audio - video, therefore, was handled in audio terms. With the shift towards digital technology, both audio and video became converted into computer language. This allows for a similar approach in handling video through audio and vice versa. One may observe how even today the way that audio and video are handled through digital means is to a certain extent intrinsically interrelated. Software such as Max MSP started out in 1987 (Di Nunzio, 2014) as an audio focused software which later included video as Max JITTER. Today both elements of the software are known as Max MSP. The software handles both video and audio giving the user the ability to create unique and ever-changing relationships between video and audio. Similarly, Pure Data started out in 1996 (Di Nunzio, 2014) as an audio programming environment that later became Pure Data Extended which has the ability to control video as well as audio. This can be also observed in a rise in VJ Software that came out of and uses the same principles of DJ software.

An interesting set of approaches can be drawn from the relationship between audio, which is spatial and three-dimensional, and the moving image, which is traditionally confined to a two-dimensional plane. Attributes such as echo and reverberation, the results of the relationship between a sound and the physical space where the sound was recorded in, or the place in which the sound is heard, have no real equivalent in the moving image. Other characteristics such as delay and feedback loops have already been implemented in video and

other moving image practices. Being interested in sculpture and how audio and visual media can be intervened upon within three-dimensional space, I believe that by understanding and implementing the spatial aspects of audio to video, or better to the two-dimensional moving image plane, one may discover intersection points between the media that allow for a spatial intervention, or at least a spatial understanding of video.

4.1 Projection Mapping

Rowe (2014), describes projection mapping as a series of techniques that project a virtual layer over physical three-dimensional objects in space. This, Rowe (2014) continues, augments the objects or spaces with digital content creating a 'mixed reality' scenario (Rowe, 2014, p.156). Yoo & Kim (2014), consider projection mapping, or video mapping as a physical audio-visual illusion that has the ability to convert any surface into a 'dynamic video display' (Yoo & Kim, 2014, p. 1181). Though projection mapping, any physical surface can be extended with digital content and increasingly so in the past decade, these techniques have been utilised to map virtual content on anything from small spaces and objects, to automobiles, buildings and anything in between.

> Projection mapping has rapidly expanded to its current status as technique of choice for a broad range of applications and types of event, from small artworks to architectural - and stadium-scale extravaganzas. (Rowe, 2014, p. 157)

Yoo and Kim (2014), point out that albeit the term 'projection mapping' is relatively new, the technique dates back to the 1960s. The terms 'video mapping', 'spatial augmented reality' and 'shader lamps' are all names that have been given to these techniques in the past

(Yoo & Kim, 2014, p. 1184). Rowe (2014), suggests that the origins of projection mapping go even further, directly descending from Giovanni Battista della Porta's invention of the 'camera obscura' in 1558 (Rowe, 2014, p. 155) and later the invention of the 'lanterna magica'. In the way that projection mapping as described by Yoo & Kim (2014) could be considered a physical illusion, similar physical/spatial illusions were achieved in the eighteenth and nineteenth century through techniques such as the 'pepper's ghost technique' (Greenslade, 2011), the 'phantasmagoria' (Grau, 2007), and the large-scale 'panoramas' (Briffa, 2009).

In the visual arts, video or projection mapping has been employed by artists such as Tony Oursler, Paul Sermon and Jamy Sheridan (Rowe, 2014) who in the late 1980s through to the 1990s produced work that explored projection on a variety of surfaces and objects, such as for instance Tony Oursler's "Crying Doll" (1989), (Meigh-Andrews, 2014; Elwes, 2005). This particular work, and the manner in which the digital layer is employed to create a "situation rather than an image" (Meigh-Andrews, 2014, p. 307). Through its superimposition over the sculptural level moves away from the idea of the projector as a 'portable display', transforming it into a tool that offers extended possibilities within a spatial dimension.

The projector in its traditional relationship to audio-visual media has in conjunction with the screen or monitor acted as a 'display', a window to, and possibly the only manner in which audio-visual media, especially those that make use of the moving image could be accessed from the physical dimension. As described by Voegelin (2010) vision always occurs at a distance, away from the seen. The viewer is always at a distance from the object or situation being observed. "Seeing always happens in a meta-position, away from the seen. And this distance enables a detachment and objectivity that presents itself as

truth…" (Voegelin, 2010, pp. xi-xii). By projecting layers of virtual/digital content onto the physical world, projection mapping techniques, combined with the transmediatic power of digital media extends the virtual realm into the physical one, creating a hybrid dimension, a place where the viewer becomes part of the artefact, or in reverse, the artefact becomes part of the viewer's world, no longer in the form of a static window that allows the viewer to observe what is on the other side, but as part of the world. The meta-position, the objective distance between the seer and the seen is reduced creating a 'mixed reality' situation (Rowe, 2014), an immersive experience of the artefact, where the boundaries between physical and digital content become increasingly blurred.

Both Rowe (2014) and Yoo & Kim (2014), investigate the interactive potential of projection mapping techniques. Both cite examples in which projection mapping has been utilised for interactive artworks, and it immediately becomes evident that there are various approaches to the idea of interactivity and perhaps to a certain degree one may speak about different levels or layers of interactivity. Rowe (2014), remarks how most projection mapping projects to date have been non-interactive (Rowe, 2014, p. 157) and are more akin to the cinematic experience. He goes further by defining interactivity as a means by which through physical interaction, the digital content, or digital processes are altered and/or manipulated. An approach that Rowe (2014) discusses in the creation of interactive projection mapped artefacts, is the use of camera-based interaction, where through a digital camera the computer is aware of its surroundings and is capable of reacting accordingly. Yoo & Kim (2014) on the other hand take an approach to interaction that is more reliant on physical input and haptic devices, in the form of joystick/joypads, buttons and other forms of sensors. Meigh-Andrews (2014) remarks how "…the sculptural objects and/or structures, their placing, and the

televisual images must be experienced directly through the physical activities and presence of the spectator" (2014, p. 293).

Meigh-Andrews (2014) continues by adding that "All installation is ultimately 'interactive' – the viewer is presented with a kind of variable narrative of spatial and representational possibilities that s/he must negotiate" (Meigh-Andrews, 2014, p. 294). This implies that even in terms of what constitutes an interaction there are numerous levels and layers to take into consideration.

The examples mentioned by Rowe (2014) turn the actual space, or rather the augmented place into the interface, through which the digital media layer is created and modified while in Yoo & Kim's (2014) examples the interface, in the form of handheld controllers is independently present in the physical space, acting in the same way as the screen or the projected rectangle that an interactive projection mapped project seeks to replace, by acting as a communication channel, a window between the physical and the digital dimension. If one takes a closer look at the examples mentioned by Yoo & Kim (2014) such as the "Urban Flipper" (2011) created by CT Light and Sober Industries and Studio Rewind's "Animal Sculptures" (2011), the interaction level, whilst instantaneous and undoubtedly modifying in real time the digital element of the artefact, cannot be deemed 'immersive'. Both these examples have a longer phenomenological distance between the seer and the seen and to a certain extent are more akin to the cinematic experience, in contrast to the "Mixed Reality Bugs" (2008-2012) discussed by Rowe (2014) that put the viewer at the centre of the artefact. Both these approaches to the idea of hybrid or mixed reality experiences brought about by projection mapping techniques offer great potential for investigation. These two distinct approaches would be suitable in different circumstances and

offer opportunities for different modes of engagement with the viewer. It becomes evident, once again, that the ratio between (transparent) immediacy and hypermediacy, and how these are employed, plays a crucial role in how the interactive artefacts not only behave but also in the way they are experienced by the audience.

4.2 Holograms

The idea of the holographic image has been a fixed obsession in the area of new media art since its inception in the late 1940s (Johnston 2008). Youngblood (1970) predicted that holographic imaging would be the future of video, television and cinema by the next century, yet the twenty-first century arrived and is well underway, and as yet, there is no indication that the holographic image is going to take over the mass media, cinema, or the visual arts. Schröter (2011) speaks of holography as an 'exotic' imaging technology (Schröter, 2011, p. 24), mainly consigned to scientific imaging and military applications, perhaps due to its relatively bland and unexciting visual properties, characterised by an apparent low resolution, monochromatic image (even though in reality the images are in very high resolution) (Boone & Markov, 1995).

Schröter (2011) discusses the hologram, more specifically the 'multiplex hologram', as an imaging technique that sits in between the photograph or the still image and the moving image. Schröter (2011) defines the conventional idea of the differences between the still and the moving image as a dichotomy where in the former no change across time is occurring between two given points (the image plane) and hence considered static, and in the latter where change across time occurs between two given points (the screen and the projected rectangle) and is subsequently considered in motion. The static image is always static

irrespective if its audience is in motion or not, and the moving image is always in motion irrespective if its audience is still or is in motion.

Schröter (2011) points out that there are arguments for never really considering any image as fixed in time as most images have or involve some kind of temporal process and are, as such, always perceived in time. The viewer is ordering the visual elements across time in order the reconstruct the narrative, hence, Schröter (2011) concludes that there are very few 'still' images (Schröter, 2011, p. 23).

The hologram offers a third possibility in the traditionally binary approach to the image and image-making. The hologram is in motion when the observer is in motion and is still when the observer is still, unlike the moving image which is in motion independently from the viewer. Schröter (2011) also points out two other imaging processes that exhibit this phenomenon with one being the flip-book, which is a sequence of static images set in motion by the viewer and the lenticular images, where an image sequence can be created by stacking an array of lenses onto an image plane (Schröter, 2011, p. 24).

Holography is a process where one records 'interference fringes' which are created when two wavefronts overlap, a process which does not differ too much from the 'stereo' principle when recording audio, and similarly to the idea of 'stereo imaging' can be utilised for both light waves as well as sound waves. "This principle [Holography] is not confined to light waves and can also be used in the recording of interfering sound waves" (Schröter, 2011, p. 25).

Holography is in fact mainly associated with light waves and is produced when the 'object beam' which is a light wave that is reflected off an object, is overlapped with a light

wave of the same kind known as a 'reference beam' and the resulting interference fringes are recorded by photomechanical means on glass or acetate plates, a process which is similar to photography, albeit utilising different optical principles (Boone & Markov, 1995; Johnston 2008; Schröter, 2011).

The most appealing part of holography, that has captivated and stimulated the collective imagination is the processes' ability to create three-dimensional images. The images created through holography are true three-dimensional renderings unlike stereoscopic images as the images exhibit true parallax (Schröter, 2011), meaning that a holographic image can offer different viewpoints when the observer moves around it. Depending on how or to what extent the object rendered in the image has been recorded, the holographic image has the ability to reproduce the object in its entirety. Another interesting aspect of the holographic image is that the object, or rather the image of the recorded object is reconstructed, every time it is viewed. Unlike a traditional image on film, one does not see a positive slide or a negative imprint of the image, but rather a cloudy grey region that when seen under a microscope contains all the required information to reconstruct the original object beam and its difference in relation to the reference beam.

> To see the recorded image, you have to look at the holographic plate under the same coherent light that was used for the recording. The light waves are diffracted through the interference fringes and the original 'object wave' is reconstructed. (Schröter, 2011, p. 25)

The interference fringes or the differences between the object beam and the reference beam are in more ways than one, a map of differences; scrambled information, instructions

on how to reproduce the image which on their own are practically impossible to decipher. When the same conditions where the image was recorded are reproduced (the reference beam), the information contained within the holographic plate is sufficient to recreate through diffraction, an image of the object in three dimensions. Moreover as one would assume, if one were to recreate the object beam the plate would then display the reference beam. The interference fringes contain bits of data, information, points of difference and rather than being a 1:1 map of the object (as holography in general is lens less, therefore should in theory always be 1:1 with the object) any part of the holographic plate, no matter how small, can be utilised to reconstruct the image in its entirety. This obviously has tremendous potential in the storage of data (Boone and Markov, 1995), and the idea of holographic hard disks in computers is not that far off, and probably something which will become commonplace in the near future. However, one nevertheless needs to tread carefully when making predictions about holography.

There seems to be a lot of confusion in the perception of holography, and what holography is. In more ways than one holography never did live up to its expectation. Even though there are multiple modes and kinds of holographic images and a small proportion of these might be capable of movement across time, the hologram is a part science, part pop culture construction, a phantom of what should have been. Schröter (2011), refers to it as a "…popular phantasm for future, hyper-realistic image technologies" (Schröter, 2011, p. 25), while Johnston (2008), consigns it straight away to science fiction:

A staple of science fiction plots, alongside time travel, robots, black holes and interplanetary travel. The science-fiction holograms were paradigms of

progress, like the stories in which they were immersed. (Johnston, 2008, p.

228)

Holography has numerous practical uses in the field of medical and other kinds of

scientific imaging as well as its ability to store large amounts of data within minute surface

areas (Boone & Markov, 1995), (Schröter, 2011, p. 25). This, however, does not seem to

satisfy the general conception of what a hologram is or rather what a hologram should be. In

2012 during the Coachella Valley Music & Arts Festival in Indio, California, the deceased

Rapper Tupac Shakur reappeared for 'one last concert' in the form of a 'hologram'. The

defunct musician appeared to be on stage to perform a couple of songs to a wildly excited

public. Apart from the fans' excitement of seeing the performance, this apparition, created a

renewed interest in holography and the perceived potential of this technology. In the same

way that the hologram first captured the public's collective imagination as a 'Holoprojector'

in the first Star Wars Movie (1977), the 'Holodeck' in the television series Star Trek: The

Next Generation (1987–1994) (Pizzanelli, 1992), and in more recent times in the movies

Iron Man (2008-2013) and Avatar (2009) as a holographic display, Tupac Shakur's

reappearance as a 'hologram' strengthens the public expectation of what a hologram should

be.

In reality Tupac Shakur's 'hologram' was no hologram at all but a two-dimensional

animation developed by special effects production house Digital Domain, and projected onto

an angled glass screen utilising the 'pepper's ghost technique' (Ngak, 2012; Shanks FX,

2014); a theatrical technique developed in the mid-nineteenth century that makes use of

angled glass screens to project actors, objects or images on stage (Sidharta et al. 2006;

Greensalde, 2011). Other instances of 'holography' popular on the internet show smartphones

and tablets being turned into holographic displays by constructing a square pyramidal structure out of acetate, or plastic from a compact disk case (American Hacker, 2015). This simple yet visually very effective technique is not a true holographic image but multiple instances of pepper's ghost that to a certain extent exhibit, or to be more precise, mimic the parallax exhibited by holographic imagery, giving the observer the impression that one can move around the projected image in three dimensions.

The problem with holography perhaps is that its illusion appears to be more real, or at least it is perceived as more real than actual holography. By utilising the pepper's ghost technique or by projecting onto smoke or water mist, in a manner similar to the Phantasmagoria effect of the Victorian era (Grau, 2003; Briffa 2009), one can overcome the problems that plague holography in order to create the appearance of three-dimensional images with minimum resources. The images created are in motion and in colour, even though creating a full-colour holographic image by aligning RGB laser beams in parallel (Schröter, 2011) is theoretically possible. Simply put, therefore, the illusion of holography meets the expectations of what a hologram should be like whilst the actual hologram, at least with the currently available technology does not.

Dawson (2000) remarks how the 'real' and 'fictional' idea of holography are so tangled into one another that it becomes almost impossible to separate them. Dawson (2000) cites Eco (1986) and his ideas on the hyperreal, where Eco sees holography as the embodiment of hyperreality.

Holography could prosper only in America, a country obsessed with realism, where if a reconstruction is to be credible, it must be absolutely iconic, a

perfect likeness a "real" copy of the reality being represented. (Eco, 1986, pp. 3-4)

Hyperreality, as the inability to distinguish between 'reality' and a 'simulation of reality', is in itself a condition brought forward by technological progress, ironically both by 'real' technological progress and 'fictional' progress. Dawson (2000) criticises Eco's approach, stating that the way Eco (1986) understands holography, and the way that he quantifies reality, is in itself a victim of hyperreality. As proposed by Eco (1986), a copy of a marble statue, for instance, which utilises 'real' marble, or by employing the 'proper' the technique utilised by the original artist, hyperreality, achieves the status of reality through its appearance. Its historical value or significance, the subject matter, and the socio-cultural contexts of the marble statue become irrelevant. Dawson (2000) reasons that in doing so, Eco's (1986) reasoning, is in itself a victim of hyperreality, as Eco's idea of holography, according to Dawson ignores crucial factors.

> Eco overlooked the physical properties of the stereogram he describes in the citation, such as the time smear, the spatial distortion and reduction, the several hundred dark vertical lines on the film, the seam of holographic film joined with sticky tape between the beginning and the end of the action, the jump in the position of the subjects from the beginning to the end of the filmic sequence and the spectral colour. (Clearly, the hologram is not the same type of hyperreal as the replicated oval office made at exactly the same size and from the exactly the same materials as the original). (Dawson, 2000, p. 18)

Dawson (2000) suggests that Eco (1986) does not make a distinction between 'real' and 'fictional' holography "The theory of the hyperreal as proposed by Eco, encompasses the actual hologram and the fictional hologram as facets of one medium" (Dawson, 2000. p. 18). Irrespective of who is a victim of what, both Eco (1986) and Dawson (2000) highlight how inseparable the actual hologram is from the concept of the hologram within the collective social and cultural spheres. This makes holography itself, rather than the artefacts and interventions produced through it (the holographic images) hyperreal. Dawson (2000) cites the work of Coyle and Hayward (1995) who speak about holography's failure to replicate reality seamlessly, as a major stumbling block for the actual process of holography.

> The notion of a potential (though immaterial) representation of the 'real'—conjurable by technology and, most importantly, 3D—has proven to be a potent myth and a drawback to actual holography, whose representations have so far consistently fallen short of the ideal… the unfortunately 'too perfect' model from which a real hologram be an inferior example. (Coyle & Hayward, 1995, as cited in Dawson, 2000, p. 23)

4.3 Holography And The Visual Arts

Baudrillard (1981), takes a cautionary approach to holography and its potential implications within the visual arts:

> This said, which type of objects or forms will be "hologenic" remains to be discovered since the hologram is no more destined to produce three-dimensional cinema than cinema was destined to reproduce theatre, or

photography was to take up the contents of painting. (Baudrillard, 1981, p. 104)

The hologram both in its 'real' and 'potential' state according to Baudrillard (1981) is essentially a projection, constructed with light in its actual state and constructed by the expectation of society in its potential state, that sits in between reality and the simulation.

The hologram, perfect image and end of the imaginary. Or rather, it is no longer an image at all - the real medium is the laser, concentrated light, quintessentialized, which is no longer a visible or reflexive light, but an abstract light of simulation. (Baudrillard, 1981, p. 104)

In this respect, when one looks at holography in terms of material and processes, there is little difference between the hologram and cinema or the hologram and painting. It is the fascination, the idea of passing to the side of the double, that has made holography so seductive for over half a century and to a certain extent gives the medium the ability to go to places that neither painting nor cinema can perhaps ever attain. You bend over the hologram like God over his creature: only God has this power of passing through walls, through people, and finding Himself immaterially in the beyond. (Baudrillard, 1981, p. 103)

Baudrillard (1981) stresses however that the idea of the hologram requires a delicate balance, a simultaneous state of being and not being.

One must never pass over to the side of the real, the side of the exact resemblance of the world to itself, of the subject to itself. Because then the

image disappears. One must never pass over to the side of the double, because

then the dual relation disappears, and with it all seduction. (Baudrillard, 1981,

p. 104)

Both Baudrillard (1981) and Eco (1986) however only take into consideration

holography in terms of its potential to simulate 'reality' and to a certain extent overlook other

factual or potential uses of the medium. Both authors base their arguments on holography

around the visual arts, acknowledging only in passing its other uses as a medium. Even

within the visual arts, both fail to discuss holography in terms of the non-representational,

abstract imagery that it can and indeed has (re)produced.

The visual arts have a love-hate relationship with holography. Lightfoot (1989) speaks

of a bias in the art world against holography. Writing about the art scene in New York in the

late 1980s, Lightfoot describes how major and minor galleries, together with influential art

journals and museums were generally devoid of any holographic artefacts. Lightfoot (1989)

compares the progress that holographic art has had in the previous decades and compares it to

video art and computer graphics which in relation do not seem to "fare as poorly" (Lightfoot,

1989, p. 419). Kramer (1975) in reaction to the 1975 show entitled "Holography 1975: The

First Decade" held at the International Center of Photography in New York (Johnston, 2006)

describes holographic art as a "technical stunt" and "a wasted opportunity". (Lightfoot,1989,

p. 420; Dawson, 2000, p. 13).

Much of the work has, I gather, been produced not by artists but by physicists

professionally involved in holographic technology. The physicists appear to

favour objects out of the local gift shop, whereas the artists do their shopping

in provincial art galleries, and both, it seems, are much taken with television

commercials. It is difficult to know which is the more repugnant: the abysmal

level of taste or the awful air of solemnity that supports it. (Kramer, 1975)

Johnston (2006), builds an argument on holography as an analog to photography, stating how

the medium transitioned from a purely scientific imaging process to an artistic one in the

1960s.

From the middle of the 1960s, however, the subject [Holography] was

reinvented and reinterpreted as an extension of photography, which reshaped

its meaning and highlighted a subset of its applications. (Johnston, 2006 p.

186)

Johnston (2006) however continues by observing how

Photographers and holographers, however, had an uneasy relationship.

Photographers did not accept that this new technology represented the future

of their medium, or even shared close affinities with it. The intellectual roots

and implementation of photography shared little with holography. (Johnston,

2006, p. 186)

Holography in itself is possibly better discussed in terms of sculpture rather than in

terms of image. Essentially a hologram is a sculpture constructed out of light, however, there

are certain aspects that do tend to be more akin to photography and image-making,

positioning holography at an interesting crossroad. Similar to the photograph, the holograph

is primarily a process that records objects, whereas sculpture in its traditional sense concerns

the building of objects through additive (modelling) and reductive (carving) processes. There

are obviously numerous exceptions to this broad generalisation. Like the photograph, the hologram is an optical process, and even though in 'three-dimensions' it is still consigned to a two-dimensional holographic plate. In a certain manner the holograph is a sculpture within the plane, a window into another dimension - a 'virtual space' - and yet, can never essentially exist as a physical (though immaterial) presence, through current technology. Mitamura (1989), whilst discussing his practice, describes the hologram as a spatio-temporal medium; a medium that not only has the ability to record and portray objects but one that can also combine multiple space-time instances; the recorded space-time and the actual-space time, onto a single plane, a medium that has the ability to move freely through both space and time.

4.4 Sound As Sculptural Matter

Sound has been solidly confirming its place within the visual arts. The manner in which sound behaves in space and its relationship to space and time makes it a prime candidate for intermedia synthesis with other media and processes. Sculptural interventions making use of sound as sculptural matter rather than simply as an effect associated with its relationship with space opens up a series of interesting directions for artistic enquiry. Space can be considered as a series of sensory and environmental stimuli which as human beings we constantly negotiate with and navigate within. Humankind is a stereoscopic animal, we have two eyes and binaural hearing that allows us to make sense of space and how space changes in time. Sound as sculptural matter can be understood as not only temporal, i.e. measured against time but to a certain extent, sound has the ability to create time itself, through the creation of aural events that we engage with spatially through our binaural physiognomy.

The contemporary drive towards interdisciplinary, cross-modal and intermedia practices which aims to break down barriers between disciplines and media would start on a wrong footing, I believe, if it were to consider sound, or to be more precise that which falls within the auditory spectrum, in isolation, as a purely temporal object. No artefact or sonic object can be purely sound-based, devoid of integration with other objects or processes occurring in simultaneity in space, be it purely physical space, digital space or some kind of hybrid modality between the two. Sound does not exist in isolation, in fact, sound does not travel through a vacuum, as it always requires some kind of physical media to propagate it. The distinction that exists between sound and light-based media is a misconception that stems from the distinction between seeing and hearing, which is in itself a misconstruction that creates perhaps more problems than it solves. This human characteristic of segregating things and attempting to observe them in isolation is counterproductive and whilst one may find benefit in utilising this approach in other areas, for instance, in a scientific approach, in an artistic context, however, one may argue that this can be a rather pointless exercise.

If one shifts away from the current understanding of how the visual and auditory systems work and considers the body as a single organ, with which we engage with media, one perhaps is capable of ironing out the problems that media and modality-specific approaches to sound create. There is no way that we could experience sound in isolation, nor vision, nor any other sensory input for that matter. If the approach with which we engage with media and the idea of space and dimensionality considers the body as a whole series of interrelated sensory receptors that in themselves are intertwined with the environment and the wealth of information that exists within the environment, one may start, on similar grounds, thinking of the artefact or art object as a series of interconnections rather than as an independent object that shares the same environment, at least temporarily with the body.

What this essentially means is that we do not simply engage with an artwork, no matter what form or modality it has been produced in, but rather, as observers we become the artefact, as the links that bind us with it could never exist in isolation. This reasoning would imply that artworks are not the product of our engagement with media but, to a certain extent that all artworks are, at least in part, human, and to a certain extent self-aware, and alive. This human, spatial, temporal, digital and conceptual synthesis, posits the artwork not only as a creation, a spatio-temporal intervention with our environment and the media that share the environment with us but as a fully functioning and self-sustaining entity which is itself capable of the act of creation.

Much in the same way that as popular knowledge has it, Marconi believed in the notion of sound never dying, of sound waves as being constantly propagating in space, that never die out but which continue vibrating indefinitely, perhaps with reduced intensity across time and space (Milner, 2010). The artistic artefact is a constantly self-propagating entity, that has the ability to generate, infinite and constantly mutating iterations of itself indefinitely. To a certain extent, sculpture, or rather the arts in general, resembles humankind playing God - creating, destroying and constantly generating images of itself.

As shall be expanded upon later, in Judeo-Christian traditions and beliefs, sound is the manner in which God creates space-time and the matter that inhabits it. This is also similarly recounted in Indian Vedic Metaphysical texts. The recount in the Bible gives the idea of a divine artist, manipulating and articulating multiple iterations of his initial creations. This analogy could be perhaps useful in understanding our relationships to the arts, how we build these self-sustaining systems sometimes in parallel to one another, and how these systems in themselves are capable of generating and creating new arrangements and assimilations between themselves.

Hockney (2005), speaks of his 'joiners' collage landscapes, describing them as spatial and temporal joiners, a creation in both space and time. Albeit the final artefact is a two-dimensional rendition, Hockey, by taking multiple photographs of the same scene in varying points in time, is essentially creating a succession of temporal events. His only limitation perhaps is his carrier media - the photographic print, even though physical space, to a certain extent, does exist between the individual polaroids when one stops considering these in terms of image and sees them as a series of objects in space. The same applies to sound-based artefacts.

The way that sound creates space-time is through the creation of events; a succession of events, that we as humans engage with through the use of our two ears, binaurally and therefore spatially. The intrinsic relationship between the creation of events in space and movement is deeply intertwined in a manner that no one could exist without the other. Quantum physics has for long spoken of space and time as not only interdependent but essentially as the same thing (Einstein, 1905; Minkowski, 1908, as cited in Overduin, 2007). However, it is only through motion, that both space and time can exist, without the creation of an event, or rather a succession of events, there would be no time, and with no time, no space and without space no movement. It is essentially sound and its integral relationship to the source which originated it that, one may argue, that continuously creates the series of events which support the model of life as we know it.

Sound has had an uneasy relationship with sculpture. Sound has long been ignored in sculpture, where the latter is traditionally considered as belonging to the visual domain. As Marshall McLuhan (1965) remarked, no object can be considered as purely visual, sonic, or tactile, but rather as a blend of sensory stimuli. Sound, therefore, never exists in isolation. In the following chapter, a number of practices and approaches to sound within the visual arts,

and more specifically within a sculptural context shall be put forward for consideration. Sound Art is considered to be a relatively recent phenomenon, however, its roots reach back to over a century ago. Whilst certain approaches and ideologies took their time to develop, there is perhaps no doubt that sound has been utilised as sculptural matter way before the digital era by artists from different fields, in different places and in different points in time.

5. Sound Art

Most inventors of electrical musical instruments attempted to imitate eighteenth and nineteenth- century instruments, just as early automobile designers copied the carriage…When Leo Theremin provided an instrument with genius new possibilities, Thereministers did their utmost to make the instrument sound like some old instrument giving it a sickeningly sweet vibrato, and performing upon it, with great difficulty, masterpieces from the past. Although the instrument is capable of a wide variety of sound qualities, obtained by turning a dial, Thereministers act as censors, giving the public those sounds they think the public will like. We are shielded from new sound experiences. (Cage, 1937, p. 23)

Kelly (2011), observes how the medium of sound within the visual arts has close ties with music, making it impossible to discuss one without considering the other (Kelly, 2011, p. 15). Kane (2013) expands on Kim-Cohen's (2009) view of Sound Art as an area of research and practice that lies outside of music - the 'extramusical' or music's other. "Unlike sculpture, and to a lesser extent, cinema, music failed to recognise itself in its expanded situation" (Kim-Cohen, 2009, p. 107).

Sound Art, according to Kelly (2011) is a medium rather than a movement or a genre, no different from oil painting, in the manner of which Kelly argues, the material out of which something is made does little to describe the content or the nature of the artwork. The term Sound Art in itself is used to describe or rather refers to both gallery-based work as well as experimental music practices, leading to artists such as William Furlong and Max Neuhaus

(Furolong, 1994; Neuaus, 2000) to question whether Sound Art is a discrete area of (visual) art practice, and even going further as to question whether Sound Art has anything to do with both sound and art themselves. Sound Art, understood in the manner that Kim-Cohen (2009) describes it, as 'music in its expanded form' can trace its roots to concepts that expanded from Luigi Russolo's Futurist Music Manifesto (1913) and later to the work of John Cage, which are perhaps two of the most cited and referenced exponents, that have had a significant impact on the role of sound within the visual arts. Both Russolo and Cage depart from the idea of an expanded musicology, with Russolo (1913) making the argument for the inclusion of noise, every day sounds in music, inspired by the sounds of the industrial age at the beginning of the twentieth century, sounds that were previously inexistent in a predominantly agrarian society, prior to industrialisation. Similarly, Cage held views of music in its closed and rigid formats as something belonging to the past. He sought for new pastures in musicology through the inclusion of noise, electronic instruments and perhaps most significantly through different processes and approaches in music making, which had a significant impact not only on musicology but also to a greater degree on the visual arts.

> If this word 'music' is sacred and reserved for eighteenth and nineteenth-
> century instruments, we can substitute a more meaningful term: organisation
> of sound. (Cage, 1937, p. 23)

The ideas that Cage developed on how sound is organised, through processes of chance and indeterminacy, and his experiments with using sounds and textures beyond what was at the time considered musical, were picked up by the Fluxus, a loosely connected group of avant-garde thinkers and practitioners, practising in a variety of disciplines and modalities, who were heavily influenced by Cage's ideologies and perhaps ambitious enough to aim to surpass Cage in his attempt at liberating music from the chains of the past (Kahn, 2013).

Coming from musicology Cage, like Russolo before him, together with Pierre Schaeffer who made use of technology and its advancements, held one thing in common that is significantly pertinent to this argument - they all aimed at making music, above anything else. Cage's "4'33" (1952), Russolo's "Intonarumori" and Schaffer's "Musique Concrete" all aimed at making noise, or better sounds outside of musicology's canons, more musical. In expanded arts terms they were not aiming at making music by other means but rather music with other instruments. Cage and Russolo kept within the idea and formats of the concert, the stage, the orchestra, the score, the manner of relating with the audience, whilst Schaeffer worked within the format of recorded music. What they were doing was essentially 'westernising' noise in musical terms. This is by no means meant to diminish their achievements, as the three were instrumental not only for a transformation in the way music is made and conceived, but their influence, especially Cage's caused shockwaves within the arts and was transposed into multiple disciplines. Having said that however, their relationship, their bond to music making and musicology, made it difficult, nearly impossible for them to lose their musical baggage, and conceive a sonic practice that is truly outside of music.

Fluxus adopted Cage's ideologies and in certain cases Schaffer's technology and sought to destroy musicology's formats. They sought to do this through an exploration of the then relatively unexplored territory of musical performance (Kahn, 1993) something that in turn inspired Cage to experiment with modalities of performance, leading to development of 'sonic fields' and 'constellations' rather than the usual format of having performers on a stage in front of the audience (Joseph, 2007).

Influenced by the Duchampian notion of the collage and the readymade, where the work of art is validated and framed by the gallery space and the institution, whilst simultaneously expressing DADAist anti-art and anti-practice sentiments, Fluxus

practitioners took their auditory performances to a whole new level, and a whole other range of places spaces and formats. More importantly what Fluxus brought to the table was a totally new approach to sound.

> Thus, the historically earlier question of What sounds? receded in Fluxus and was replaced with questions such us Whether sounds? or Where are sounds in time and space, in relation to objects and actions that produce them? or What constitutes the singularity of 'a sound'. (Kahn, 1993, p. 33)

> With Fluxus, or more accurately after Fluxus, what was previously considered as Avant Garde music (the study of sound within an artistic context, a non-mainstream area of practice at the periphery of music, but still perhaps within the realm of music, as it followed, for the most part, its formats and structures), evolved into what we now call Sound Art, severing itself from musicology and becoming music's other. An area in the fringes of both music and the visual arts, that has since then (and more so in recent times) however received more interest and to a certain extent recognition from the visual arts than it has from music. The approach and the formats laid down by the Fluxus group, perhaps could explain the reason for its adoption by the visual arts and the reluctance of music to embrace it.

> Cage had already thrown the last dirt on dissonance and noise; in the Fluxus venture the question of noise was forgotten once and for all, and musical sound and sound moved very close to each other. However, Fluxus questions about sound were framed almost entirely in terms of acoustic, psychological kinaesthetic properties. (Kahn, 1993, p. 33)

> Technology played an important role in the establishing of sound as an area of artistic inquiry independently from music. Up till 1877 music was only live. With Thomas Edison's invention of the phonograph, music ceased to be exclusively live, the performative element,

the dynamics of the concert hall, the stage, the seating arrangement, the relationship between the performer and the audience, were now replaced with the recorded sound. Music became, to use a contemporary term 'on demand'. Whilst the invention of the phonoautograph by Eduard Leon Scott de Martinville in 1857 had before Edison managed to capture or record sound, Edison's phonograph was the first capable of reproducing a recorded sound. Sound was a fleeting instance, something that one could witness but never capture, taking place at a particular place in a particular point in time, and was therefore bound to the here and now. The phonograph changed this. Its popularity and ready adoption by society had a profound impact and even dramatically changed the manner how society understood and related to sound, which by the 1950s Thompson (2002) observes had become reconceived into a signal, no longer as a result of a physical interaction with matter. Artists became intrigued with this new capability of capturing sound, and by the early twentieth century the Italian Futurist painter, Luigi Russolo had already conceived the idea of sound, or more precisely noise as fundamentally absent in music. In his 1913 Futurist Music Manifesto *L' Arte Dell Rumore,* Russolo advocated for the introduction of noise in music. Interestingly Russolo, in what can be perhaps considered as the first sound installation of a sculptural nature documented in history, constructed a series of hand-cranked instruments which he called "Intonarumori", which is Italian for noise intonators as instruments to be included within an orchestra ensemble. Christoph Cox, explains that the reason why Russolo decided to build the "Intonarumori" rather than use record players was that he could not get his hands on one, which whilst plausible is perhaps impossible to verify (Barnes Foundation, 2017). Russolo might have been inspired by Filippo Tommaso Marinetti, who is credited as the founder of the Futurist Movement and who experimented with sound poems such as "Sang Tumb Tumb" (1912) which Russolo cites in his 1913 manifesto. Marinetti's poem also appeared in part in

Cabaret Voltaire edited by Hugo Ball (1916, pp. 22-23; Ades, 2006) the DADA journal which

led to DADA practitioners becoming also interested in the production of noise, albeit more in

the manner of divorcing meaning from speech as can be exemplified by Kurt Schwitters and

Hugo Ball's Dadaist sound poems as can be seen in Hugo Ball's "Gadji beri bimba" (c.1916)

reproduced below (Rumens, 2009).

'Gadji beri bimba'

gadji beri bimba glandridi laula lonni cadori

gadjama gramma berida bimbala glandri galassassa laulitalomini

gadji beri bin blassa glassala laula lonni cadorsu sassala bim

gadjama tuffm i zimzalla binban gligla wowolimai bin beri ban

o katalominai rhinozerossola hopsamen laulitalomini hoooo

gadjama rhinozerossola hopsamen

bluku terullala blaulala loooo

zimzim urullala zimzim urullala zimzim zanzibar zimzalla zam

elifantolim brussala bulomen brussala bulomen tromtata

velo da bang band affalo purzamai affalo purzamai lengado tor

gadjama bimbalo glandridi glassala zingtata pimpalo ögrögöööö

viola laxato viola zimbrabim viola uli paluji malooo

tuffm im zimbrabim negramai bumbalo negramai bumbalo tuffm i zim

gadjama bimbala oo beri gadjama gaga di gadjama affalo pinx

gaga di bumbalo bumbalo gadjamen

gaga di bling blong

gaga blung

Hugo Ball c.1916

In the late 1940s Russolo's vision of a music made of noises was concretised through another advancement in technology - the magnetic tape, that in the capable hands of the visionary French composer Pierre Schaeffer became a tool or an interface with which one could physically collect, playback, reorder, reverse and construct sounds into musical compositions. Schaeffer's *Etudes de Bruits* or in English 'Studies of Noises' (1948) consists of five studies of noise that were first performed together under the title "Concert of Noises" (1948) on French National Radio on October 5th 1948 and are considered to be the first instances of "Musique Concrete". Musique Concrete or 'concrete music' stems from the idea of music being abstract, remediated through a composer, a score, a conductor, instruments and the performer, which dilutes its energy. Musique Concrete aimed to offer a more direct approach to music making, by using sounds rather than instruments that recreate the sounds and noises of life, a collage of sound that might have roots in the Surrealist and Dadaist practice of collage, which Schaeffer felt was a more concrete approach to music making, hence the name Musique Concrete (Barnes Foundation, 2017) . Often hailed as the godfather of sampling, Schaeffer's influence on music ranges from the 1970s' Psychedelic and Progressive Rock, such as, for instance, the introduction to Pink Floyd's "Money" (1973); Electronica in the 1990s where acts such as Aphex Twin is reported to make use of sounds derived from putting knives into a kitchen blender and using the sound of

sandpaper grinding on a record player needle (Bemis, 2003); down to contemporary electronic and ambient music and Hip Hop music. Schaeffer's approach, as well as the nature of the media and the technology that he was making use of, follows both the aesthetic and the physical process of cinematic montage. The technology that Schaeffer developed upon, and later the sound production and manipulation technologies that derived from his practice and ideas would, in turn, a couple of decades later, shape the processes and production of video art. The relationship between sound and the moving image, how the two have developed together as well as each other, puts sound as a process, as a media, well within the domain of the visual arts.

Whilst highly influential within the visual arts, Cage's ideologies were also reportedly influenced by the visual arts. Christoph Cox in his 2017 presentation at the Barnes Foundation (Barnes Foundation, 2017) recounts how Cage's "4'33'" (1952) might have indeed been influenced by Robert Rauschenberg's "White Paintings" (1951) an idea that was then further iterated into the domain of the moving image through Nam June Paik's "Zen for Film" (1964).

> 4'33", the silent piece, is Nam June's Zen for Film. The difference is that his silence was not sounds but something to see… In [4'33"] the sounds of the environment remain, so to speak, where they are, whereas in the case of the Rauschenberg painting the dust and shadows . . . come to the painting. In the case of the Nam June Paik film . . . the focus is more intense. The nature of the environment is more on the film, different from the dust and shadows that are the environment falling on the painting, and thus less free. (Kostelanetz, 2000, as cited in Ursokie, 2014, p. 32)

Christoph Cox, however, points out that as early as 1948, Cage had proposed a 'silent' piece entitled "Silent Prayer", which was rejected. Perhaps it was Rauschenberg's paintings that rekindled the idea in Cage's mind, or perhaps it was a question of waiting for the right timing or the right institutional support, however, Cage himself, as it appears acknowledged the similarity between the works, at least in conceptual terms.

> Cage himself described Paik's film as forming a kind of conceptual trilogy with Robert Rauschenberg's White Paintings of 1951 and his own composition 4'33" the following year. Cage had previously characterized the White Paintings as a kind of temporal event or performance, a kind of filmless cinema in which the canvas becomes a screen for the projection of lights, shadows, and particles. (Ursokie, 2014, p. 31)

4'33" and indeed all of Cages' oeuvre's importance cannot be overstated. What is however especially significant in 4'33" and the way that it relates to the development of sonic practices within the visual arts is as Christoph Cox places it (Barnes Foundation, 2017) the shifting of the attention from the foreground to the background, and whilst Cage's piece conformed to the established conventions of music, artists from the Fluxus group such as Max Neuhaus, who Cox puts as the first person to use the term 'sound installation' to describe his practice (Barnes Foundation, 2017), took Cage's idea of focusing on the background and took it outside of music's conventions. In his 1966 piece "Listen", Neuhaus takes the audience outside of the concert hall, and takes them around in what could be now defined as a 'sound walk' where the audience was encouraged to listen to the surrounding sounds and in doing so his idea was that a space, could be converted into a place (Barnes Foundation, 2017). Cox also gives some very interesting contemporary examples of this

practice of 'sound walking' such as Akio Suzuki's "Oto Date" (Listening Point) (1996 - to date) where Suzuki walks around cities and urban spaces, listening to sounds that he finds interesting, and marking points using stencils and spray cans so that an audience can stand there and listen in the same spots. Another example is Kristina Kubisch's "Electrical Walks" (2003 - to date) where the audience walks around an urban space with a specially developed pair of wireless headphones that transduce electromagnetic fields signals emitted from electronic devices such as ATMs, Electrical Gates, Vending Machines, lighting systems, neon advertising and so on (Kubisch, 2017), in order to experience the city in a different manner, through the act of listening (Cox, 2011).

In his presentation at the Barnes Foundation (Barnes Foundation, 2017), Cox mentions a number of individuals and artworks that he uses to recount his version of Sound Art, offering a rather interesting concise history of Sound Art. The picture he paints is a very interesting one, as the examples he gives are very physical, even sculptural in more ways than one, and whilst his picture is perhaps incomplete and has some notable omissions, for the purposes of this chapter, it is fitting to include most of the examples that Cox gives, in the same context in which he places them to propose sound as sculptural matter, as most of the examples that Cox gives are indeed very fitting. It is not this chapter's purpose to provide a historical timeline, nor a practice review of sorts. Cox himself, never really considers the relationship with sculpture in his presentation, however, going through the version of events as Cox places it can be beneficial to an understanding of sound and its relationship to the visual arts, and more importantly to sculpture. In the following section, the practitioners that shall be discussed are the ones that Cox himself discusses - I also stick to and in the order with which Cox discusses these artists. Whilst adhering to Cox's timeline I shall, however,

discuss these practitioners in the light of how these practitioners have made use of sound in a sculptural manner or have approached sound in a physical and spatial manner.

5.1 Sculptural Approaches to Sound

In 1969 La Monte Young in collaboration with his partner Marian Zazeela exhibited a sound and light installation entitled "Dream House" at the Heiner Friedrich Gallery in Munich, Germany. "Dream House" was developed from a very physical, spatial understanding of sound; one that combined with the idea of time was intended to develop an environment in sound and light. Young's contribution to the environment was through sound, whilst Zazeela focused on the light element. This installation or environment was developed from ideas that Young had already articulated by the early 1960s under Cage's direct influence. The installation consisted of three parts: a continuous live sound environment, a light frequency environment, as well as frequencies sung at 'timed intervals to be determined', where Young and other artists periodically performed, mainly vocally, building on the other two environments which Young believed had the capability to "…free the artists from the artificiality of measured time, and allow them to perform in real time" (Goldsmith, p. 14).

What is perhaps most significant in this artwork is Young's idea of sound as a physical phenomenon, that has tangible spatial qualities and his attempt at manipulating these in order to create an artwork that Goldsmith (2004) quotes Young in calling a 'living organism':

> By 1962 La Monte had formulated the concept of a Dream House in which a work would be played continuously and ultimately exist in time as a "living organism with a life and tradition of its own. (Goldsmith, 2004, p. 10)

When a continuous frequency is sounded in an enclosed space such as a room, the air in the room is arranged into high and low pressure areas. In the high pressure areas the sound is louder, and in the low pressure areas the sound is softer. Since a sine wave has only one frequency component, the pattern of high and low pressure areas is easy to locate in space. Further, concurrently sounding sine waves of different frequencies will provide an environment in which the loudness of each frequency will vary audibly at different points in the room, given sufficient amplification. This phenomenon can rarely be appreciated in most musical situations and makes the listener's position and movement in the space an integral part of the sound composition. (Goldsmith, 2004, p. 11)

The sine waves that Young selected as a drone sound for this environment is 50Hz, "50 Hertz AC (derived from 220 volt power line frequency) will be used as the standard to which all other frequencies are related and tuned since it functions as the underlying drone of the city and all AC-powered equipment" (Goldsmith, 2004, p. 12). The manner in which all other frequencies in the installation relate to one another comes from Young's earlier "The Two Systems of Eleven Categories 1:07:40 AM 3 X 67 – " (first revision of "'2-3 PM 12 XI 66 – 3:43 AM 28 XII 66 for John Cage' from 'Vertical Hearing Or Hearing In The Present Tense') (1967 and 1966 respectively) (Goldsmith, 2004, p. 12). Young attached particular importance to the drone sound for two reasons, the first being that a long (duration), stable drone was important in order to tune the intervals precisely to one another (Sitisky, 2002, p. 251). Tuning was an integral component in Young's understanding of sound.

Tuning is a function of time. Since tuning an interval establishes the relationship of two frequencies in time, the degree of precision is proportional

to the duration of the analysis, i.e. to the duration of tuning. Therefore, it is necessary to sustain the frequencies for longer periods if higher standards of precision are to be achieved. The fact that this information is not generally known to musicians may be one reason that only a few examples of pitches of long duration such as organum, pedal point, and the drone are to be found in music. On the other hand, astronomers have known for some time that if a measurement or comparison is to be made of two orbits which involve many years of time, the degree of precision of the measurement will be proportional to the duration for which the measurement is made. (Young, 1969)

The other element of the drone that Young was interested in was its ritualistic and shamanic properties. Inspired by Cage's interest in oriental philosophies, Young developed an interest in Nada Brahma, the belief that the world is sound in Indian Vedic metaphysics (Barnes Foundation, 2017). This belief system puts sound as the building blocks of the cosmos, where it is the motion of sound, rather than matter, shaping the universe through vibration, these vibrations are called Nada (Berendt, 1991). This ideology has striking parallels to the idea of sound as the creative force that created the universe found in Judeo-Christian traditions. "In the beginning there was nothing. Then God said 'let there be light' and there was light" (Genesis 1:3). The opening lines of the first book of the most important text in the Judeo-Christian traditions seems to point at the belief that the act of creation was indeed a sonic one. Dissecting this text one can observe its significance in this argument, and obviously nothing should be taken at face value however certain elements are very interesting. As the book of Genesis recounts, in the beginning there was nothing, no light, (obviously), no time, just nothingness. Then God said - and this part is what is perhaps more important here, the act of saying which is essentially one of the first documented sources that

point at mankind's conception of creation, recorded in history. The act of making sound is what essentially started time, which has been ticking ever since, at least according to these religious traditions.

These concepts might be easily dismissed as not possessing much value outside of religious contexts, however what is perhaps fascinating is how they seem to have developed independently in different cultures and different points in time. "Dream Room" embodies these ideologies in physical space, creating an environment that surrounds the viewer both aurally and visually, creating a space that in Young's own words, as cited in Goldsmith (2004) behaves as an organism, self-propelling and continuous.

> Dream Houses will allow music which, after a year, ten years, a hundred years or more of a constant sound, would not only be a real living organism with a life and tradition all its own but one with a capacity to propel itself by its own momentum…It will become easier as we move further into this period of sound. We will become more attached to sound. We will be able to have precisely the right sound in every dreamroom playroom and workroom, further reinforcing the integral proportions resonating through structure (re: earlier Architectural Music), Dream House (shrines, etc.) at which performers, students, and listeners may visit even from long distances away or at which they may spend long periods of Dreamtime weaving the ageless quotients of the Tortoise in the tapestry of Eternal Music. (Young, n.d., as cited in, Goldsmith, 2004, p. 16)

The drone sound or the continuous sound was also explored in public spaces by Max Neuhaus. In 1977 after many years of negotiation Neuhaus succeeded in obtaining permission to use a disused underground air vent in Times Square, New York as a resonant

chamber. Entitled "Times Square" (1977) Neuhaus amplified the nearby tunnel junction (Reilly, 2013) and created a series of haunting clouds of sound that are physically related to the resonant chamber itself. The installation ran 24 hours a day 7 days a week from 1977 till 1992 and was later reinstated on a permanent basis in 2002 where it continues to run to date. Neuhaus intentionally left the installation unmarked, Cox (2011) quotes Neuhaus about this particular work "It doesn't exist in time. I've taken sound out of time and made it into an entity" (Neuhaus, n.d., as cited in, Cox, 2011). On the nature of sound installation, Neuhaus observes:

> In these imaginary places that I build, often the moment the listener first walks into the space, it is not clear that a sound is there. But as you begin to focus, a shift of scale happens… In working a sound, the only way you can get distance is over time, unlike working with something you can see, where you can step back from it in space… It is a crucial point in building the piece. I am working with the plausibility of its sound…I often make a sound which is almost plausible within its context when you first encounter it. The point where a person realizes that it is not plausible is when he jumps into the piece; he's swimming on his own from then on. (Neuhaus, 1994 p. 1)

"Times Square" falls within a category of Neuhaus' works that Neuhaus calls 'place pieces' (Cox, 2011) which are rooted in a single place, as opposed to his other 'moment pieces' that exist in different places. The place pieces, unlike the moment pieces, are continuous, always there as is the case with "Times Square".

> I sometimes construct an almost physical place with sound. The piece in Times Square is a good example; it is outside, in the middle of a large open plaza. It's a large block of sound, which you walk into. Even though invisible

and intangible, it is like a solid place in the middle of this open space. Times

Square is not a place where you expect cultural intervention; if there is one,

you expect to see and hear it. It was not hard to make something that people

had to find in that situation. There, there is no need to alter your aural focus;

you alter your contextual focus when you find that work. (Neuhaus, 1994, p.

2)

Like his earlier "Listen" (1966) installation, Neuhaus develops a relationship of what

could be called an active engagement with the audience, where the nature of the work

demands an intentional effort of aural attention from the audience. Like in Cage's work, the

emphasis on listening is what defines Neuhaus's practice. Neuhaus, unlike La Monte Young

who worked predominantly with sine waves for their purity, makes use of sounds that he

often calls 'plausible', in the manner with which they relate to the space. Neuhaus'

interventions in space make use of the character of the sound, in order to create or recreate a

place. The way that Neuhaus approaches sound is again, as in most of the examples put

forward by Cox (Barnes Foundation, 2017) very physical, relating to the place itself, and how

the sound behaves in a particular space, or to the matter that composes the source of the

sound itself, which gives the sound its character, or what is often also called the colour or

timbre of a sound.

One could describe sound character as having several continuums of meaning

lying between distant points, say, harsh and smooth or rich and thin or warm

and cold, superimposed upon one another. In the area between these points,

within the nature of the sound itself, lies an immense zone of meaning. Its

expressions are transcultural; they are neither literal nor codified. (Neuhaus,

1997)

The character of sound and its relationship with place is also a very active area of research and artistic practice that falls within the umbrella term of Sound Art. Raymond Murray Schafer, a Canadian composer, developed the notion of the 'soundscape' in the late 1960s. The development of the soundscape perhaps can be seen as an inversion of that which had previously happened in image-making. Music, the principal art form that dominated the realm of audition, started out as abstract, an organisation of sounds that relate to each other abstractly in terms of intervals, between one pitch and another. The idea of the soundscape was to a certain extent to paint a picture of an environment, of a place through sound, making sound 'concrete', not in the manner of Pierre Schaeffer's "Musique Concrete" that utilised 'real sounds' but rather by placing the sound and layering it within its own environmental context. The soundscape as ideated by Schafer was a middle ground where science, society and the arts met.

> The home territory of soundscape studies will be the middle ground between science, society and the arts. From acoustics and psychoacoustics we will learn about the physical properties of sound and the way sound is interpreted by the human brain. From society we will learn how man behaves with sounds and how sounds affect and change his behaviour. From the arts, particularly music, we will learn how man creates ideal soundscapes for that other life, the life of imagination and psychic reflection. From these studies we will begin to lay the foundations of a new interdiscipline-acoustic design. (Schafer, 1993, p. 4)

Schafer contends that sound is an immersive experience and as such, the way that humankind perceives sound is an integral component of the experience of listening, locating the idea of the soundscape itself as a direct descendant of ideologies which stem from

Merleau-Ponty's (1960) phenomenology. Soundscape as a concept, as described by Schafer (1977) himself comes in many formats and modalities: a musical composition is a soundscape, as is a radio transmission, naturally occurring sounds, as well as the man-made acoustic environment. Like the landscape, the soundscape is a measurement of change, both in terms of how the environment changes from place to place or from the same place at different points in time. Schafer frequently compared sonography to photography, underlining how achieving the sonic equivalent to photography is problematic, especially as sonography depends on the perceptual experience of the listener. He remarks how the Western world is dominated by the visual, and sound loses its significance, to the extent that one has to develop the ability to disregard sound, in the form of noise pollution, background noise and so on… in order to be able to function properly in society (Schafer, 1993, p. 11).

Schafer differentiates between the eye as a receiving organ upon which humankind has little wilful control upon, and the ear which he calls "the main receiving organ" (Schafer, 1993, p.11), an organ which humankind has developed a perhaps more articulate control upon. Hearing, Schafer observes, is "a way of touching at a distance" (Schafer, 1993, p. 11) and as such is more personal, more intimate than seeing. Perhaps a sonic photograph, more so than the visual photograph is dependent to a greater extent on the receiver, the listener. Nevertheless, Schaefer's concept of the soundscape developed from visual equivalents, and the way it is structured borrows heavily from the canons of visual perception. Schaefer divides the elements that compose the soundscape in three; the 'keynote', the 'signal' and the 'soundmark'. Deriving directly from the notion of figure and ground used in drawing and painting the keynote and the signal act as the background and the foreground. In an interesting mix of musical terms applied to visual perception, keynote sounds as described by Schaefer are the ones created by geography and climate; natural sounds such as wind, rain,

water, birds, insects, forests and so on. To these, one may also add man-made sounds, such as traffic, electrical hums, and all sounds that somewhat recede in the background, whilst in turn directing and determining the sounds that occur in the foreground, or as Schafer calls it the signal; the sounds that we listen to consciously. Any sound can be listened to consciously and as such, in a soundscape the figure and the ground can swap places at any point. Examples that Schafer gives of the signal are bells, sirens, horns and so on, however, these can also include voice, musical instruments and any other form of sound that is at least momentarily the focus of conscious attention. The third term that Schafer uses is the soundmark which is directly derived from the idea of the landmark. Schafer describes the soundmark as "…a community sound which is unique or possess qualities which make it specially regarded or noticed by the people in that community" (Schafer, 1993, p. 10). The soundmark, therefore, can be understood as a sound that has a particular relation to a specific place, or a specific object that in itself also has a direct relationship with a specific place or a specific kind of place. As in the case of Cage, Schafer's ideologies lean heavily on the act of listening. Schafer however also developed a very interesting almost scientific approach that in itself is very physical or in the very least spatial, relating to particular places. Schafer's idea of the soundscape is still to this day an active area of artistic research and practice, and can be observed in the works of Emeka Ogboh in "Lagos Soundscape" (2008) and Jan Winderen's "Disko Bay" (2007). In these examples the soundscape is utilised both as a document, a sonic photograph of a particular place at a specific point in time, and also in a manner in which an acoustic environment is recreated, or reconstructed, a kind of sonic painting, that is perhaps less objective, less factual, and conducted in a layered manner that aims at conveying the artist's experience, rather than acting a snapshot of a particular place in time (Barnes Foundation, 2017). The concept of a soundscape also has very strong links to that of the

soundwalk, as discussed earlier through the works of Neuhaus, Suzuki and Kubisch, where the artists act as a curator of sounds and places, directing the audience to the sound rather than bringing the sound to the audience.

Cox (2011; Barnes Foundation, 2017) mentions how around this time the art world was also playing with ideas of dematerialisation and the dematerialised art object (Lippard, 1973), and notes how perhaps it is no coincidence that interest in the aural within the visual art developed, and accelerated in this period.

Perhaps one of the most significant contributors to this growth in sound in the visual arts especially in the area of sculpture was Robert Morris. Morris came in contact with Cage in the early 1960s and in his piece "Box With the Sound of its Own Making" (1961), Morris brought together Minimalist ideologies of the art object as an object that validates its own existence.

> But only in the case of object-type art have the forms of the cubic and the rectangular been brought so far forward into the final definition of the work. That is, it stands as a self-sufficient whole shape rather than as a relational element… They simply separate, more or less, from what is physical by making relationships themselves another order of facts. The relationships such schemes establish are not critical from point to point as in European art. The duality is established by the fact that an order, any order, is operating beyond the physical things. Probably no art can completely resolve this. (Morris, 1968, p. 33-34)

In "Box With the Sound of its Own Making" (1961) Morris presents a wooden cube, simple and unadorned in Minimalist fashion. Accompanying the box Morris included a three

and a half hour recording of the sounds made whilst producing the box. The approach of combining the art object with the process of art-making became central to Morris' art-making process, in particular in the field of sculpture. These ideas were later articulated in text (Morris, 1966, 1966b, 1967, 1968, 1970, 1993) where Morris developed upon concepts previously developed by the Abstract Expressionists, most notably Pollock whom he championed, into looking beyond the limitations of a figure and a ground, as previously discussed through the work of Judd (1965).

> The primary problematic concerns with which advanced painting has been occupied for about half a century have been structural. The structural element has been gradually revealed to be located within the nature of the literal qualities of the support. It has been a long dialogue with a limit. (Morris, 1966, p. 42)

Influenced by Cage, Morris introduced the notions of chance and indeterminacy in the process of art-making as central to the artwork itself, and in doing so conceptually developed the artwork as something that does not sit still in time and space.

> What art now has in its hands is mutable stuff which need not arrive at the point of being finalized with respect to either time or space. The notion that work is an irreversible process ending in a static icon-object no longer has much relevance. (Morris, 1993, p. 69)

Morris points at the reconsideration of art-making as an act of making rather than a form to arrive at.

Whatever else art is, at a very simple level it is a way of making. So are a lot of other things. Oil painting and tool making are no different on this level, and both could be subsumed under the general investigation of technological processes. But it is not possible to look at both in quite the same light because their end functions are different, the former being a relation to the environment, oneself, society, established by the work itself, while a tool functions as intermediary in these relations. Perhaps partly because the end function of art is different from the intermediary function of practical products in the society, a close look at the nature of art-making remains to be undertaken. (Morris, 1970, p. 62)

Later in the same essay, he observes:

The Minimal presented a powerful solution: construct instead of arrange. Just as the solution can be framed in terms of an opposition (arrange/build), so can the present shift be framed dialectically: don't build…but what? Drop Hang, lean—in short, act. If the static noun of "form" is substituted for the dynamic verb to "act" in the priority of making, a dialectical formulation has been made. (Morris, 1970, p. 66)

These ideologies, especially in the manner they were expressed in "Box With the Sound of its Own Making" approach sound in a physical tangible manner, not only as the result of the process of (art) making but as the process itself and hence the art object in itself. The scenario that Morris presented in this work could be similar to Pierre Schaeffer presenting his "Musique Concrete" compositions with the objects from which the sound was

recorded. Whilst this might sound identical to a live music scenario, however in Morris' case is taken beyond the conventions of music making, as the box becomes its own music system, a self-contained entity that carries with it the moment of its own creation. It is reported that Morris first showed this work to John Cage, and Cage sat for the full duration of the recording listening to the sound, which impressed Morris. From an interview with Jack Burnham (Joseph, 2007) Morris recounts Cage's reaction to "Box With the Sound of its Own Making",

> "When he came I turned it on. I said this is something I made. I turned it on, and he wouldn't listen to me. He sat and listened for three hours. And that was really impressive to me. He just sat there". (Morris, n.d., as cited in Joseph, 2007, p. 48)

Another influential figure in the development of the sonic arts was the American Alvin Lucier. Lucier developed an understanding and relationship with sound that was based on the nature of sound itself as a phenomenon as well as how it is perceived by humankind. Works such as "I am Sitting in a Room" (1969) and "Vespers" (1968) as mentioned by Cox (2009, 2011; Barnes Foundation 2017) explore sound as a physical phenomenon, though its behaviour in space. To these one may also add "Chambers" (1968), "Music on a Long Thin Wire" (1977), "Music for Solo Performer" (1965) and "Clocker" (1978) as primary examples of how Lucier understood sound as an acoustic phenomenon with a tangible spatial presence and how these are perceived by the listener and as such approached in a very physical and spatial manner.

In "Vespers", Lucier works with physical (acoustic) echoes in an environment. The performance consisted of blindfolded performers that navigate a space with echolocation equipment developed by Sondols (Sonar Dolphin echolocation devices). The echolocation devices produce a series of pulses at a predetermined repetition rate. As the sound bounces and reflects around the space, the performers create an 'image' of the space through their aural perception that allows them to navigate the space (Lucier, 1979; New World Records, 2002).

Lucier also developed an interesting approach and relationship with technology. In "Music for Solo Performer", sometimes also referred to as the 'brain wave piece' (Straebel and Thoben, 2014), Lucier makes use of an EEG (electroencephalogram) which is a device that measures and records the electrical activity of the brain, in order to produce sound in a live performance setting. In "Clocker", Lucier makes use of a galvanic skin response sensor, that measures minute changes in skin resistance, that are created through the amount of secretion from the sweat glands which are directly dependent on the emotional state of the subject (Boucsein, 2012) or in this case the performer. The data generated from the galvanic skin response sensor controls the delay rate of an amplified clock creating a situation where the performer is capable of altering time; slowing it down and speeding it up, even theoretically stopping it simply through thinking about it. The perception of sound as a phenomenon and the tools that were used to measure this became an integral part of Lucier's oeuvre.

Sound as a phenomenon was a central motif explored by Lucier. In "I am Sitting in a Room", Lucier made use of the resonant frequencies of the space itself, in order to manipulate the sound over time. The installation consists of a recorded sound spoken by

Lucier himself, where he explains the process of the installation, and the expected outcome. At the end of the recording which is transcribed below, Lucier makes reference to his own speech impediment, his stutter, adding a more human level of engagement and perhaps in the manner that goes beyond the ideologies of Judd (1965) and Morris (1966, 1966b, 1967, 1968, 1970, 1993), Lucier includes as part of the artwork not only the process of making, and the material qualities, but also the act of becoming that is fused with the maker itself, where the artwork itself, a produce of the artist, 'smooths out' his human flaws. Collins (1990) also makes reference to Lucier's stutter calling it "the rhythmic signature of the piece" (Collins, 1990, p.1). The transcript for "I am Sitting in a Room" taken from Lucier's original 1969 score reads as follows:

> I am sitting in a room different from the one you are in now. I am recording the sound of my speaking voice and I am going to play it back into the room again and again until the resonant frequencies of the room reinforce themselves so that any semblance of my speech, with perhaps the exception of rhythm, is destroyed. What you will hear, then, are the natural resonant frequencies of the room articulated by speech. I regard this activity not so much as a demonstration of a physical fact, but more as a way to smooth out any irregularities my speech might have. (Collins, 1990, from the score of 'I am sitting in a room', Lucier, 1969)

In "I am Sitting in a Room", the sound recording of Lucier's voice is played repeatedly in the space, on a pair of tape recorders that keep playing and recycling the speech until the resonant frequencies in the room keep reinforcing themselves, overwhelming the voice, essentially destroying any semblance of human speech and with that any meaning that

the text itself has. The space itself, its architectural volume determine the rate and which resonant frequencies are amplified, essentially acting as a filter to the original sound (Lucier, 1979). "I am Sitting in a Room" is a powerful demonstration of the physical capabilities of sound, and how a spatial approach to aural phenomena can be utilised and intervened upon as sculptural matter.

Other artists who have made use of the physical nature of sound and its behaviour in space include Steve Reich, who in the late 1960s pioneered the concept of 'process music'. In his piece "Pendulum Music" (1968) Reich makes use of microphones and speakers in order to create a controlled 'phase piece', an instance of temporary feedback loops through physical engagement, with the sound created through the process of swinging the microphone. On "Pendulum Music," Reich (2000a) writes:

> When it was done as a concert piece at the Whitney Museum in 1969, during an event of my music, it was 'performed' by Bruce Nauman, Michael Snow, Richard Sierra, James Tenney and myself. They pulled back their measured microphones and I counted off 4-4 and on the downbeat, they all let it go and sat down, including me. Then the microphones begin to 'whoop!' as they pass in front of the speaker because the microphones had been preset to be loud enough to give feedback when it's in front of the speaker but not when it swings to the left and the right. Over a period of ten minutes, which was a little too long for my taste, and as the pendulums come to rest, you entered a pulsing drone. Once it hit the drone, I would pull the plug on the machine and the whole thing ended. It's the ultimate process piece. It's me making my peace with Cage. It's audible sculpture. (Reich, 2000a, p. 1)

Reich worked with the idea of phase which he saw as a series of relationships that drifted in and out of sync, "Instead of a particular relationship, here is a whole way of making music, going from unison through all these contrapuntal relationships, all the way back to unison. All the possible relationships, rational and irrational, are there." (Reich, 2000b, p. 1)

Phase is an interesting phenomenon in acoustics, it relates perceptually both to time and motion in space. Technically, however, this is mainly a timing issue, commonly brought about whilst recording with multiple microphones where the sound reaches microphone A milliseconds before microphone B. This depends on the space that the audio is being recorded in and where the microphones have been placed. In a stereo field where two channels of audio combine together, phase can be thought of as how far along its cycle a waveform is. 'In phase' means that both waveforms are synchronised and moving together. 'Out of phase' means that one of the waveforms is further along or behind the other. Theoretically, two identical waveforms that are 180 degrees out of phase (the furthest apart that they can be) cancel each other out completely. Phase is usually dependent on timing, where a waveform is slightly (milliseconds) before or behind the other, however, it can also be understood as the result of polarity in the electrical components of the hardware.

In Reich's case, in his early tape works, recordings moved in and out of phase spontaneously as early recording gear was not very reliable in keeping time accurately. Whilst the differences were negligible when playing back a recording on a single machine, by adding multiple machines, the timing between one and another tended to drift slightly over time, creating physically built audio effects such as echoes, delays, flanging and ringing (Cohn, 1992).

Other examples of artists who have worked with feedback and tape loops include Elaine Radigue, a pupil of Pierre Schaeffer who created a series of sound installations in the

early 1970s based on feedback and tape loops that mutated across time and were distinctly different every time that they were installed (Holterbach, 2011). Christoph Cox interestingly adds that Radigue frequently installed her works in gallery spaces, often in collaboration with visual artists (Barnes Foundation, 2017). Contemporary artist Adam Basanta, works with tuned feedback loops combined with computer algorithms to produce work which is evocative of the early experiments in sound and its physical relationship with space in the manner of Lucier, Reich and Radigue, with the added capabilities of real-time computation that control the feedback loops from getting out of control, thus extending the permanence of the intervention in the space, in a way making his installations appear more sculptural, more permanent, and less performative. In reality, the performance is continuous, performed by computers that never get tired as human performers do. His piece entitled "Pirouette" (2015) consists of a microphone on a stand placed on a slowly revolving pedestal. Around the pedestal, Basanta places seven suspended speaker cones that the microphone slowly revolves above. Each time the microphone passes on top of a speaker it creates a tuned feedback loop that increases and decreases in volume as the distance between the microphone and the speaker changes. After nine complete rotations, it finishes a melody from Tchaikovsky's Swan Lake (1875), extending the duration of the original melody from one minute to around 10 minutes (Griffin, 2016). Basanta comments in a interesting manner on this particular piece: "I think of it as a composition in the sense that I'm composing a set of relationships between the equipment and people" (Griffin, 2016, p. 1), echoing a common sentiment in contemporary artistic practice, one that includes the audience as an integral part of the artwork itself. In "A Room Listening to Itself" (2015) Basanta creates a situation where the audience is invited into a system that is composed of speakers, microphones, computer

algorithms and space itself. The system as described by Basanta, turns the audience into part of the feedback loop, observing and reacting to their motion and behaviour in space.

> Using the acoustic phenomena of tuned microphone feedback alongside recursive amplification networks, the gallery space is turned into a giant resonator that amplifies both acoustic activity and inactivity as a product of spatial relationships… As gallery visitors walk through the room, they inadvertently modify its acoustic properties by both creating and absorbing sound, modifying the audible relationship between microphone, speaker and acoustic space. The visitors' sounds are integrated into the work… In this sense, visitors become part of a feedback loop, both attending to and participating in the relationships found in the gallery space as they move through it. (Basanta, 2015)

In 1980 Maryanne Amacher installed her first large-scale sound installation entitled "Sound-Joined Rooms" (1980). In this installation, Amacher developed an idea of structure-borne sounds, rather than airborne sounds. Structure-borne sounds made use of the architecture itself, the walls, the glass, plaster, panelling, furniture etc, as a carrier medium for soundwave, making the vibrations physically manifested. (LaBelle, 2006). The resulting installations were very powerful experiences, where sound could be physically felt, all around including within the audience's own body (Barnes Foundation, 2017). Amacher was mainly interested in psychoacoustic phenomena and experimented with auditory illusions which she referred to as 'auditory distortion products', sounds that are generated within the listener's own ear when subjected to particular tones at the correct levels, such as for instance her composition "Making the Third Ear" (1999) (Haworth, 2011). Amacher developed a physical understanding of sound that she often referred to as sculptural. In "TEO! A Sonic

Sculpture" (2005), Amacher created a 3D multichannel installation, where she bridged multiple elements such as spatiality, physicality, place, technology and a tuning system based on the "Lenoid meteor showers recorded by the European Space Centre" (Amacher, 2005).

Christoph Cox (Barnes Foundation, 2017) mentions an interesting 'sub-category' of Sound Art practices that as per the examples discussed above approach sound in a very physical manner. Cox refers to this as a 'mute Sound Art' citing the works of Jennie Jones' Acoustic Paintings such as "Blues in C Sharp" (2014) where Jones uses acoustic panelling on the painting that dampens the sound of the environment that the painting is placed within, and the work of Christine Sun Kim, a deaf artist that in her piece "All Day" (2012) records on paper the gestures of American sign language, creating a visually powerful graphic notation. The work of Bruce House, in particular, "Concert" (2015) also works along these lines, and in a manner akin to the work of Amacher, House creates a 'concert' composed out of sounds below 20 Hz, on the threshold of human hearing, understanding sound as an extension of touch. Christian Marclay, similarly works on the potential for there to be sound, expected sound or imagined sounds, that are accessed through the relationship between sound and image. In "The Sound of Silence" (1988) Marclay presents a black and white photograph of Simon and Garfunkel's record (1964) of the same title, using the photograph, a 'mute media' to capture the silence that the title precludes (Barnes Foundation, 2017).

Of course, there are many more examples which one can mention that Cox (Barnes Foundation, 2017) does not mention in his presentation. Of significant importance is Brian Eno's exploration of generative music, Tom Nunn's exploration of experimental musical instrument building, that itself develops from Harry Partch's building of custom sculptural instruments, and which has bred a whole line of experimental instrument builders that operate in a grey area between sculpture and musicology. An example of these include Marc

Appelbaum, Hans Reichel, Yuri Landman and Bjork who for her album Biophilia (2011) built custom hybrid instruments based on nature rather than musicology, as well as a range of digital instruments in application format for mobile devices, which acted as an interactive musical album, where the user not only could listen to the song written as Bjork intended but also create their own arrangements/composition using the same instruments and musical ideologies as devised by Bjork (Dombal, 2011). Also worthy of note is Gerhard Trimpin, who invented his own computer protocol to communicate with his instruments well before the invention of MIDI (Musical Instrument Digital Interface) and is considered a pioneer in the utilisation of MIDI in sculptural installations (Leitman, 2011, p. 22).

Experimental musical instrument building as an area of research and practice grew in popularity in the early 2000s, headed by NIME - The International Conference on New Interfaces for Musical Expression. Starting out as a workshop at the Conference on Human Factors in Computing Systems (CHI) in 2001, the conference grew into an international yearly event, held all around the world that brings together artists musicians, and scientists and over the years has featured numerous artists who are considered as pioneers in the field of Sound Art including Toshio Iwai in the 2004 edition in Hamamatsu Japan, Trimpin in the 2007 New York edition and Paul De Martinis in the 2009 Pittsburgh edition as keynote speakers (NIME, 2014). This area of research combines concepts from Human-Computer Interaction (HCI) with musicology, interface design, installation art and DIY culture.

5.2 Sound in the Visual Arts

From the visual arts, there have been a number of practitioners who have developed interesting relationships with sound. Marcel Duchamp's "With Hidden Noise" (1916) can be

considered as one of the first sound sculptures produced. Consisting of a ball of nautical twine, clamped between two brass plates, concealing a hidden object that Walter Arsenberg, a friend and a patron of Duchamp placed inside, without ever revealing its nature to Duchamp. The actual 'content' of the artwork, remains unknown, experienced only through handling the artwork and listening to the rattling sound produced (Temkin, 2001, p. 48; Hegarty, 2007). Duchamp's "Sculpture Musicale" (c.1912-1921) consisting of a note on a small piece of paper is considered similar to Fluxus pieces of the early 1960s in the manner of how it combines objects with performance, audio to visuals, the known to the unknown and the explained to the unexplained (Kotik, 1991). The Score for this work reads as follows:

> Sounds lasting and leaving from different places and forming a sounding sculpture which lasts.
>
> To *lose* the possibility *of recognising* 2 *similar objects* - 2 colours, 2 laces, 2 hats, 2 forms whatsoever to reach the Impossibility of sufficient *visual memory*, to transfer from one like object to another *memory imprint.*
>
> -Same possibility with sounds; with brain facts. (Duchamp, c1912-1921, p. 168)

Duchamp also devised a series of 'compositional apparatus' consisting of a funnel, several open-ended cars and a set of 85 numbered balls that correspond to the pitches of notes on a piano (Kotik, 1991).

Yves Klein explored the relationship between his monotone works on canvas and sound, attempting in "Monotone Symphony" (1947-1948) to recreate his work on canvas in acoustic space.

> The symphony lasts for forty minutes and consists of one single, continuous long drawn out 'sound', it has neither beginning nor end, which creates a

dizzy feeling, a sense of aspiration, of a sensibility outside and beyond time.

(Kline, 1948, p. 168)

Lazlo Moholy-Nagy is reported to have produced sound-producing sculptures (Hegarty, 2007) and his interest in the relationship between the aural and the visual is well documented (Kostelanetz, 1970). In 2016 an exhibition held at the Guggenheim Museum entitled "Moholy-Nagy: Future Present" a concert entitled "Moholy-Nagy: Optical Sound" was included in the exhibition's programme. The concert took place on July 21st, showcasing Moholy-Nagy's work in the medium (Pearlman, 2016). Moholy-Nagy is credited as the inspiring force behind the 1969 "Art Through Telephone" exhibition, held at the Chicago Museum of Contemporary Art, curated by Jan Van Der Marck, which included thirty seven artists amongst whom were John Baldessari, Mel Bochner, Jack Burnham, Dick Higgins, Joseph Kosuth, Les Levine, Sol LeWitt, Robert Morris, Bruce Nauman, Dennis Oppenheim, Richard Serra, Robert Smithson, Stan Van Der Beek and Nam June Paik. Artworks were either created/activated by the telephone, or instructions for the construction of installations were imparted over the telephone (Platzker, 2008).

In 1970 Jack Burnham curated an exhibition entitled *Software* at the Jewish Museum (1970) and the Smithsonian Institute (1971) in New York that featured a number of sound installations and sound-based works such as Les Levine's "Wire Tap" (1969-1970), consisting of twelve speakers that relayed in real time a series of conversations between the artist and anyone who phoned him on the day. Guerrilla Radio's "Giorno Poetry System" attempted to free the air-waves and reclaim them for everybody. During the *Software* exhibition, they broadcast daily works of poetry by Vito Acconci, Joel Oppenheim, John Cage, Jim Broody, Andy Warhol & Bridgit Polk, Jim Caroll and many others, over radio transmitters with ear-plugs that were given out to visitors at the reception desk. David Antin

exhibited "The Conversationalist" (1969-70) where the audience was invited to tell a story after being prompted by a recorded message played on tape that randomly assigned a word for the audience to build their story around. The stories were recorded and the audience then would listen to all the previously recorded stories, then their own at the very end. Theodosius Victoria's contribution to the exhibition through a work entitled "Solar Audio Window Transmission" (1969-70), consisted of ten solar battery operated radio units that were individually connected to ten panes of glass at the front side of the museum. Using contact sound reproducers, the glass panes were converted into speakers that emitted radio transmissions at a low volume from a variety of sources. The weather conditions and the position of the sound determined which of the radio units would work at any one time, encouraging the audience to discover the transmissions by listening to the window panes. Robert Barry exhibited "Ultrasonic Wave Piece" (1968) where 40kHz waves (inaudible) reflect around the space, interacting with the viewer and creating constantly changing patterns and forms within the space. Allen Razdow and Paul County exhibited "Composer" (1970) which consisted of an electronic sound synthesiser that was controlled through a computer program that the audience could interact with, in order to create a real-time audio composition, based on random numerical data (Burnham, 1970).

By the late 1960s and early 1970s sound as a medium found itself increasingly within the context of the gallery space. More and more so-called visual artists were making use of or exploring the possibilities of sound, and as visual artists tended to understand sound physically, they attempted to manipulate it in the same manner that they were accustomed to. In the mid-1970s John Grayson compiled a collection of essays on the subject of Sound Sculpture. Published in Canada under the title *Sound Sculpture: A Collection of Essays by Artists Surveying the Techniques, Applications and Future Directions of Sound Sculpture*

(1975), the book paints an interesting picture of the subject, looking at the current trends at the time, and also at the past and the future possibilities of Sound Sculpture. In the book a number of artists are discussed, some coming from musicology such a Harry Partch, Lou Harrison and Raymond Murray Schaffer, others from the visual arts such as Harry Bertoia, Charles Mattox and Reinhold Pieper Marxhausen.

Reinhold Pieper Marxhausen produced sculptural work that looked at the relationship between objects and their sound. The sounds of whiskey bottles, saws and door knobs were harnessed through the building of strange, often dangerous looking contraptions that the audience could play with to produce tones. His best known work consists of metal wires welded to a round object. By connecting two of these together with steel bands Marxhausen created headphone like sculptures that a listener would place on his or her head, like with a conventional pair of headphones, and by caressing the metal wires, one could hear a whole range of hauntingly beautiful sounds (Marxhausen, 1975). Harry Bertoia similarly produced metal sculptures out of wire, predominantly in bronze that made a sound when caressed. Over the years Bertoia constructed numerous sculptures in various lengths thicknesses and heights, that he kept in a specially acoustically treated barn. The sculptures, that already had a very striking visual presence would resonate with each other, triggering each other off, resulting in a range of wonderful bell-like organic sounds that Bertoia recorded and released on a number of records entitled "Sonambiet" in the early 1970s. On sculpture and its relationship with sound Bertoia commented "For a number of years I had realized that sculpture has existed in silence through time, looking at sculpture, like walking in a forest, I thought: 'Why is sound left outside?'" (Bertoia, 1987, p. 186).

Stephan Von Huene built mechanical contraptions that created sound. A mix between eighteenth-century automata as mentioned by Burnham (1968) and the Duchampian idea of

the found object and the constructed assemblage, Von Huene created animated sculpture 'machines' making use of pneumatics, that cannot be clearly defined as automatons, nor as musical instruments. Allan Kaprow (1975) comments on Von Heune's work as

> Von Huene's art is located at a point just between those turn-of-the-century fantasies of machines that come alive, and archetypal evocations that reach beyond time. It thus escapes both the topicality of modernism and the datedness of the recent past. There is no nostalgia in his beings who articulate their own existence almost didactically and "in tongues". They seem on their own, stylistically removed from now just enough to perform without either necessity or apology. They are perhaps even a little smug in their mystery. What they are not, that is, what is absent, is of no importance to them. It is what makes their magic so potent. (Kaprow, 1975, p. 26)

Contemporary practitioners that work along similar lines include Pedro Reyes who in his "Disarm" (2013) project, assembles what could be defined, for lack of a better term, an automaton orchestra constructed out of firearms confiscated from drug cartels by the Mexican authorities. Reyes (2013) makes use of software and digitally controlled motors processes to achieve this result, however, the element of 'magic', of transformation, as mentioned by Kaprow (1975) in relation to Van Heune's work is a presence that is equally present in Reyes' work. David Jacobs created a number of air driven sonic sculptural pieces in the late 1960s. Constructed out of rubber, metal, motors and pipes of various materials, Jacobs created sculptural work out of soft and hard materials that made sounds. Operating in a manner similar to reed instruments, these sculptures were interactive and possessed very tactile qualities. In his notebook, Jacobs writes "Sound is an integral part of my sculpture at this time, shaping space at least as effectively as any visual elements" (Jacobs, 1975, p. 35).

In the pages of Jacob's notebook, reproduced in Grayson's (1975) publication, one can observe his approach to Sound Sculpture. Numerous sketches demonstrate his background as a sculptor in a conventional matter, and in the fashion, which is somewhat of a common practice within the visual arts, his works reference those that came before him. A sketch entitled "Homage to Brancusi" dated 1967 (1975, p. 41), clearly demonstrates how Jacobs combines sculptural form with its potential to produce sound. On this particular sketch, Jacob comments "A smacking force reminding me of Brancusi's "Kiss." this became "Breather," a rhythmically inflating piece of escaping air sounds" (Jacobs, 1975, p. 64). Similarly, Charles Mattox created sculpture that was meant to be touched. A student of the sculptor David Smith, Mattox combined sculptural forms with audio-kinetic mechanisms that he devised, making use of electromagnets, mechanical gears, springs and electronic circuitry. His sculptures were often interactive such as his "Theremin Piece" (1969) or involve the sense of touch directly, such as in The Fuzz is Your Friend (1967) built out of springs and monkey hair which Mattox states creates erotic overtones through the movement of the fur (Mattox, 1969).

A common thread that ties these artists is their approach to sound, sound as matter with which to produce sculpture. Often used in conjunction with light such as in the case of Charles Mattox and Gyorgy Kepes, and earlier as in the works of Lazlo Moholy-Nagy and Oskar Fischinger, and in contemporary times through the work of Christian Blom, sound was no longer confined solely to music and became a material in the sculptor's arsenal. The sculptor, here was not building instruments to suit a musical system, neither a conventional one, nor-self made such as in the case of Harry Partch and Lou Harrison, but rather looked at sound as sound, and aimed to produce sound not necessarily attached to meaning, just as perhaps a light bulb produces light, rather than music. The two areas, of course, overlap significantly. The prevailing ideas in the 1960s and 1970s of the art object and materiality, as

idealised by the minimalists; the dematerialisation of the art object brought about by conceptual art; Fluxus's interest in the psychoacoustic qualities of sound; the practice of the expanded arts; and an interest in technology, all contributed into the developing of a physical understanding of sound, making it perhaps easy for us today to talk about sound as sculptural matter.

When Suzan Philipsz won the Turner Prize in 2010 for her piece "Lowlands" (2010), a piece that could not be touched nor seen, Sound Art was placed in the spotlight and is now a very rich area of artistic research and practices. The emergence of Sound Art as one of the new pillars of the visual arts in the early part of the twenty-first century, however, cannot be distilled to a single event. Kelly (2011) as well as Cox (Barnes Foundation, 2017) mention a 'sonic turn' occurring in the late 1990s and early 2000s where the primacy of vision within the visual arts was challenged. Cox mentions a number of factors for the emergence of this so-called 'sonic turn', which is essentially a shift in the manner that we think about sound. The demise of the record industry, brought about by peer-to-peer file sharing at the end of the 1990s led artists to find different ways of not only selling their work but also producing it and funding it. Bjork, for instance, was one of the early adopters of tablet-based technology which she used extensively not only to write her 2011 album Biopihila but also as a platform to access her album. Biophilia was launched as a series of applications (apps), that were not only musical tracks but also instruments. The change in how music was distributed and engaged with, combined with new digital technology that facilitated the production, manipulation, interaction with and distribution of sound, caused for a total rethink of our relationship with sound. Cox (Barnes Foundation, 2017) notes how simultaneously these trends were picked up by artists and academics, in turn leading to curators becoming more

interested in the role of sound within the visual art, and consequently, more and more artworks that made use of sound were being shown.

5.3 Sound - Time

Sound as a physical force present in our lives at practically every instance is both spatial and temporal. Sound propagates itself continuously from its source across space, utilising air as a carrier vehicle, in its airborne form, and matter in its 'structure borne' form (LaBelle, 2006) across time which flows continuously in a single direction.

In simple scientific terms, sound is a pressure wave vibrating at a defined frequency. Frequency as a scale of measure, refers to the number of oscillations per second, or in simpler terms, the distance between the peaks and the troughs of the pressure waves and how many times this cycle is repeated within a second. The spatiality of sound, apart from the obvious movement radiating, or emitting from the source as a result of some movement or action, is also dependent on the sensory apparatus with which we, as human beings are equipped. As binaural beings, equipped with two ears, we experience sound similarly to how we experience vision, - stereoscopically where we make use of cleverly computed assumptions through shadows and reflections in order to gauge the distance and the direction in a three-dimensional world, and for the most part we do this relatively successfully.

In terms of temporality, we have a different relationship with sound and most of what we know about sound, at least in terms of how it is perceived, always to a certain extent involves some kind of relationship with time. Rhythm, repetition, the idea of tempo (which in terms of audition is unique in its relationship with time when compared to other senses), depend totally on their relationship with time. Breaks in the sonic object are always temporal

and sonic distances or to be more precise, distances in terms of the aural domain are always based on time. Here one is not referring to the idea of intervals or pitch but rather sound and its relationship with space. In clearer terms, the distance between one sound and another is almost inevitably expressed in time.

If one wants to look deeper into the relationship between sound and time there are some fairly interesting observations to be made.

Time is a measure of distance, a distance operating perhaps on a separate plane to space (for the argument's sake we shall look beyond quantum physics for now and the idea of space-time as inseparable) and measures the distance between one event or another. In musicology time is measured in two ways: in standard or 'absolute time' and in tempo (Beats Per Minute) - as in John Cages's "4'33"" (1952) which has an indicated tempo of 60 bpm in the 1953 'Kremen Manuscript' version (Tonspur, 2010). Sound is therefore being measured temporally as the distance between an event (a sound) and another but also in terms of minutes and seconds for a predetermined succession of events to take place. If this is turned on its head and one takes a look at the concept of time as a measure between on event and another, then sound, the event, can be seen as what is creating time.

As ridiculously far-fetched as this proposition sounds, this has been contemplated by humankind extensively, that is before reason and rationality get in the way. Nevertheless, I believe that this is a fascinating thought to entertain, especially in the light of new technologies and digital media and their capability to dismember the sonic experience into separate components which shall be discussed later on in the thesis.

The notion of time created through a succession of sonic events and propagated through the sustained succession of such events has been thwarted perhaps by the creation of a standardised idea of time. This concept of a standard time which in itself is measured

against something cyclical, predictable and relatively unalterable has occluded our understanding of time and remodelled it into an understanding of time as something that flows linearly, constantly and invariably. The idea of time being created through the distance between one event and another goes against the notion of a standard time, as time, in this case, would be akin to water dripping from a waterspout, a kind of trickling time, time that is capable of accelerating, decelerating and standing still indefinitely.

Our contemporary understanding of the world around us has also coloured the way we look at space, particularly the relationship between time and space. Thompson (2002) explains how through advancements in electronics in the 1950s sound was virtually stripped of its relationship with space and reconceived into an electronic signal. The result of this is that when we think of space and its relationship with sound we only consider the acoustic qualities of the space we are listening to the sound in, and we consider this in terms of echoes, reverberations, reflections and so on. Sound also has a very physical relationship to matter, to materials and their qualities and to objects' three-dimensionality.

5.4 Sound - Music

As a researcher in the area of software and sculpture with a special interest in the sculptural qualities and possibilities that sound offers, I observe and experience numerous problems in stripping down the idea of sound and consequently building sonic objects and constructions that are devoid of ideas and elements of musicology. Whilst I do not believe that there is anything essentially wrong with the concept of musicology in general, it imparts on sonic art practices and even more so on our primal understanding of sound the same limitations in art-making as expressed by Judd (1965) when he argued against the then prevalent ideas of

painting and sculpture, referring to them as unnatural, man-made limitations. Judd advocated, or rather proposed the concept of a new three-dimensional object that is neither painting nor sculpture, an object that is not constrained by self-imposed limitations such as the rectangle in painting.

In my previous research in this area (Galea 2013; 2015), my reasoning was that sound as a three-dimensional object fits the idea as put forward by Judd. Accordingly, I developed work that can trace direct influences from ideas developed by Judd (1965), Krauss' (1979) *Sculpture in the Expanded Field* and Youngblood's (1970) concept of Expanded Cinema. In the realm of sound studies, the work of Pierre Schaeffer, John Cage and Harry Partch and also the inclusion of ideas from a broader spectrum in the performing arts such as Cunningham's well documented collaborative relationship with Cage have deeply influenced my practice and the direction of my research.

The influence of Cage on the visual arts as discussed earlier in this chapter needs little introduction. Cage, however, struggled perhaps with letting go of his baggage that came with his understanding of musicology. Nonetheless, he looked actively at ways of overcoming this. He looked at oriental ideologies for answers and expanded the musical octave by adding more steps or micro tonalities between each note. Cage also explored the timbre and the qualities of sound by amplifying everyday objects and using them in performances and compositions such as his "Child of Tree" (1975) and his "Prepared Piano" pieces (1938-1952) which whilst departing tangentially from standard music and performances, as discussed earlier, still fit in within the formats of music. This is very interesting as it highlights the crux of the problem in musicology and how this perhaps limits the territories where one can explore and intervene sonically. As put very eloquently by Appelbaum (2003) our understanding and relationship with music is cultural. Cultural selection (a social version

of the evolution of the species as described by Darwin), looks at how ideas or objects and the vehicles that made these possible are reinforced or on the opposite end of the spectrum, forced into obscurity depending on how society relates to them, assimilates them or rejects them. Bjork, for instance, claims that Western musicology is based on Christian traditions and symbology (Dombal, 2011), which she rejects, opting instead to devise a music system based on nature. Whilst Bjork's claim might appear strange at face value, it would make perfect sense that the Western idea of musicology has been developed to reflect ideas derived from Christianity, which dominated Western culture at the time, and perhaps today as the social and cultural structures have shifted in different directions, musicology and the sonic arts in a broader context should reflect these changes rather than trying to preserve ideas that are perhaps now distant in current social and cultural domains.

The particular problem faced in this area relates purely to the corrupted understanding of sound that has been developed over time. The corruption, or rather the tinting of our understanding of sound, presents numerous problems when trying to dissect the elements of a sculptural sonic practice. These problems run across the board and manifest themselves in varying degrees of intensity in perceptual, physical and mechanical as well as in the electronic and digital spaces.

It is important to stress how the use of the word 'corruption' here is not intended in a negative manner, but as a reminder that there is attached to sound socio-cultural alterations that colour the way sound is understood and which has resulted in a situation where all structures that deal with sound are based on.

Sound in itself, pure sound, follows no real structures. It is obviously subject to physical laws, however on top of this there is a layer of man-made structures of meaning and relationships that have become so ingrained in the idea of sound that it becomes practically

impossible to achieve any kind of separation between one or the other. Whilst it is true that sound is engaged with, in perceptual terms, in a manner that is different from that of vision, which tends to offer a more objective distance to any external stimuli (Voeglin, 2010), cultural elements are ingrained in the manner that we not only understand sound but also how we engage with it.

Every approach one takes in sound is governed to some degree by its relationship with music. This is not only true for our understanding, approach and appreciation of sounds that for instance govern our ideas of rhythm, melody, harmony and so on, that which perhaps together with intention distinguishes between what we would consider as wanted and unwanted sounds, between music and noise. These factors depend very little on our sensory apparatus and more on social and cultural structures. This gets further reinforced by individual taste like, for example, the appreciation of a particular genre or sub-genre of music over another. There is no biological predisposition to, say, hip-hop music or heavy metal and whilst certain genres are associated with certain ethnicities, geographical distribution, gender or age brackets there are multiple examples of individuals that break this cultural association.

Social and cultural constructions and their effects go however further than that. The influence of these factors spills over into the physical, electronic and digital realms through cultural selection and reinforcement (Appelbaum, 2003).

A sound-making device or instrument that does not fit well within the structures of musicology or what is considered 'wanted sounds' in social and cultural contexts, quickly falls out of favour, as a result of this such an instrument or device would not be reproduced or produced in multiples, which leads to a lack of availability and consequently to the lack of knowledge on how to use or operate the device, finally resulting in the instrument to fade out of memory. On the other hand, an instrument or device that is capable of creating and

reproducing sounds that are considered desirable would get reproduced, and individuals would learn how to operate it and utilise it, thus propagating its longevity.

It is important perhaps to point out that musical instruments here are being discussed as physical/mechanical propagators, creators and articulators of sound, and more significantly the tools and interfaces in the creation of intentional sound. In a sculptural context, and this I believe is true for most art forms, there has to be some sort of intention, irrespective of its form - modelling, carving, assembling but also finding and collecting should be initiated consciously for the result to be considered an artwork.

The relationships sound has with music, therefore, determines the shape things take from a mechanical or physical point of view. This is also true for the electronic and digital realms, and this is perhaps where the relationship between sound and music becomes most problematic for the purposes of this research.

In digital and electronic audio production, the protocols used, the way that the hardware, as well as the software, are designed follow physical models, in a way emulating the physical world (Manovich, 2001), or at least this would always be the starting point. Electronics are in themselves governed by physical laws and therefore share certain limitations with the physical/mechanical world. The way that the hardware is engineered, however, down to the component level, the number of steps in control voltages, the range of the oscillators, the speakers, amplifiers, timing chips for sequencers and so on, are always built for and within a musical context, making it practically impossible to cleanly severe the ties music as a structure imposes on sound and the intentional production of sound outside of the Western concept of music. This phenomenon is also surprisingly carried across in the digital world.

Musical Instrument Digital Interface or MIDI as it is more commonly known is arguably the longest standing computer protocol in terms of creating, receiving and redirecting sound. Whilst it is effective, it is riddled with a number of limitations that have led to the creation of other computer protocols, most notably Open Sound Control (OSC) which has been gaining ground, as it is capable of handling larger packets of data and is also capable of processing a wider range of data. On the downside, it is notoriously tricky to set up and most popular software applications for sound making and processing are not geared towards working with OSC. In the case of MIDI, networking and connectivity are more reliable and readily available as most software and hardware is designed to work with MIDI out of the box, making it a universally applicable, easy to configure, reliable and ideal for most applications.

In my research, I have made frequent use of MIDI as it allows for one to interface data across multiple computer applications. MIDI requires very low processing power and (in computational terms) is a very simple process that sends strings of data made up of binary (ones and zeros). This simplicity makes it possible for one to convert MIDI data into a myriad of other formats, making good use of the digital dimension's ability to network, send, receive, manipulate and transform data with which to then intervene directly within the physical world, thus extending the dimensionality of sculpture and extending the data generated through these processes beyond the remit of sound.

In the project "Soundwave Sculpture" (2016) relative spatial distances generated through changes of directions are converted into MIDI data through digital processing in real time. This process can also be reversed and MIDI data can be utilised to generate spatial coordinate data which can be used to create physical models of sound data with a 3D printer. This process shall be discussed further on (section 7.6).

The major problem that MIDI presents is congruous to what was discussed previously. MIDI as a protocol, has been designed with a musical application in mind, and whilst it does this relatively well, it becomes once again impossible to separate the musical structure from the data being processed in order to create sculptural sonic objects through digital translations and permutations that are devoid of the ingrained musical structures and content. Other computer protocols and computer audio engines such as Juice 5, which is used to create audio applications and plugins on all major platforms - OSX, Windows, Linux, Android and iOS - make use of the MIDI protocol in order to create almost any kind of audio application imaginable. This presents a double degree of ingrained musical structure, the one present in MIDI and the ones present in most audio production and processing software that have MIDI ingrained in their operating structure.

Perhaps the only way to get rid of this intrinsic relationship with music, would be to totally start anew, where one would have to practically reinvent the wheel - to remove all social and cultural conventions, traditions, even the very mathematics that musicology derives from, to accommodate for the new found freedom that technology has to offer. This is neither practical nor is it the purpose of this research. The ingrained relationship with musical structures and their basis on Western ideologies and beliefs which can be found down to the level of how individual components are built is unavoidable in this research, especially in light of how digital processes, in this case, are being used in order to manipulate and distort processes and understanding in physical space. This on its own is perhaps the greatest limitation in terms of practice that this research has to contend with.

5.5 Sound in Matter, Sound in Space, Sound in Memory

As a material with which to produce sculpture, sound presents its own set of characteristics that can perhaps be considered alien to the realm of the visual arts. Exhibiting sound within a gallery space is not as simple and straightforward as exhibiting a painting, or a conventional sculptural artwork. Connor (2007) comments on how sound is 'extramural', it cannot be contained by the traditional gallery wall. Like odour or gas, Connor (2007) observes, sound leaks, goes around corners and cannot be contained by the conventional partitioning of the gallery space. It permeates and penetrates beyond conventional boundaries, in ways that perhaps the art world itself, and the politics that govern it when it comes to displaying artwork can control. Sound also adds elements beyond the traditional gallery experience.

> Much of the work that is characteristic of sound art has either gone outside or has the capacity to bring the outside inside. Sound is doubly extramural: in a disciplinary sense, it adds to art a dimension that has traditionally been left to other, more temporal arts; secondly in a more immediate or phenomenological sense, it introduces timely events into the permanent, partitioned world of art. Sound art comes not only through the wall but round the corner and through the floor. Perhaps the greatest allure of sound for artists, more than ever conceived of their libertine vocation somehow to go over the institutional wall, is that sound, like an odour or a giggle, escapes. (Connor, 2007, p. 130)

Sound rather than spatial, as this inevitably always boils down to acoustics, can be understood as volumetric. A voluminous form, an object residing in space, as an occupant of the same space, travelling within it, across a temporal plane. Burnham (1968), notes how it was Archipenko, first, followed by Hepworth and Moore, that developed ideas on the

interiority of volumes within sculpture, a modality of art-making that perhaps previously resided at the surface appearance of things. Connor (2007) notes how Sound Art perhaps developed from and works within this paradigm, and that sound unlike vision that can determine the state of things from the exterior, has the capacity of observing things from the inside out, such as in the case of a sonar, or echolocator, or when for instance a doctor listens to a heartbeat or the breathing of a patient. Connor deems sound sculpture as the act of manipulating matter from the inside out rather than the outside in (2007, p. 136).

Sound in the physical world is always to some extent a consequence of an action and occurs in almost every process and daily interaction we have with matter. Matter itself is instrumental in the resulting sound produced. Sound vibrated through its carrier medium and the frequency at which it vibrates is entirely dependent on its source which can be defined as an amalgam between material composition (air, wood, bone, metal, glass, plastic, stone, and so on) and the form or shape of the source. The other factor integral to the creation of sound would be an external or internal force acting upon the source.

Energy initiated externally is translated from one form into another through vibration within the source. Sound is therefore inseparable from the action and the source which in itself is inseparable from the material that it is composed of and its form, all of this measured across time, with time being a measure in distance between action and no action, a change in state between nothing and something. This is how sound behaves in the physical space. This inevitably leads to a reconsideration of the relationship between sound and its source.

Connor (2007) argues against the idea of sound objects, stating that sounds, whilst embodied are not embodied into bodies as understood by vision. Sound objects, Connor states, do not exist in themselves. Considering, for instance, the sound of the sea or that of a siren, these objects are never the origin of the sound but rather the occasion for sound. No

sound exists on its own but rather as a mix, or compound of multiple sounds, the effects of space and the listener, therefore there cannot be such a thing as a sonic object.

> In order for sound to be audible, it is always necessary for us to be in us just as much as we are in it. We inhabit sound because it happens to us. We do not inhabit the world of vision because our acts of looking are constantly doing things to the world. (Connor, 2007, p. 135)

Voegelin has a similarly interesting observation in this regard:

> Seeing always happens in a meta-position, away from the seen. And this distance enables a detachment and objectivity that presents itself as truth… By contrast, hearing is full of doubt: phenomenological doubt of the listener about the heard and himself hearing it. Hearing does not offer a meta-position; there is no place where I am not simultaneous with the heard. However far the source, the sound sits in my ear. I cannot hear it if I am not immersed in its auditory object, which is not its source but sound as sound itself. (Voegelin, 2010, pp. xi-xii)

Within this research, I have developed ideas and research projects that revolve around the idea of there being sonic objects. Whilst I do find Connor's argument valid and worthy of consideration, digital processes allow one to approach the concept of a sonic object from a totally different angle. This shall be further expanded upon in Chapter 7, especially in section 7.21. One can also however note the concept of audio synthesis, that predates anything digital, as potentially nodding in the direction of the sonic object. Audio synthesis is not dependent on the relationship in physical terms, between the sound and the material and form of its source, at least not in terms of what we can relate to on a human scale, but rather

replaces this relationship with differences in voltages and resistances. Digital audio synthesis, for the most part, attempts to emulate this approach. However, through digital computation, some interesting modulations based on abstract elements have been developed that extend beyond the analogue or electronic variant.

Electronic circuitry and the creation of audio synthesis, for the first time, broke sound's relationship with matter and form and arguably also space. This was achieved through the simple idea that any sound could be recreated by generating waves and modifying them electronically. Through the years there have been multiple types and approaches to audio synthesis; additive, subtractive, wavetable, frequency modulation, phase distortion, sample-based and physical modelling as well as sub-harmonic and granular synthesis just to name a few. These approaches to audio synthesis have transitioned smoothly into the digital realm, to extend beyond the physical limitations of electronic circuitry and the laws of electromagnetism, however, the process remains the same; an audio signal is passed through a filter or a number of filters in order to alter the timbre of a sound. In the physical world timbre, often referred to as the character or the colour of a sound, is totally dependent on the relationship between the matter and the form of the source generating the sound. To illustrate this point one might think of a piano, a trumpet and a guitar; whilst all are capable of generating the same pitch or frequency (note) they have distinctively different sound characteristics to them. The difference in sound is dependent on the physical make up of these instruments, once again it is their shape and material composition that alters and gives them distinctively different voices.

The problem with audio synthesis in sculptural terms is that sound is always approached and acted upon in a two-dimensional manner, always linearly by plotting frequency and amplitude, or changes in frequency and amplitude against time.

Sound as sculptural matter, should not only be approached as a physical phenomenon, or simply in psychoacoustic or phenomenological terms. In the same way that sound behaves in a certain manner when subject to the laws of music, within the visual arts, more specifically within sculpture, sound is expected, at least to a certain degree, to behave within the territories associated with sculpture. Sculpture, music, drawing, dance and any other form of artistic expression are not merely a question of techniques, materials and supports, there is also a cultural expectation. Art is always to a certain degree self-referential, and these self-references create what can be described as a form of (re)mediated shorthand. The arts should always aim to and perhaps have a responsibility to meet, and ideally exceed what is expected of them by society, or at the very least challenge this in an intelligent manner. These cultural expectations have been built through the centuries from humankind's interaction with the arts. Whilst the employment of sound within sculpture presents a series of challenges, this does not, or rather should not alter sculpture to a degree, where it is no longer recognisable, or understood as such in a socio-cultural context. Conversely, sound should not be subdued in a manner that compromises its nature to accommodate the cultural imagination of what sculpture is. To illustrate this point one might think of when Alexander the Great assimilated elephants within his army. The elephants did not suddenly stop being elephants, and become horses nor did his army stop being an army, and became a circus, but rather their new relationship made both (arguably) more powerful. That being said, I do not believe, that assimilating elephants within the army was necessarily a smooth transition.

As a sculptor, and this is perhaps due to a bias resulting from my background within the visual arts, it is our cultural understanding of sound that concerns me the most out of the relationship between sculpture and sound. Beyond the musical, things have changed significantly since the time of Russolo. The increased availability of any sound imaginable, the phenomenon of 'on demand' has led to a certain understanding of sound that is coloured by the technology that we use to access it. The way that, for instance, speakers are thought of, built and arranged colours the way we not only experience but also how we think about and create sound - the speakers are again a mere tip of the iceberg. Both digital and analogue sound production and reproduction come with added or lost baggage that makes it differ significantly from the way one would experience sound in nature. With the assimilation of a wide array of technologies in our daily lives - in computers, televisions, phones, cars, mp3 players and so on, 'stereo sound' becomes an almost natural default, a quasi-natural element, or at least that is what we have become accustomed to think (Draxler, 2009).

Lucier (1979) spoke about how through technology and acoustic engineering, we have always tried to create sound in a neutral manner, to minimise reflections and the relationship between sound and specific places. We try to make audio recording sound as if these were all recorded in the same place, and we always assume and create sound for a single static listener.

Perhaps a re-understanding of how we engage with sound and our expectations in terms of our sonic experience is needed. In this research what immediately became clear is that what is relatively simple in the physical world presents a complex series of problems that make a true three-dimensional reproduction of sound fairly problematic. The first and most fundamental hurdle that we face is a relatively simple one in conceptual terms but has presented itself as elusive and troublesome to overcome. Sound, or better if we were to

reverse engineer things, the speakers we use that replicate our sound source are more often than not stationary, most times also, these are intended for a static, be it seated or standing, audience. The sound itself is often recorded through stationary microphones, sometimes even to record a moving sound source, like for instance, when using omnidirectional microphones to record ambient sounds. Naturally, in the real world, if we want to hear something more clearly we would go closer to it, or if something is too loud we would step away from it. What makes sound in nature is more often than not, in motion, and for the most part so are we. The fundamental problem with the production and reproduction of sound that we perhaps fail to take into consideration is that both the source and the receiver are potentially in motion and can spontaneously change both speed and direction.

A somewhat thwarted cultural understanding of sound is however not the only hurdle that practitioners within the area of Sound Art face. It has become customary for one to attend a visual arts exhibition, and find a number of headphones hanging beside a work. Whilst headphones have the advantage of controlling sound and cutting off the listener from outside 'noise', in a way giving a more intimate experience, this also can be employed as a means of protecting the rest of the show from 'unwanted noise'. There seems to be an uncomfortable relationship between artworks that make use of sound and the manner in which they are exhibited. Kelly (2011) observes how visual art critics and writers have trouble describing sound art, observing how "…their lexicon does not include an ongoing dialogue with audio concepts" (Kelly, 2011, p.13). In order to engage with sound on a sculptural level, and indeed all forms of and modalities of art, one has to engage with the artwork on multiple levels, employing multiple sensory apparatuses. Isolating one or the other perhaps hinders the level of engagement, especially in work that is interactive, and ideated as a relational system. "All thinking requires a sensory basis" (Arnheim, 1986, p. 68) and whilst engaging with an

artwork, multiple senses work together in order to construct a specific experience. Each sensory apparatus however relates in a different manner to a specific stimulus. Arnheim goes further to suggest that even mental faculties such as memory can be reconstructed differently through a different sense.

> When a dancer, to the accompaniment of a melody, executes movements which… possess an articulation and complexity analogous to that of the melody, it will be possible for many to reproduce the melody even after listening to it only once, whereas hardly anyone can do the same with the movements of the dancer. (Arnheim, 1986, p. 68)

These sensory discrepancies are very powerful vehicles for the creation of cross-sensory (re)mediation of meaning, where a single artwork may elicit experiences, or provoke thoughts on a number of levels, accessed through different senses or modalities of engaging with the artwork. In the piece "(Re) Diffusion" (2016) (section 7.19), the visual and the auditory, together with the illusion of the tactile, work incongruously, presenting a multi-faceted sculptural situation that attacks or engages with multiple senses separately and simultaneously.

Whilst each sensory apparatus is experiencing these stimuli individually, these stimuli are processed by a single processing unit, the brain, and when the information received from vision does not correspond to the aural or the tactile, new experiences with engaging with the world emerge. These experiences, temporary suspensions of disbelief are fleeting, and just like in machine learning in computing, the human brain adapts, learns from these experiences and stores them as memories, memories that are coloured by and created through the artistic intervention. To a certain degree, this is the level on which sound works in the visual arts. It

is relatively easy to remember a tune, a particular set of noises or sounds. These sounds in themselves elicit the visual, spatial and relational elements that they were experienced within, again allowing the artist room for intervention on a wider socio-cultural level. Memories too are never stable, they are constantly being modified every time they are accessed, like a vinyl record or a cassette tape. Memory is malleable, just like any other material within the plastic arts. Through sound, however, one is capable of engraving deeper within the audience's brain and shaping their understanding of particular situations. Sound allows for time, temporality to be induced into memory, beyond the static nature of art that is purely visual, and through this, sound allows for the idea of change across time, which works both ways. By changing the artwork through interaction, the action initiated by the audience feeds back, essentially changing the audience permanently through interacting with the artwork itself. As the audience leaves the gallery space, they themselves are transformed through the experience of engaging with the artwork and making new connections which they might have not made otherwise. Sculpture tends to work with this idea too. One has to build up the form of the sculptural object across time, as sculpture, in its traditional format cannot, unlike the image, be taken in all at once. Its appearance is across time, sequentially built up, however unlike the moving image this sequentiality is never predetermined and linear. Sculpture and sound spatialise time, and through using both in parallel, Sound Sculpture has the capability to engage in a meaning-making process with the audience, that perhaps goes beyond what either of these elements can achieve individually.

5.6 Restructuring the Narrative

Audio-visual media are to a certain degree, at least in the way that they have been traditionally utilised, are narrative by nature. For the most part, the audio-visual media have

been employed in the creation or the reconstruction of narrative. The major problem with the format of audio-visual media is that irrespective of the number of plot twists, multiple approaches to the narrative and simultaneous narratives and movements, time always flows in a single direction, there is always a starting point and end point. Even though a particular video, movie or audio piece may go back and forth in its temporal structuring of the narrative, a sequential progression of the narrative elements, no matter how fragmented, is always travelling in the same direction, at the same speed through time. In the audio-visual media the picture plane is never in motion, it is static, fixed within the boundaries of the screen or the projected rectangle. It is the passing of time that creates an illusion of movement.

When it comes to sculpture however, the idea of narrative, or rather the narrative element is not the first thing that springs to mind. Though narrative elements have been present in sculpture for centuries, sculpture, as perhaps best illustrated by the Minimalist movement, can exist happily without narrative. A fusion between spatial and temporal media creates a different order or rather a different sequential structuring of the narrative element. The idea of a spatial narrative, whilst being inevitably sequential, is not necessarily linear. More importantly, the viewer is not bound to a single narrative sequence, multiple narrative sequences with varying durations through time can coexist within a spatial narrative framework.

Bal (2008) observes how the audience's movement through space and the temporal sequentiality involved in a gallery visit, makes an exhibition always to some extent narrative. She continues by referring to the spectator as 'co-narrator' "fulfilling in her own way the script that predetermines the parameters within which the story can be told" (Bal, 2008, p.

20). This effectively puts the audience in a position to create rather than consume the narrative. Interactive, non-linear narrative artefacts add further variables to the experience. Rather than being accumulative like a novel or a movie, where the viewer accumulates understanding thus building a relationship to the narrative, every input by the active user changes the relationship between the various parts of the relational system that constitute the artefact, which, in turn, also changes the relationship between the artefact and its physical presence within the space it occupies.

Walsh (2006) explains how the medium plays a major role in how the narrative is transmitted and articulated, arguing against the idea of the narrative being constituted of 'medium independent content' (2006, p. 855). In order for narrative to be transmitted it requires a vehicle, a medium; be it word, text, image or moving image. He observes how narrative in some cases is being transmitted through a break in the medium, such as the gutter in comics and graphic novels and in the spatial distance between the artefacts as described by Bal (2008) prompting the question on the very nature of narrative. Walsh (2006) describes narrative as a cognitive process.

> Narrative processing, then, is a mode of articulation of the data of experience: "articulation" must be understood to mean the production of meaning, the creation of structure, rather than the expression of some mind-independent content. (Walsh, 2006, p. 860)

> Walsh continues by stating that "It goes without saying that the meaning-producing act of articulation is also potentially a communicative, or meaning-transmitting act" (2006, p. 860). Narrative according to Walsh can be approached from two different perspectives "In one perspective, a narrative is the object of interpretation; in the other, it is a means of

interpretation." (2006, p. 861). Herman (2003) describes it as "making sense of stories" and "stories as sense-making" (2003, pp. 12–14). With this view in mind, therefore, one may speak of a dual nature of narrative that alternates between breaks in the medium, to provide meaning as in the case of the gutters in graphic novels, but more importantly places narrative as an active means of generating new data or meaning within the medium, resulting in an artefact system that is self-generated and to some extent self-aware.

Meigh-Andrews (2014), referring to his multi-channel video installation work of the 1990s describes the breaks in the medium as central to his work at the time.

> I have often sought to create multi-channel works in which the space between the monitors was of crucial importance to the experience. One of my primary intentions was to draw the attention of the spectator to their own perceptual relationship to the work they were engaging with. (Meigh-Andrews, 2014, p. 301)

5.7 Sound Art and Narrative (Creating place through aural Narrative)

Anderson (2012), discusses sound art and its difficult relationship to narrative. She notes that even though sound is deeply connected to imagery and narrative, it is sound's relationship with space that often defines it as a medium within the visual arts.

Whilst within a sculptural approach the spatial qualities of sound are fundamental, Anderson (2012) points out the importance of oral story-telling in the creation and construction of narrative, a sound-based narrative process that for millennia was the major propagator of the narrative. Whilst oral story-telling is still present within the contemporary arts, it is perhaps consigned to other media, rather than sound art, such as radio or theatre (2012, p.1), Anderson's viewpoint on sound art combines the oral tradition of the narrative

with the act of listening. Anderson sets this in specific sites and location, a process by which Anderson states that one through listening, constructs an idea of 'place'. Anderson views the idea of site-specific sound works as a series of relationships between the voice, the narrative and the place.

Anderson criticises approaches to sound art, more specifically ideologies of sound as a media as understood within the visual arts such as the ones taken by Licht (2007) who understand sound solely in terms of its physical presence, proposing sound as a non-narrative medium which seldom attempts to relate to, or express, human interaction (Anderson, 2012, p. 2).

Similarly, LaBelle (2006b), views sound as an entity that reacts with space, physical space, as a phenomenon that is 'real' and not 'in the mind'. Thus he concludes that sound art is a practice that investigates the dynamic relationship between sound and space. This approach whilst fundamental in the understanding of sound in sculptural terms, is more akin to acoustics, belonging within the realm of science rather than the visual arts. Even though LaBelle does indicate that other more suggestive elements are instrumental in experiencing the aural artefact, LaBelle (2006b) does not seem to go beyond the idea of Russolo (1913) who spoke about sound's ability to evoke instances and images from the world, consigning sound to its role as a 'trigger', a sonic signifier that complements a physical source (LaBelle, 2006b, p. 40).

What Anderson (2012) describes, goes beyond the idea of a trigger, an instrument utilised to conjure up something else. Humankind relates to sound in numerous ways. In the same way that vision is not only about looking (an optical process), but rather about seeing (a mental process), the way we relate to sound is not simply by hearing, but by listening (Cage, 1934), which is an active rather than a passive process. Being part acoustic and part mental as

a process, listening is affected by numerous sources that go beyond the ear. Factors such as memory, association, emotion, experiences and imagery are all factors that contribute to the act of listening. Listening, like seeing is therefore an interpretation, an interpretation that is built from various components that are never static, continuously evolving and continuously changing relational distances between one and the other.

Anderson (2012) identifies three main elements of 'productive listening' and observes how in conjunction with the narrative, sound engages the listener's imagination through the space or location where one is experiencing the sound in order to construct a personal idea of 'place'. Anderson locates these elements as the space where the sound is being experienced, the source of the sound (the storyteller's disembodied voice) and the listener's own personal 'inner voice'.

Anderson (2012) describes the experience of voice, narrative and place as an intimate one, a personally created 'virtual reality' where sound does not merely blend into the background but is an active component in creating personal, alternate realities. These realities Anderson explains are constructed through an interplay between the source and the spatio-temporal location of the experience as experienced by the listener; the particular place in space and time where the sound is being experienced.

> Listening allows fantasy to reassemble the visual fixtures and fittings, and repositions us as designers of our own environment. It challenges, augments and expands what we see, without presenting a negative illusion, by producing reality of lived experience. (Voegelin, 2010, p. 12)

Anderson (2012) expands upon Brewster's (1999) views, describing the act of walking through a 'sonic space' as if it were walking through a landscape, experienced from within, with all one's body. This phenomenon stems from the nature of hearing, where no matter how far or near the source, one always hears the sound within their own head (Voegelin 2010). Anderson explains how this sensation is akin to the sensation of being immersed in a story, where one builds his or her own 'virtual rendition' of the story, through non-visual stimuli such as when one is listening to a radio drama or reading a book. This factor combined with the location in space and time where the narrative is being experienced creates what could be referred to as singular 'mixed reality' experiences where through aural narratives, one's notion of time and space is altered, augmented and extended or totally changed and distorted.

> By visualising the narrative the story tells (a narrative which exists only through the act of listening to its telling), we lose awareness of our surroundings and time is distorted. (Anderson, 2012, p. 3)

Aural narratives and their relationship to the physical environment where one experiences the narrative has a profound effect on the listening process and in turn the material that is being listened to, the narrative has an impact on what one makes out of these surroundings. Tuan (1991), suggests that even though aural instances and experiences disappear as soon as they are experienced, these experiences are carried through time and space within the mind. These experiences will in turn affect one's subsequent experiences and understanding of the surroundings. Anderson (2012) speaks of the landscape, or the environment forming a duet with the narrative, with the environment taking an active role in narration, whilst itself, or the listener's perception of it, being shaped by the narrative or the act of narration.

The room, view or landscape can start to transform as what we hear excites

our imaginations and forms various 'structures'… A change in light, warmth,

smell or atmosphere shifts the meaning and experience of a story from

previous tellings. (Anderson, 2012, p. 6)

The manner in which the aural narrative is tied to the space or the environment in

which it is being experienced always makes sound art to a certain extent site-specific. This

does not imply that aural based artefacts are always created with a particular space in mind,

but that the relationship between the artefact and its environment is an intrinsic part of the

artefact, as is the temporary relationship to its audience, and the pieces of the experience that

the audience carry in their mind through time and space. The auditory artefact is always to a

certain extent dependent on the creation of a specific 'place' within space and time.

 Another factor that is instrumental in the creation of an aural artefact is the source of

the sound. Anderson (2012) discusses the voice, both the voice that is performed in front of

an audience and the disembodied voice which the audience experiences through a speaker or

other auditory output devices. One must also keep in mind, however, that narrative or rather

aural narrative rather than oral, is not necessarily always vocal, as in a product of the voice.

The source of the sound or the voice in the case of Anderson's argument is a significant factor

in the creation of an 'aurally induced place'. Factors such as pitch, intonation, intensity and

tone all combine to create different relational hooks and triggers with the audience. Whilst it

might seem obvious whilst discussing aural narratives to point out the source of the sound as

instrumental in the experience, the source is not necessarily solely aural in nature. In terms of

voice, whilst the sound could be identical, having a performer and a recording of the

performer creates a totally new set of relationships with the audience. Gestures and reactions

to audience feedback could create a totally different dynamic and consequently a totally

different experience of the artefact. In terms of other aural sources, a multitude of factors come into play; colour, shape, visibility or non-visibility of the source, volume, clarity and whether the source is usually associated with the sound being created.

Mitchell (2005), in his essay "There are no visual media" (2005, pp. 76-79), discusses Marshall McLuhan's (1965) ideas on 'sensory ratios' describing how one may never refer to anything as purely visual, tactile or aural, but rather as a mixture of senses in different ratios. Similarly when approaching the idea of aural narratives and the creation of place, one must also consider other non-aural aspects in what might appear to be an otherwise aural artefact.

The most interesting point raised by Anderson (2012) is her idea of the 'inner voice'. This is perhaps the most complex part of her idea of how aural narratives and space combine to create a 'place', but it is also by far the most captivating element of her research in this area.

Anderson (2012), describes the idea of an 'inner voice' as a kind of 'running commentary' that one constantly has with one's self. This phenomenon could be perhaps akin to when one visualises mentally a concept, an idea or a story, some kind of mental construction or reconstruction of external stimuli, part of the process of interpretation. This 'inner voice' is an active conscious internal dialogue, but also a means of generating sound; aural content which bypasses the ear, some kind of sonic imagination.

> These internally realised sounds are figments of our imagination. Even though the storyteller is not present, the listener's inner voice responds to the sounds and described situations in oral narrative sound works. (Anderson, 2012, p. 10)

This phenomenon is also present when one reads a text, making reading to some extent an aural process rather than just a visual process. One can hear the sound of the word when looking at a text, silently within his or her own head.

This phenomenon leads Anderson (2012) to question the role which this 'inner voice' plays when combined with an oral/aural narrative and the environment in which the narrative is being experienced. This inner commentary is in dialogue with the external stimuli and interaction and experiences play a decisively important part in how an aural artefact is experienced. Anderson (2012, p. 10) suggests that this inner voice may act as a co-narrator with the external auditory stimuli when listening to a story, in a way perhaps exposing a facet of the process of interpretation or mental assimilation of the narrative. The inner voice is an active function within the process of listening, a dialogue between the aural stimulus, the environment and one's self. This points at an act of listening that rather than being passive, is, on the contrary, creative and productive (Anderson, 2012, p. 12).

6. Spaces in Sculpture

My studies have led me to numerous avenues for approaching my initial research preoccupation sculpture and its relationship with software. This being an area of research that is growing and expanding rapidly in multiple directions has led me into areas that differ considerably from one another. These 'focal' drifts as I like to call them have had a profound effect on my understanding of sculpture and its relationships with the numerous elements that constitute it. In the initial stages of this research it was immediately evident that digital technology, perhaps more specifically software, was to play an important role in what makes sculpture 'sculpture' today. What was more elusive was where and in what way this relatively recent boom in technology is altering not only our understanding of but also the very nature of sculpture.

In my previous research and practice in the visual arts, I have suggested that sculpture is an act of reconsideration, an intervention in meaning and the socio-cultural structure with which we construct meaning (Galea, 2015). At that point I was looking at digital technology as an extension of the act of sculpture, augmenting the range and possibilities within which to intervene on meaning. Even though I have in the past put considerable thought in the areas of dimensionality and hybrid spaces and places, I always viewed software and technology as some kind of a piggyback extension of one's sculptural practice. In a certain sense, it was more of an amalgam rather than a fusion. As my focus shifted to breaking down things into their most basic components in order to understand them better, I started looking at technology as an extension of space, rather than the act of sculpture itself.

Technology now determines the rate at which we assimilate new things, new concepts and ideas. The way that technology operates within the socio-cultural strata, brings elements

previously beyond human scale into focus, thus modifying society and its production of culture. Technology however does not operate autonomously. If one were to be presented with alien technology, that would perhaps be more advanced than anything ever developed by humankind, chances are that one might never understand the purpose, capabilities and implications of this technology and how it can alter our understanding. Technology needs to be applied for it to have any impact. Sculpture and software both have the capabilities to apply technology, however, it might be important to keep in focus the nature of, as well as the primary objectives of both sculpture and software in relation to technology.

There has been a trend, that might perhaps reach back (at least within the scale of current temporal sensibilities, within an art historical context), to the beginning of the twentieth century for artists to make use of technology for the sake of perceived innovation and originality, getting into a race where as soon as technology acquires new capabilities, artists seem set out to claim its application within the arts first. I admit to having been guilty of this on multiple occasions. The danger of this lies in the distortion of the artistic roles and perhaps even responsibilities within the dynamics of techno-social, and techno-cultural relationships.

Ellul (1954) quotes politician Jaques Soustelle commenting on the motivations for France to build an atomic bomb: "Since it was possible - it was necessary" (1954, p. 54). This frames quite eloquently the dangers of losing grasp of 'the bigger picture' and illustrates an increasingly growing trend in artistic discourse and practice.

Technology does not in itself change the way art is made in the same manner as when cooking and consuming a bowl of rice, it is irrelevant if one is cooking or eating with a spoon, a fork, chopsticks or a spork. The way the rice cooks, and the way it tastes remains unchanged, what changes perhaps is the way the process of cooking and consuming is

experienced. Similarly, technology that is applied to society, in multiple different processes, constructions and sub-frameworks (that include, but are not limited to Politics, Arts, Religion, Science and so on), does not change the modality of application. To refer to our previous analogy, the cooking or the eating and the taste, but rather the audience. It is the audience that is changing, or to be more precise, the understanding of the audience, brought through a shift in viewing point brought about by the new layer of technology. Whilst technology, sculpture and the audience are intrinsically tied in a relational system that is fluid and composed of constantly shifting relational distances, the roles of each of these components are not really interchangeable. One may think about these roles in a manner where sculpture, essentially never changes. To sculpt is an action - to shape and this is done through the addition and removal of information. Technology acts as a multi-axis platform with multiple degrees of freedom that is constantly in motion and upon which the audience sits. It is therefore not sculpture that changes through technology, but rather the audiences' viewing angle of it.

> Sculpture becomes 'thingified' by means which cannot be perceived except
>
> through the rules for ordering finite or infinite sets of abstract points in a given
>
> continuum. (Burnham, 1968, p. 148)

Formalist interpretation of sculptural output is therefore to a certain degree inevitable. In the spirit of Existentialist philosophy, there is never a single version of 'truth' or 'reality' as these are multifaceted constructions - only interpretations exist. Burnham (1968) reflects on the work of Merleau-Ponty (1960) in the field of phenomenology. Applying these ideas to sculpture, Burnham notes:

> Traditionally the sculptor has concerned himself with the making of objects -
>
> even when those objects served only to objectify theories or non-concrete
>
> expressions of reality. In general, the sculptor has given little thought to the

fact that the viewer not only is free but must reconstruct the sculpture for himself. In this respect, the act of perception and bodily gesture while standing among objects - and in turn being perceived by other beings - forms the locus from which Merleau-Ponty has developed his phenomenology. The perceiving person constantly interacts with objects, others and the self to create a closed conceptual unity. Given a limiting number of perceptual experiences, how does our world picture manage to transcend our actual knowledge of reality? This is a question which acts as a leitmotif through much of Merleau-Ponty's philosophy. (Burnham, 1968, p. 174)

The conceptual and intellectual toolkit with which we look at, interact with and understand sculpture, is always inevitably based on the viewer's or society's previous engagement with previous artwork, and with previous encounters with artistic or sculptural situations. Visual formalist tools, current experience and memory all contribute towards the sculptural experience. Whilst Formalism and formalist tendencies within current artistic discourse can be considered as all but dead, one may argue that formal analysis is still an integral component of the aesthetic experience. What has changed, at least in sculpture is the metric, the formal elements themselves. When sculpture was invariably anthropomorphic, formal analysis was carried out in terms of stylistic elements, and their effect on anatomical proportion; Archaic, Classical, Hellenistic, Manneristic, Baroque and so on, just to name a few. *"Structure was anatomy and the problems inherent in carving and casting limbs, texture was the simulate of natural textures; and colour was all but unheard of"* (Burnham, 1968, p. 110). Modernism's influence, moving away from anthropomorphism into abstraction and the whole gamut in-between changed the formal analysis from stylistic into visually descriptive and physical characteristics: Scale, structure, texture, proportion, composition, context,

colour, which later evolved to include latent kinetic and potential chemical energies as well as material composition with the introduction of plastics, rubbers, glass, aluminium, steel, concrete and other then unconventional sculptural materials, that were previously invariably, stone, bronze and occasionally bone and wood.

Nowadays a formalist approach or examination of sculpture cannot ignore light, sound, software, interaction, audience, cultural references, data, networks, interfaces and devices, each of which come with their own set of formal elements as well as the complex and occasionally uneasy relationship with space and time.

The idea of formalism or as Burnham calls them "material-optical-tactile features of sculpture which can be identified and logically examined as separate entities" (1986, p. 110), has changed considerably throughout the ages. One cannot measure or approach sculpture with measuring devices in use twenty, thirty, fifty, a hundred or three hundred years ago. Formalism shall always be a key component to sculptural experience and understanding, however its meaning, roles and characteristics, like those of sculpture, cannot remain static, rooted in the contexts of the past, and must adapt to current scenarios, as they have, even though we now tend to identify these as other things. A characteristic that is prevalent within art history and theory that causes much confusion and frustration is the obsession with naming everything and slotting things into orderly pigeonholes. Natural evolution, organic growth and development within one area is interrupted by a confusing array of names and terms that refer to both periods and ideologies, at times interchangeably, even though one or the other might still be developing on the side, out of the focus of the 'grand order of things'. This was after all post-modernism's major rejection and reaction to modernist ideologies, however, there is still a trend to consider the past as a linearly occurring narrative. Coining new terminologies for every change of direction, proclaiming ideologies as 'dead' and

replacing these with new ones inevitably implies that the former have ceased existing and are no longer relevant. Ideologies and approaches have been running in parallel for millennia, Baroque sculpture and painting in Malta is still alive and kicking, at times showing more vitality than contemporary artistic interventions. Cultural selection as described by Appelbaum (2003) is what pushes certain cultural products in the spotlight and others into obscurity. Huhtamo (2016) explains whilst talking about media archaeology how 'dead ends' have been re-examined and 're-activated' on numerous occasions with the Renaissance being a classic example of this. Often it is not a change of name or terminology that is needed, but rather an understanding that socio-cultural structures and frameworks are alive and in constant transition, thus altering the manner in which we look at things. The tools with which we look at and understand sculpture are unchanged from those used by our predecessors, the relative intervals between art and society, as well as our sensory apparatuses, remain unchanged, however, our vantage point has shifted considerably. One does not call a bull something else if one is looking at it from above for the first time. It would be ridiculous to call a bull a 'neo-bull', or a 'bird's eye bull' but rather one would say 'this is a bull seen from a bird's eye view'. This happened to me the first time I used a drone quadcopter, seeing somewhere from above and especially navigating from a new vantage point, led to an initial confusion and disorientation. Places I knew well from navigating at ground level became unfamiliar, in some cases unrecognisable. I did not however call this new terrain 'new-Malta' and declared it an independent republic (although in hindsight that could have been a good, fun idea) and if I had, Malta would not have ceased to exist.

A similarly interesting conundrum exists within the relationship between sculpture and space. Sculpture by most definitions has an inevitable relationship with space. There are however numerous diverging opinions on this matter that range across a wide spectrum of

degrees of interrelations between sculpture and space, that are again, a question of vantage points.

The first and most obvious link between sculpture and space is sculpture's physical occupancy of space. This derives from our understanding of mass and volume which in themselves are measured in terms of volumetric space. Aristotle's theory of 'place' is determined by the dimensionality, or rather the interior boundaries of a containing structure; therefore space exists within matter or objects and is measured as the distance between breaks in matter, the space within a defined area. Other approaches locate space as everything outside specific boundaries, as something that begins as soon as sculpture ends, an invisible area that surrounds sculpture and puts it at the centre of its surrounding environment. This can be thought of as environmental space, as the area immediately beyond physical matter, that in itself constitutes the boundaries of an object. Space is also seen as the in-between, the negative mold of matter, and the area between objects. In the traditional, pre-modernist notion of sculpture, space was perhaps not given much thought beyond occupancy. Perhaps at the time 'place' in terms of location was given more thought as this came with notions of prominence and prestige.

After Modernism, the relationship between sculpture and space became much more prominent, and occupancy started giving way to how sculpture engages with and moves within space, with the notion of occupancy being read in terms of how sculpture behaves in space and how space can be used as a formal and compositional element.

Burnham (1968) states that space does not have any role within sculpture at all "…space is a fiction which derives topicality from painting theory…" (1968, p. 148).

Space as an active plastic concern of the sculptor grew out of Post-
Impressionist and Cubist realisation that pictorial space could be reordered at

will. That is, local distortions and depth compression could affect a painting just as could changes of colour. (Burnham, 1968, p. 148)

Burnham writing in the late 1960s was perhaps too invested in the idea of the relationship between the sculptor and the scientist and equated sculpture to the scientific model, where the model serves as a physical externalisation of a conceptual model, where physical matter is made to stand in for more complex ideas and the limitations of the physical model do not impede the understanding and growth of the conceptual model. This reasoning might well explain Burnham's disinterest in spatiality, which he replaced with ideas of structure, as here he is engaged in virtual and mental spaces rather than physical spaces, however Burnham shows little interest in these too. On the mathematical theorisation of dimensionalities that extend beyond the third dimension of space, whilst acknowledging the artistic interest that this might elicit, he categorically rejects these and deems them as 'spatial fantasies' and 'aesthetic fairy-tales', concluding that whilst intriguing "the translation of such an idea into an object with any palpable meaning has so far been impossible" (1968, p.149).

Gabo (1957) however, thought of space in a different manner and equated space or the perception of its presence to the perception of sound and light on our senses, seeking to fulfil the desire to embody space without matter, in the way that music or light fill a room. This was in direct opposition to the then prevalent trend as described by Burnham (1968, p. 152), that sculpture was dominated by 'image-making'.

Up to now, the sculptors have preferred the mass and neglected or paid very little attention to such an important component of mass as space. Space interested them only insofar as a spot in which volumes could be placed and projected. It had to surround masses. We consider space from an entirely different point of view. We consider it as an absolute sculptural element,

relapsed from any closed volume and we represent it from inside with its own

specific properties. (Gabo, 1957, p. 168)

New technology has brought up a whole range of 'new spaces' or rather new dimensionalities. The reconsideration or the making sense of these new spatial territories have also brought forward a number of previously existing but never really considered spaces into sculpture. Mental spaces, colour spaces, digital and virtual spaces, imaginary spaces all have become active areas of potential sculptural intervention.

Software can also be thought of as a space in itself, not only an extension of space, or an independent replica of space, but rather a separate, or semi-independent dimensional plane that extends the physical dimensional planes, rather than a reconstruction in another place of an artificial version of the 'real world'. Software therefore can be seen as an expansion, an extension, not an augmentation, akin to an appendage - something that is attached to, without real function outside of what it is attached to. In this way, software and other forms of digital technology (that almost invariably run on software) become integral to the process of art-making. This in itself changes not only what is possible in sculptural terms or where one is possible of intervening but also the very nature of sculpture itself. Sculpture is not augmented but modified, something is added to it, not upon it, essentially changing sculpture itself.

This is obviously not the first instance in which sculpture was altered radically. Still, the extent that software has changed everything around us is impossible to ignore, and of course, this permeates across every level of society, culture and the way we go about relating to, understanding and experiencing everything around us including sculpture. The major shift within the software age is that sculpture and the way we intervene upon meaning is capable of overcoming numerous physical limitations. In software, or the digital dimensional plane we can arguably control time, space and everything in between, individually, simultaneously

and in as many multiples as we deem necessary. We can simulate things, erase them and construct self-sustaining worlds that have the capability of moving in and out of as many dimensional planes as we please. Sculpture is no longer three-dimensional but multi-dimensional, it is no longer bound by physics and the laws that govern the universe. Sculpture is now closer to being capable to output a 1:1 rendition of our ideas. Things can now float in mid-air, change colour just by thinking about them, or by talking to them, or alternately by looking at them, the possibilities have become endless. An artistic intervention could be simultaneously staged in multiple places around the world at the same time, and it can be experienced personally and individually on our hand-held devices.

Our phones, tablets and wearable technologies extend the range of the arts in the same manner that they extend our lives. In many instances we have become totally dependent on software, to the point that our lives and day-to-day activities cannot function without software, in the same manner that we experience them today. People are being born and growing up without ever knowing the world without digital technology and therefore the arts, sculpture in particular, cannot overlook the changes that this has brought with it. Our cultural baggage has changed, our education and the way we go about understanding and looking for things have changed. We are now aware and directly influenced by cultural artefacts, trends and iconography developed in other societies that share very little with the ones that we live in, halfway around the world. We get to know of things right as they happen, in real time and we can talk to anyone, anywhere whenever we please. Our knowledge is stored online, our memories are in a cloud somewhere and our personal data has become an invaluable asset, to be protected at all costs.

In the same manner our relationship with sculpture has shifted significantly, much in the same way that connectivity and globalisation has homogenised our social and cultural

structures, which manifests itself directly in the cities we live in - like for instance, the way we look for a coffeeshop that has WIFI to send emails and catch up with the paperwork we have pending, or the way we use our phones to find the nearest McDonald's for a quick bite. Similarly, sculpture is increasingly becoming more and more 'internationalised'. There is no longer a real distinction between works produced in different parts of the world. This is especially true with work that makes heavy use of new media and technology, as unlike other traditional materials like wood, stone and clay, whose availability and physical characteristics vary significantly from one geographical region to another, an iPhone, for instance, is the same irrespective if it is in Malta, China or America.

What this does to sculpture apart from changing the structures it operates within and upon in order to create, reconstruct, and articulate meaning is to also create a shift in the way that it is created. Sculpture as a practice, the 'mechanics' behind the action have been significantly impacted by software and how software has had the capability of emulating the 'real world' in a space that whilst present in the real world is somehow totally independent of it. Extending this further and thinking of digital and virtual spaces not as places or spaces in themselves but as a part of the 'real world'; an added dimensional plane has the potential to move sculpture into new and interesting territories. Software becomes not only a tool or a medium to manipulate in its own bubble, which we access through two-dimensional windows we call screens, but, by being reconsidered as an intrinsic dimensional component of space, we can fuse software with physical space, doing away with dimensional windows and opening the door to a new modified state of being, both in terms of sculpture and also in terms of software itself. Sculpture can perhaps be the key to doing away with the screen and the projected rectangle and fuse software with the world itself as shall be discussed further on in Chapter 7 (sections 7.1, 7.2, 7.3).

The idea of multi-dimensional processes, of computers being controlled by physical engagement and motor skills that we are accustomed to in our daily lives, as well as 'computerised' sculpture that is aware of its surroundings and can adapt to, react and make decisions for itself, is held together by the idea of sculpture as a series of relationships rather than as an object itself. In the initial stages of this research, I have looked at the sculptural artefact as a relational system built up of a number of incongruent elements and developed work that looked at the idea of 'sculptural situations' (Chapter 7, sections 7.6 - 7.21). The idea behind a sculptural situation bridges across multiple facets of what constitutes an artwork in the twenty-first century, and may be grouped thus: artwork that is not tied down to ideas of disciplinarity and modality; artwork that puts the audience or rather considers the audience as an integral part of the artwork; artwork that is constantly shifting across time as it is reactive to its environment; artwork that is simultaneously physical, digital and virtual; artwork that in itself is generating new artwork, such as a spatial and temporal montage as described by Manovich (2001) that is built upon a series of constantly shifting relationships; and artwork that is constantly streaming new iterations of itself. The sculptural situation is perhaps best described as an intentional assemblage of elements that create the potential for sculpture to occur, with sculpture being the reconsideration, the reassignment of meaning of physical (and digital) artefacts, of elements that make up our world. This works along the lines as, for instance, the concept that a piano is not a musical piece in itself but rather potentially the key to every musical piece ever written in the Western world. However, the sculptural situation is not a tool, an instrument like a piano, but rather, to use the same analogy, the piano together with a musical system - a predetermined or rather intentionally established series of relationships which in music are known as intervals. Each artwork under the umbrella of the sculptural situation has these semi-predetermined interval structures that

are fashioned by the artist. The audience becomes the performer, the person sitting at the piano, so to speak. However, the elements that are interwoven together in the artefact system, unlike the piano and its relationship to the performer and the musical system, work across multiple levels and are made up of a range of elements that are seldom considered together as part of the artwork itself. The sculptural situation is comprised of social and cultural elements, physical elements, such as objects and humans as well as digital and virtual elements such as software and code, mechanical and electronic elements, spaces, sounds, temporal and temporary elements that come together in order to create a different kind of sculpture to the ones we are traditionally accustomed to.

Once the audience is being considered as part of the artwork itself, the artwork borrows, temporarily at least, from elements that make humans human. At a basic level, characteristics like mobility and fine motor control, as well as on more sophisticated levels, elements such as self-awareness, memory and imagination, to name a few, are to be found. Through electronic, mechanical and digital elements the interaction with the physical, material and spatial elements are conveyed into digital elements that are processed, digested, converted and translated back into the physical dimensional planes. This in turn informs the decisions or the reactions that the human component shall take or make in engaging with the system, and the cycle is repeated in a continuous consequential loop that is constantly generating new versions of itself until the human element takes over and takes a self-initiated decision to stop or step outside of the loop.

In conducting this research and exploring how and in what ways do sculpture and software converge, if they do, and what new process and materials, approaches and ways of generating, constructing, modifying and articulating knowledge can be or have been initiated through the fusion of the two, it became clear that my practice had evolved significantly since

the initial stages of this research. What became interesting to observe, however, hard to identify at first, was that this 'evolution' in terms of practice developed in totally unexpected directions. In a way, it could initially appear that my practice was moving in an opposing direction to the concept of a total integration between software and sculpture and the idea of sculpture as multidimensional physical/digital hybrid intervention in society. However, the result was quite the contrary. The practical projects and experimental research conducted as part of this thesis, have in a way come a full circle, and I found myself back to my original starting point on multiple occasions, each time however with new knowledge and experience(s) that informed each and every successive loop.

6.1 Digital Space: The Nature of (Cyber)Space

The term cyberspace has become synonymous to the Internet, or as it was previously known, the World Wide Web (Strate, 1999). Cyberspace is a series of interconnected relationships between computers, an environment through which communication over computer networks occurs. Even though the term itself generally fell out of favour in the latter part of the 2000s, the idea of cyberspace and the way that it has been approached in its relatively short history can be an invaluable tool in making sense of the notion of 'physical' and 'virtual' space.

Anders & Sheridan (2001) look at cyberspace as a "subclass of space" (2001, p. 1), a rapidly growing environment that is being created by humankind in an "…ongoing and extensive migration of social and intellectual structures [into cyberspace]" (Anders & Sheridan, 2001, p. 1). Space according to Anders and Sheridan is an idea that allows humankind to imagine and adapt (2001, p. 2). They argue that on a daily basis, human interactions with their environment occur in a 'place' rather than a space, with 'place' being

defined as "a particular moment in time and particular part of space" (2001, p. 2). It is through the concept of space that one can detach himself from the unique space-time scenario that constitutes the place and apply one's experiences to new and unknown scenarios. Space, or to be more precise one's experience of it,

> Is the byproduct of sophisticated, innate operations that integrate sensory/ cognitive processes to produce a holistic image of our environment. This image– itself an artifact – seems transparent to us. Yet, though we take it for granted, this image is a highly-evolved information management tool, a map, a concept that helps us flexibly and effectively relate to each other and to our world. (Anders & Sheridan, 2001, p. 1)

Anders and Sheridan's understanding of space as a mental construct, that conditions one's experience of the world, is in itself conditioned by the social and cultural frameworks and contexts that one is in contact with, which in themselves could limit the individual's concept of space. "By extension, our concepts of space may not allow us to even recognize the unique characteristics of truly other, times, places, and spaces" (Anders & Sheridan, 2001. p. 2).

Space as an idea, a concept, is a continuous assimilation and articulation of sensory and cognitive data, received constantly from one's environment. Digital media, and the idea of an interconnected cyberspace that the media operate within, extend one's experience beyond their physical body and immediate environment, thus changing one's cognitive model of the world (Anders & Sheridan, 2001, p. 2).

Cyberspace, therefore, can be understood as a dimensional environment or a dimension within the notion of space, where although devoid of gravity and physical matter, contains entities that are arranged spatially. Within cyberspace, the digital media extend our experience beyond our physical location and limitations, as media within cyberspace behave differently to media in physical space. In simple terms, cyberspace is space accessed through computer-based media, or better, software-based processes (Anders & Sheridan, 2001, pp. 2-3).

Another interesting facet of cyberspace that Anders and Sheridan point out is how cyberspace and its relationship to the physical environment is constantly in a state of flux. They point out how cyberspace actually predates the computer age and can trace its origins to Norbert Weiner's ideas on cybernetics.

Cyberspace…actually predates computer graphics. The spatial effect of telephones gives its remote users the illusion of being in the same room, for instance. Cognitively there is a momentary collapse of the space separating them. Hanging up the receiver restores the space to its normal dimensions. (Anders & Sheridan, 2001, p. 3)

Given its communicative nature and its interdependence with the computer networks that sustain it, cyberspace is a social space and has a profound influence on the behaviour of the occupants within it. As with architecture, the conventional realm of social spaces, Anders and Sheridan (2001) argue that the space in itself affects the behaviour of its occupants "Environments temper the actions of their occupants" (Anders & Sheridan, 2001, p. 3), thus they conclude one must not look at cyberspace solely as an extension of one's 'perceived

space' but also as an extension of the socio-cultural environment beyond its physical setting. Cyberspace has the ability to act as a 'cultural amplifier', as has been clearly demonstrated by the key role that social media took in the 2011 Arab Spring Uprisings "…the programmable nature of cyberspace makes it possible for a single person to have enormous social effect" (Anders & Sheridan, 2001, p. 6). Moreover, cyberspace has the ability to create and modify social and cultural trends and redefine norms.

Through the migration of social and intellectual into cyberspace, computers are becoming increasingly complex machines with the ability to generate and articulate content into new directions autonomously.

> The language that resides in computers is different in one important respect from the language that hibernates in books. A recipe written in a book cannot cook a meal by itself. The recipe must be activated by a human being who cooks the meal. However, a recipe written as a program in a computer can cook a meal quite easily, and it can cook endlessly. Given this fact, as human beings translate more and more of their intellectual and social processes into computer code living in cyberspace, it is very important that we be able to say precisely what we want… Flexible, adaptable, and uncontrollable language lives in cyberspace. (Anders & Sheridan, 2001, p. 8)

6.2 'Real Space' and 'Virtual Space"

The digital media residing in cyberspace and their interaction with the physical dimension inevitably brings about the discussion of 'real space' and 'virtual space'. The conventional understanding of a 'virtual space' is the dimension that exists within a computer, or a

computer network framework as is cyberspace, whilst the definition of 'real space' is usually understood as the physical dimension, the physical environment where one's actions and processes occur on a daily basis, what Anders and Sheridan (2001) refer to as the 'place'. When one however thinks of space as a concept, as discussed by Anders and Sheridan, space becomes inevitably always to some extent virtual, as it is a mental concept, a map, that is grafted upon the physical environment. On the other hand, the idea of a 'virtual space' implies that objects within this space or which derive from this space are somewhat less real, as if it were a figment of one's imagination, with no real presence in the world. The American Abstract Expressionist sculptor David Smith once wrote: "Everything that is imagined is reality, the mind cannot conceive unreal things" (Smith, n.d. as cited in Grey, 1989, p. 66). If reality is to be determined by actions and processes occurring within a specific place where the observer and the observed are in direct engagement, everything and more importantly everywhere is to a certain extent real.

Through the process of assigning meaning and making sense of one's surroundings, every object, instance or space is 'virtually reconstructed' within the brain, every situation or location, therefore, has a virtual aspect to it. Consequently, every situation or location, whether caused or created by man, nature or software, is, just because of its presence within the world, real. Anders and Sheridan (2011, p. 5) describe the idea of virtuality and reality as *"two aspects of any situation"*. Thus they conclude everything has a 'real' and a 'virtual' aspect - "Everything is real, everything is virtual" (Anders & Sheridan, 2001, p. 4).

As previously discussed, space itself, our understanding of it and our relationship to it is in constant flux. New territories and spatial planes emerge, merge and disappear. Space is not a static, unchanging terrain, and can be approached from numerous angles. Space in itself

is multi-layered and multi-faceted and similarly so is our understanding of it and the manners in which we can approach it.

In this research the idea of space or spatiality and its consequent relationship to both software and sculpture has been in constant (re)negotiation. The multiple facets of space become, as mentioned earlier through the writing of Gabo (1957) 'absolute sculptural elements' acting not only as the confines or boundaries or the container of artistic intervention but also as the 'matter' with which sculpture itself is produced. Space is essentially a measure of distance and this can apply to physical volumes as well as digital, virtual, mental and imaginary planes. Space is also temporal and textual, a pause in a sentence, between one word or another, between a sound and another. It can be both relative as well as absolute, sharing numerous characteristics with time, which in itself can also be considered as a measure of distance. The following is a list of spaces that have been identified and intervened upon in this research:

1. Space as the environment, the volume of a/the room, and of outdoor space, that we shall refer to as the environmental space. In terms of audio and sound this relates to ideas of acoustics, echo, reverberation and the propagation of sound in space. Sculpturally this might perhaps reflect negative space, the area around and between the physical, material and tangible elements of the sculptural intervention.

2. Space as the source, volumetric space as the sculptural artefact or the source of the sonic object. The area of direct intervention, that result in the creation of a sonic object.

3. Space in time. The distance between events in time, events being sonic, mechanic, digitally or human instigated, this we could perhaps refer to as the 'temporal space'. Time itself in musicology can be both 'relative' (the idea of tempo in music) and

'absolute' (measured in hours, minutes, seconds and so on) with these having both similar and differentiating relationships with the multiple layers of space.

4. Another area of space that has been investigated in this research is colour space, this shall be discussed in the following section (section 6.3) and further on in the context of the project that this idea has been developed from (section 7.9).

5. Space as a compositional tool. Space understood as a series of 'instructions' for the creation of sonic objects that can either be, in conjunction with temporal space unraveled across time, or at the other end of the spectrum, in its compressed 'time zero' format in volumetric, material space where the source is in itself both the instrument and the notation (Galea, 2015).

The different layers of space as described above have varying relationships with time. In physics, Einstein spoke of space and time as interwoven, and like in a piece of fabric they can be somewhat warped but not really separated. By looking at space as multi-layered and multi-dimensional, the relationship with time expands and contracts, and becomes integral in some areas and rather irrelevant in others. Rather than interwoven this understanding could be perhaps described as hinged, where space and time move towards and away from each other and change their relationship whilst still maintaining a point of contact.

6.3 Video as a Space for Sculpture

McCloud's (1994) theory of closure, when referring to how the narrative continues and propagates itself through inference across the gutters in comics and graphic novels, and Walsh's (2006) stance that narrative is not constituted of medium independent content, bring up some interesting ideas on space, more specifically the space between images. Similarly

when one thinks of the moving image, what Deleuze (1986) refers to when speaking of cinema, an art of 'movement and time', and thinks of the moving image as primarily made up of a series of images played in succession, (traditionally in cinema at 24 frames per second) one might ponder in sculptural terms, whether the ideologies suggested by McCloud (1994) could be applied in this context, or rather media. Is there space between the frame rates of a moving image? and if there is space, could a sculptural intervention occur within this space? The moving image is essentially a cyclopic rendition of a stereoscopic image, by having two eyes, vision in humans is stereoscopic rather than three-dimensional. Movement, our environment and our tactile interaction with our environment together with the matter that inhabits it is three-dimensional, however, neither our visual nor auditory systems are three-dimensional but rather stereoscopic. Sculpture by nature is three-dimensional, and sound is capable of moving around in three-dimensional space, the image however is continuously bound to a singular plane. As a sculptor one ponders the question of the moving image, where exactly does it move to and where is it that it comes from?

In the early days, cinema was silent, it was the recording of light and its changes across time on a light-sensitive support, so whilst time was created through a succession of events always happening in a linear manner space was always absent in this configuration. In digital media however a whole set of new relationships with space and the moving image can be formed. Digital technology has allowed for stereoscopic vision to make a comeback, with relative ease, even though there has been little change since its inception in the Victorian era. More importantly, the digital media bring about a whole notion of digital spaces through the moving image's newly re-considered relationship with sound and other conceptual or rather virtual spaces where sculpture as a process can happily occur within the moving image.

Digital technology, like sculpture, is also social and cultural artefact, but it is not entirely virtual, abstract or intangible. It is a synthesis between physical hardware-based and software-based processes that work together in order to produce a new dimensional space, accessed primarily through the screen and the projected rectangle that act as a kind of dimensional window. This may create more problems than it solves, as virtual or digital spaces are in themselves places, or as Anders and Sheridan (2001) refer to them, when talking about cyberspace, as subclasses of space where content is arranged spatially and accessed through a computer. Digital spaces however are not entirely virtual. Processes run on silicon chips, electromagnetic currents, transistors and capacitors, which combine, write and erase content on physical drives and even spaces such as the cloud run on physical servers located somewhere in physical space (Bratton, 2016).

More significantly, digital devices such as computers, cell phones and tablets do not only exist in physical space but are also capable of engaging with it by receiving and also transmitting content simultaneously, which is being modified by and in turn modifying the physical world. A cell phone, for instance, is capable of listening and seeing, but it is also capable of showing and 'speaking' - making sound, which is a physical, tangible force in the physical world. A cell phone essentially is as large as the space it occupies, or the environment it is set in, as it is capable of physically intervening in the world.

Other conceptual but also to some extent physical spaces that digital technology has brought about, which relate especially to the moving image are colour spaces. More specifically, within this research, ideas were developed on RGB colourspace, (section 7.9) which can be essentially considered as the building blocks of video. RGB as a space is a series of relations between the colours red, green and blue and how different blends, ratios or

distances between these colours build up the moving image, the digital moving image, pixel by pixel. As a sculptural practitioner, this is a very fertile area of artistic enquiry and research.

The way we relate with content, to matter, be it physical or digital and the meaning-making process which we utilise to make sense of our environment is essentially a continuous translation between stimuli and our social and cultural understanding of them. Sculpture in itself is more an act of remediation or reconsideration of matter rather than the physical intervention upon it. Thus, sculpture is more of an intervention in society, through reorganisation of information, rather than one in matter. The digital technology, including both the software and hardware elements, are like sculpture, social and cultural artefacts. Software, however, has another interesting facet to it. Software has the ability to translate virtually any kind of stimulus into another, at the lowest level, the lowest common denominator - machine language; converting everything in a series of on and off pulses, thus enabling us to connect things, or rather create connections or equivalences between elements that perhaps should have never been connected. By looking at video from a sculptural perspective and deconstructing it to its building blocks, which is then translated, even though somewhat artificially in a more spatially capable media, such as sound allows for a new understanding of both media in entirely new manners.

7. Projects

7.1 Practice as Research

This research makes use of 'practice as research' as a means of gaining theoretical insight through empirical practice. In my previous research (Galea, 2015) I had made use of a bricolage of methodologies as developed by Kellner (1999) and Rogers (2012) in order to be able to take a "multi-perspective, multi-theoretical and multi-methodological approach to inquiry" (Rogers, 2012, p. 1). In interactive artworks that make use of sound, as well as experimental musical interfaces it is common to adopt approaches used in Human-Computer Interaction (HCI) in order to effectively evaluate the way that humans and computers relate to each other. Approaches such as the one adopted by Stowell et al. (2009), Wanderlerly and Orio (2002), Kiefer et al. (2008) as well as those employed by Van den Haak & De Jong (2003) and Johnson (2011) all make use of discourse analysis as a means of evaluating the relationship between humans and computers. This approach has been criticised for the cognitive competition between processes in the brain where Perez and Zartorre (2005) suggest that the brain process that are involved in speech and music partially overlap (Perez and Zartorre, 2005, as cited in Stowell et al., 2009, p. 96), which is noted by Stowell et al. (2009) as a limiting factor in their approach. Strain, Shaikh, and Boardman (2007), Chuchacz (2009) and Pugliese et al. (2012) suggested gathering data through documented footage of the interaction, where participants would retrospectively reflect upon their experience that is re-triggered through watching themselves engage with the interface.

O'Moharian (2011) criticises the idea of a qualitative approach based on retrospective reflection and proposes a framework that gives equal weighting to all the stakeholders,

opening up ideas on the relationship between not only the interface or artefact and the performer but also between the performer and the audience.

In this research, these methods, after careful consideration and evaluation, were seen to be unsatisfactory for a number of reasons. The idea of a sculptural situation, as a system of interconnected relationships, should give equal weighting to all the components that make up the artefact. This works on the same level as the approach that O'Modharian (2011) proposes, however, O'Modharian only gives weighting to the human actors and would only explore a single dimension if this had to be applied to the idea of a sculptural situation. As previously discussed the concept of a sculptural situation locates the meaning-making process as one that is assembled over time from all elements within the sculptural situation and whilst it is true that the audience is an integral part in the creation of meaning, as the audience ultimately construct their own meaning through interpretation, within a sculptural situation the audience is an integral part of the artwork itself. This makes HCI methodologies very limiting when applied to sculptural situations as they only look at a single relationship, excluding the others. In a sculptural situation, the artwork as an ensemble is considered as a semi-autonomous or rather living being, capable of determining its future and aware of its surroundings.

This has led me to look at other areas of practice that look at the process of making rather than observing as a way to generate and observe data. In performance studies, 'practice as research' has been developed and sustained, and whilst arguably not perhaps as fully fleshed out as other more established research methodologies, it offers a refreshing alternative to conventional research methodologies that can be limiting in translating artistic insight or experience into something that can be critically analysed and beneficial to others in the manner in which it contributes to knowledge (Trimingham, 2002). 'Practice as research' translates in clear and understandable terms the insights and understanding that practitioners

have reached through their practice. Trimingham (2002) suggests the employment of a 'hermeneutic-interpretive spiral model' "…where progress is not linear but circular; a spiral which constantly returns us to our original point of entry but with renewed understanding" (Trimingham, 2002, p. 56). As a part of the understanding changes, so does the whole, in a way echoing the dynamic that a sculptural situation creates. Trimingham (2002) continues by stating:

> The in-built dynamism of the spiral is the only paradigm model that can account for such change in theory in relation to the on-going practice, whilst also successfully defining the area of research, and preventing it from spiralling out of control. (Trimingham, 2002, p. 56)

Through revisiting the point of entry, the understanding is articulated by reviewing the theory in a new light that has been informed through the practice. Another important aspect is the practitioner's point of entry. No two practitioners tackle the same research area alike and the questions asked will inevitably shape the resulting outcome. Similarly 'practice as research' acknowledges that the practitioners' intimate relationship with his or her research shall effect the outcome. In the case of a sculptural situation, we get what Trimingham refers to as a 'double hermeneutic' possibly, even triple or quadruple, as it is not only the researcher that determines the outcome but also the audience and any other independently active element within the research.

Camilleri (2013) places the idea of 'practice as research' as an area between 'search and research' which he defines in the following manner.

> "Search" indicates a specific artistic quality or aesthetic choice as an objective and is dependent on the artist's quest for expression, renewal, or development. It should not be confused with "research", which focuses on the identification

and definition of principles in the creative process and is not bound to specific

artistic results or choices. (Camilleri, 2013, p. 153)

Thus Camilleri (2013) makes it a point to define that whilst research is made possible

through artistic search, one cannot claim that all artistic practice constitutes research.

Research is therefore determined in this context as something that is capable of being

transmitted beyond the original context of generation, and more importantly to others who

did not partake in the process (2013, p. 154).

Artistic research as noted by Camilleri (2013) citing his own practice as an example,

is multilayered and works with and within a number of interdependent modalities which can

be considered, as Camilleri suggests, to be multiple layers working simultaneously. Camilleri

understands these as "overlapping facets of the same endeavour" (2013, p. 161). Camilleri

locates his practice in a no man's land which he describes as a series of in-betweens which

are considered as a sign of ruptured binaries, a space where new directions and possibilities

are created.

Nelson (2013) observes how the notion of 'practice as research' developed from

artists' involvement in modern higher educational institutions, particularly at PhD level

(2013, p. 3), as tension arising between artistic studio practices, awarding bodies and

university protocols were at odds on the question of what constitutes knowledge in research

(2013, p. 3). Nelson develops ideas of theory imbricated within practice, calling it 'praxis'

which is sometimes also referred to as 'material thinking' and makes a clear distinction

between the idea of documenting one's practice and clear research outcomes. Whilst one does

certainly not exclude the other, it is through critical reflection, measured against a starting

point, as mentioned previously by Trimingham (2002) that practice adds to knowledge.

Nelson (2013) like Trimingham (2002) and Camilleri (2013) focuses on the performing arts

that by nature are temporary, fleeting and ephemeral. Similarly my practice is constantly evolving against time, and thus the practical deliverables cannot really be considered 'objects' in a stable form, as would be in the case of painting, drawing, photography and film, or as in the case of literature where one produces a publication, or as in music where one generally produces a score. In performance, as in the sculptural situation, documentation only leaves, or rather 'captures' traces of the artwork itself. Nelson (2013) suggests a 'telling otherwise' strategy to documentation, an idea which resonates to that of 'sculpture by other means' developed in this research, derived from Levi's (2012) understanding of expanded cinema. Rather than thinking of documentation in terms of 'what was', Nelson suggests a 'what might be' approach to documenting works that do not translate well into current audio-visual material, noting how the idea of 'documentation' has now been replaced with that of 'evidence' and that of 'document' with audio-visual media. One should not confuse the document with the performance, or the sculptural situation (in this case) itself (Nelson, 2013, p. 6). Documentation is one of the multiple modalities of generating evidence that validate the research outcomes with other forms of evidence such as observation and critical reflection, making 'practice as research' a multi-pronged approach to the articulation and generation of new knowledge. Nelson (2013) also stresses that no single approach to research can lead to a single unbiased answer, and it is important to understand that 'practice as research' does not position itself as a method for arriving at 'the' answer but rather as 'an' answer to the areas of enquiry: "in the twenty-first century no methodology or epistemology can be taken to yield an unmediated, self-evident truth" (Nelson, 2013, p. 6).

Quoting an extract from Pears (1971) that reflects on Heidegger's idea of material thinking, Nelson (2013) uses the analogy of riding a bicycle to highlight the reasoning for, and indeed the need of a 'practice as research' approach within the arts.

"I know how to ride a bicycle, but I cannot say how I balance because I have

no method. I may know that certain muscles are involved, but that factual

knowledge comes later, if at all, and it could hardly be used in

instruction." (Pears, 1971, as cited in Nelson, 2013, p. 9)

Research conducted through practice can be therefore understood as not solely an

abstract thinking endeavour in order to reach a solution to a problem, but rather as a method

through which a practitioner 'practices' until he or she obtains resolution.

In this thesis, my practice was constantly fuelling new directions, new insights and

new areas of inquiry. Problems that arose within the practice itself led for shifts in focus,

across multiple disciplines. As has been argued previously, the visual arts are inherently self-

referential, and as articulated by Huhtamo (2016) using a metaphor from McLuhan (1967) of

looking at the present through a rear view mirror whilst marching backward into the future

(McLuhan, 1967, as cited in Huhtamo, 2016, p. 69), we look at the past for answers, in order

to build upon it. The manner in which we now create knowledge however has been shifting

and as described by Capra (1988) a shift in the 'social paradigm' has changed the way that we

relate to and create knowledge by thinking of it as a series of interconnected networks. These

networks do bridge us to the past but also allow us to move laterally, across disciplines, and

into considering other formats and modalities. Through the specific problematics of my

practice, I searched for answers beyond the conventional remits of the visual arts. New ideas,

new approaches and new ways of thinking inevitably filtered into my practice and the manner

in which I began to approach art-making changed significantly. Even though perhaps

externally my practice does have a marked aesthetic, which links all the bodies of work I

have produced in the past decade together and with which I continue to work, the way I

related to my practice, informed by looking at it through the acquisition of knowledge from other sources, significantly altered my understanding of sculpture. Through a change in approach in art-making, the idea of sculpture was revisited on multiple occasions, and this dynamic interplay between practice and theory, between practice and academic research, evolved into a totally new mode of understanding and relationship with sculpture, which in turn allows me to propose new insights in the field of sculpture.

7.2 Sculpture and Image-Making

From a sculptor's point of view, it has been increasingly hard, but also increasingly unavoidable, not to address the relationship with image-making. Sculpture is unequivocally visual for the most part, even though perhaps on different levels then painting, photography, drawing and film. In Mitchell (2005) the idea of McLuhan (1964) of 'sensory ratios' leads to the conclusion that there is no such thing as 'visual arts' or rather the word 'visual' in the term 'visual arts' is misleading. Grau (2007, 2016) whilst speaking about media art history, stresses on how the digital media, like a plethora of previous media now consigned to semi-obscurity, has the capability to output content that works on multiple senses simultaneously, most commonly the visual, the aural and the tactile. Digital media as described by Manovich (2001, 2013) have assimilated virtually all preceding media and media formats and therefore have the ability to output content in different mixes and clusters in keeping with McLuhan's concept of sensory ratios, even as technology evolves. The concept of sensory ratios however does little to address the relationship between image-making and sculpture.

Hensel (2008) writes:

IMAGES are not reducible to a particular technology (like graphic prints or neutron autoradiography), not to certain devices or tools (paint brushes or telescope), not to symbolic forms (perspective), not to genres in the broadest sense (still life or summation image), not to an institution (museum or lab), not to a social function (construction or diagnostics), not to practices/media (painting or Morse Code), materials (canvas or photographic paper) or certain symbolism (Christian iconography or alphanumeric code)—but they are virulent in all of them. (Hensel 2008, p. 39, as cited in Grau, 2016, p. 29)

We live in an image-based society, as we have indeed for the past centuries, albeit the rate at which we now come across images, with which we are being continuously bombarded, has dramatically accelerated through the development and increased accessibility of technology. We have become not only very proficient at consuming and assimilating these images but also experts in creating them. Through social media, we construct images of the self that are at times different from the 'real' self, to stand in for us on different dimensional spaces, on platforms such as Facebook, Twitter and Instagram as well as the creation of avatars of ourselves, which is a virtual reconstruction of the self, that we use to navigate the digital/virtual landscape.

As human beings we are not composed of images, however we tend to think of ourselves and others in terms of image. Like humans, sculpture shares similar presence and motion in space, a shared element of physicality that equates humans and sculpture more to the idea of an 'object' than that of an 'image'. Traditionally sculpture is in the round and therefore cannot be consumed retinally all at once from a single viewing angle like a painting, a drawing and a film can. Like when reading a novel, sculpture is a culminative experience, requiring motion in space across time order for it to be taken in, at least in terms

of optics, in its entirety. In terms of image, sculpture is continuously reconstructed by the audience through their position in relation to it. The freedom of motion that the viewer has in space makes this reconstruction not necessarily linear, not necessarily finite in terms of time, having no real duration like other media such as video and film have (Merleau-Ponty, 1960; Burnham, 1968; Bal, 2009; Paul, 2016). This creates an 'aggregate image' (Grau, 2016) a term which Grau does not use in relation to sculpture but rather to explain how hypermediated content, both in digital as well as older media is engaged with by the audience.

Burnham (1968) states that sculpture from Modernism onwards was dominated by 'image makers', suggesting that a newly found use of colour such as in the brightly painted metal sculpture of David Smith, the polished and reflecting surfaces as employed by Constantin Brancusi and the same David Smith, created and distorted imagery, in a manner that the resulting artworks were more about the image rather than form, volumes and matter. In classical sculpture, the Greeks created anthropomorphic figures to 'stand-in' for the gods, creating sculpture in the 'image of' the god Zeus or the god Apollo, working on the lines of the images' inherent representational qualities. The painter Pierre Soulages in the 1950s spoke of 'presenting' rather than 'representing' when describing the ideology behind his practice. In sculpture, this concept was picked up by the Minimalist movement's notion of the object that validates its own existence (Judd, 1965). Grau (2016) posits the concept of 'aggregate images' as not only being constructed of hypermedia imagery and processes but also as being built from images and image-making capabilities of the past. In essence, our current understanding, capabilities and approach to the image, is built upon past knowledge and understanding of image-making. "No image can be 'read' if one has not read other images before" (Grau, 2016, p. 28).

This last statement perhaps might shed some light on the relationship between image-making and sculpture. Rather than within the histories of media art, perhaps the answers or the direction that one needs to take when considering this subject could well lie in the 'reader' and the 'writer' themselves rather than in the genealogy of processes and outputs. For this, it might be necessary to zoom out a bit and consider the very nature of the artist and the art maker, perhaps even more than that of the viewer or the audience, as this has been looked into extensively in the past. More importantly one needs to look at the artist and the viewer and how the two relate to each other through the artwork.

7.3 The Writer and the Reader in Sculpture

Much has been written on the nature of art and the reasons which compel artists to make it, and the audiences to be drawn to it. Plato described art as an imitation of nature. Socrates similarly viewed art as an imitation of things as they are or as they appear. For Klee (1959) it was not to reproduce the visible but rather to make visible. Pablo Picasso, quoted in Ashton (1988) remarked how art is not the truth but a lie, a lie that makes us realize the truth. LeWitt (1969) thought of ideas alone as art, whilst in *What is Art?* (1897), Tolstoy spoke of art as a transmission of feelings by means of colour, line, movement, sound and words. Danto (2013) sees art as embodied meaning, and Ai Wei Wei (2011) sees art as politics.

Whilst I feel in no way qualified to make any kind of attempt at defining art, as a practitioner within the arts I do have a set of beliefs of what, my idea of art is and where the motivations behind my practice stem from. I have identified three major attributes that I believe are critical to art-making. Art for me should always create new knowledge and understanding. Secondly, for there to be art, I believe that there has to be an intention to make

art. Thirdly, for there to be art, content, idea or expression has to be (re)mediated through the artist's intention. This last point when placed in the context of the search for a deeper understanding of the relationship between art-making and sculpture, puts the artist (and also the audience) as media him/her self. The artist becomes a remediator or part of the remediation process. To perhaps further clarify this point, we can look at how the artist behaves just like traditional media that have the capability of remediating thought into object, or into image, and the digital media, that have the capability of virtualising these processes and remediating them into further forms of audio-visual output. The artist behaves in a similar manner, remediating content through his or her consciousness (intentionally), behaving like media rather than solely being the manipulator of media. Similarly, the viewer makes use of his or her consciousness in order to 'read' or access the now polymediated content.

The process of image-reading therefore, or perhaps more importantly image-making in this case, hinges on the idea as proposed by Descartes of art as a language of the individual human (Wadhaugh, 2013): "Man as an individual, atomicist self, essentially rational and autonomous, but caged in both a material body and a social system that determined the language alone his humanity can express itself" (Serracino Inglott, 2000, p. 22).

Both the 'writer' and the 'reader' of the image effectively colour the remediation process which eventually culminates in the making of or the experiencing of an artwork. The making and the reading of images is not only about reading previous images and media art history. It also concerns a unique and personal interpretation from the writer as well as the reader in terms of the way that information is encoded and decoded.

The significance of this in terms of sculpture is that essentially the aggregate image constructed by the audience is not only dependent on the audience's previous exposure to sculpture, art history, or the historical contexts under which sculpture was made, nor its technical and material considerations. Each and every member of the audience has their own unique and personal manner of assimilating or experiencing sculpture. We are increasingly experiencing constant changes in how we experience and assimilate knowledge, that does not follow the rigid linearity of art histories. More importantly technology is playing an increasingly important role in how we construct our memories and in turn how this builds our visual, aural and tactile literacy.

We live in an internationalised and increasingly globalised society, where cultural icons and their creation can traverse oceans and continents at lightning speeds. Jackson Pollock famously remarked:

> The idea of an isolated American painting, so popular in this country during the thirties seems absurd to me, just as the idea of creating a purely American mathematics or physics would seem absurd… the basic problems of contemporary painting are independent of any one country." (Pollock, 1944, p. 570)

Pollock's remarks become increasingly relevant in our age. In sculpture more than referring to an optical, or to use the Duchampian term, 'retinal' image, we could probably use 'cultural image' or 'socio-cultural image'. It is perhaps how the artist 'codes' the sculptural intervention, making use of continuously developing international cultural idioms in relation to how the audience 'decodes' that culminates in a sculptural experience, and such codes are not always, and not necessarily visual.

In my artistic practice, whilst producing sculpture, I have seldom thought in terms of image. All the artworks I have made have a 'visual consequence' of some form or another, and the degree of how this relates to the work itself is varied. In some cases the visual consequence works in the same direction of the artwork such as in "Point and Shoot" (2016) (section7.10) and "(Re)Diffusion" (2016) (section 7.19) and is utilised to strengthen the intervention and emphasise certain elements or the context under which the artwork was produced, or how this is intended to be read. In other instances, the visual element is purely accidental or driven by function, rather than by a conscious aesthetic decision. One may argue that certain aspects of functionality that I use to create interactive works, operate on a degree of visual familiarity, meaning that the viewer instinctively 'knows' how to engage with the sculptural artwork as the physical objects being utilised are familiar, at least on a visual level. Moreover, these may perhaps be originally designed to be visually self-explanatory, which in turn prompts my decision to use them as interactive interfaces in the first place, such as in "Soundwave Sculpture" (2016) (section 7.6) where the nature of the interaction is integral to the sculptural experience.

In other artworks such as "Karrotti" (2016-2017) (section 7.17) and "SelfPortrait in 5.1" (2016-2017) (section 7.13), the image is an element utilised in a somewhat deceptive manner, a device to lure in the audience and create an instance of visual-aural opposition, or a surreal situation.

Most of my sculptural output relies perhaps even heavily on visual anchors. In terms of 'image' however, at least in how these were conceived, image-making as a factor, was never part of the creation process, which to a degree goes against my understanding of art as something that is initiated through conscious intention. Whilst I do appreciate that I do make frequent use of happy accidents and this comes from the very nature of an experimental

approach to practice, which can start off somewhere and then take a different trajectory over time, the main reason why I find it so problematic to think of most of my sculptural output in terms of image is that for the most part, a large amount of the work I have produced does not really have a finite visual form, and are (re)composed anew every time they are exhibited, making it hard to think of these therefore in terms of image. I like to think of my sculptural works as blocks of Lego, or a sand pit, where one builds a castle, then destroys and rebuilds. The visual component is intrinsic to, however never really the end output of, my practice.

On a cultural image level however, I would define my practice as a product of its age. The digital medium/platform can be viewed as the go-to medium/process for immediate cultural intervention (Grau, 2016) in the same way that steel is my go-to material for arriving at form (and occasionally function) quickly, immediately and fluently.

> My reverence for iron is in function before technique. It is the cheapest metal. It conceptually is within the scale of my life. And most important before I knew what art was I was an ironmonger. The iron element I hold in high respect. I consider it eidetic in property. The metal particularly possesses no artcraft. What it can do in arriving at form economically—no other element can do. (Smith, n.d., as cited in Grey, 1989, p. 50)

The nature of my practice is based on immediacy, understood as the here and now, again, reflecting the age we live in, where everything is instant, only a click away - real-time, virtual processes that have tangible effects within a physical dimension. The cultural image that is created through my practice is relevant to the context that I operate within and as such always considered of primary importance. Other forms of image-making, whilst present within my practice are not always a primary concern. Admittedly though it

is through image-making, or rather the reading of the resultant visual image, the level on which my sculpture is engaged with first, and it would be deceitful to state that my sculptural practice has little thought towards visual or aesthetic considerations.

7.4 Tracing a Historical Genealogy for My Practice

The most radical change worldwide since the 1970s has been the exponential increase in electronic and digital technology, the development of the internet, and the global increase in mobile communications. This has changed the way in which we think about ourselves as human beings, and about the concepts of space and place, factors crucial to the production of sculpture. There is a new sense of geography, which is more political and economic than physical, and less bound to maps, territories and boundaries. Additionally, the way in which we access knowledge has changed, and, for example, the history of international art is now instantly accessible to a worldwide audience. There is more source material and imagery than ever before, and this bewildering, unedited mass seeps into the unconscious and effects it. Artists are possibly more aware of this than the rest of us, and the sculpture they are making today reflects this. (Collins, 2007, p. 6)

Through art history and media art history (Grau, 2016), media archeology (Huhtamo, 2016) or the history of sculpture itself as an independent area of artistic inquiry (Read 1964; Burnham, 1968; Krauss, 1977, 1979; Collins, 2007), one may notice that there is no single and linear chronology with which to associate or anchor one's practice to. Nor are there any emerging dominant trends within the recent history of sculpture that point at a

unified direction. Judith Collins in the preface to her book *Sculpture Today* (2007) notes how "Sculpture has probably changed more during the last 30 years than at any other time in its 30,000 year history" (2007, p. 6). Expanding on Gombrich (1995) who states that "there is no art, only artists", Collins (2007) suggests that this could well apply to sculpture, echoing Gombrich and stating "There is no sculpture, only sculptors" (2007, p. 6), which perhaps is possibly a most accurate depiction of the current sculptural landscape(s). Simultaneity is not a phenomenon only of our time, and artistic practices, motivations and preoccupations have been occurring contemporaneously since the dawn of time. Art history is by and large however, still rooted in the past in terms of approach, and tends to create linear and absolute 'metanarratives' based on labels and 'isms'. On this Collins notes:

> The last three decades have witnessed the rise and fall, and in some cases, the rise and fall again, of modernism, post-modernism, Conceptualism, Minimalism, Post-Minimalism, Arte Povera, Neo-Expressionism, Land Art, Neo-Conceptualism, Dematerialisation, Neo-Dada, Maxsimalism, Process Art, abstraction and figuration". (Collins, 2007, p. 6)

Huhtamo (2016) is similarly critical of art histories' approach:

> The assumed objectivity of the dominant narratives about media culture and its history raised suspicions. Did they really provide truthful accounts of the past(s)? What if something essential had been left by the roadside, cracks filled in, and stains painted over? Media archaeologists turned away from linear histories built around "winning" technologies. Influenced by Michel Foucault's archaeology of knowledge, they began exploring the archives for

omissions, undetected or masked ruptures, and dark corners. They were determined to shed light on things that had been deemed as dead‑ends and forgotten back alleys, treating these as symptoms to tease out alternative ways of reading the past. Attention was paid to ambitious failures: ideas that might have succeeded had the constellations of cultural circumstances been favourable. By including the excluded, the past could be made to speak with fresh voices that also shed light on the present. (Huhtamo, 2016, p. 70)

Quoting Marshall McLuhan (1967) ''We look at the present through a rear-view mirror. We march backwards into the future'' (McLuhan, 1967, as cited in, Huhtamo, 2016, p. 69). Huhtamo (2016) writes how artists are drawn to the past for inspiration and makes it the media archaeologist's (over the art historians') job to locate the genealogy of current artistic expression, offering in a way an alternative to the historical grand narratives perpetuated by art history. I do however at times find this approach to be only amending or extending these dominant narratives.

Whilst sculpture is still present and very active as a field of practice and research, the term in itself has been gradually falling into disuse. We now refer to most of what would be previously called sculptural work as installation art, or immersive, environmental and interactive art. To a certain extent, art history, criticism and theory fell somewhat out of love with the term sculpture and use a myriad of alternate names for it. A noticeable exception to this would be video sculpture, which perhaps has a clear, traceable genealogy, something that contemporary forms of sculpture clearly do not.

In quantum physics there is a theory of 'retrocausality', (Leifer and Pusey, 2017) where actions in the future have a direct influence on the past. In a nod to Robert Zemeckis' *Back to the Future* (1985), retrocausality could be a fitting way to understand how our future understanding, shapes our vision of the past. As Dennis Gabor (1964) once famously said, about the future and how it cannot be predicted, but can be invented, I believe that this is the position, or rather the shoes that contemporary artistic practice should aspire to fill.

Going back to Collins's statement "There is no sculpture, only sculptors" (2007, p. 6), one may indeed conclude that every individual sculptural practice has its own historical genealogy and more importantly that this runs in parallel to multiple other practices that influence and determine the outcomes of one another, being that artists live in the same societies that they observe, and react to. The influence of technology and globalization can be seen as the creation of one huge mega-society leading to common preoccupations between artists on every corner of the globe as described by Pollock (1944). This, however, does not alter the individuality of each and every practice. Irrespective if working in groups or engaged in some form of collaboration, artistic practice remains an individual understanding and reaction to environments and stimuli that the artist encounters, and as such are always coloured by a personal vision, a personal interpretation of the world.

7.5 A Personal Approach to Sculpture

In this section, I shall discuss my practice, how it came to be, the influences, ideologies and motivations behind it as well as my approach to sculpture.

As discussed previously, I have had considerable difficulty to retrospectively align my sculptural practice with the historical and ideological narrative progressions of the past. The

elements that I believe make up my practice, and the way that they come together can be attributed partly to chance, in the form of particular combinations of circumstances and material availability, and partly to sustained interest in particular areas. The major influences on my current sculptural output come from various sources, from various disciplines and from different points in time. These are mixed with the social and cultural contexts that I experience as a member of society on both macro and micro levels that combines itself with an influence and fascination with technology, in all its formats and instances - past, present and future. During discussions with my tutor Professor Vince Briffa, the term he utilised to describe my practice as an 'a la carte practice' had struck me particularly. What Professor Briffa was referring to here, is my tendency to cherry-pick elements from various points in history, from various technologies, aesthetics and disciplines in order to create my sculptural output. Professor Briffa pointed out to me that it is the way that these elements are being bridged together that is most interesting, how a particular (and personal) selection of elements, ordered in a specific sequence or manner, combine to create something new.

The word bridge becomes very significant in this context, as, at times, the elements that I make use of span considerable distances both in terms of temporal as well as conceptual and ideological terms. Bridging means to create links between one place, or between one thing and another. More importantly, bridges allow for movement from one area to another, in both directions, but also offers a range of in-betweenness. The bridging of mental, temporal and physical elements, all of which are never measured with the same metrics and are seldom accessed through the same dimensional planes is perhaps symptomatic of a techno-cultural society and the manner in which I access and assimilate information. Elements from the DIY and Remix cultures (Paul, 2016) both of which were

boosted significantly by the Internet and digital technology, have a strong influence on my sculptural practice as they integrate with elements of materiality, modalities of art-making, together with an inclination towards certain practices and assumptions borrowed from art history.

If I were to attempt to chart a genealogy of practices which I believe I have been directly or indirectly influenced by, I would perhaps start with my fascination with metal. Since my undergraduate studies, working on sculpture where my only goal and intention (with a total disregard for visual aesthetics) was to construct work that could physically balance itself. I have been drawn to steel for its direct, quick and economical way of constructing form. I was also always interested in its weight, its relationship with fire and the ritualistic, almost shamanic qualities involved in steel-working processes. Later I was drawn to the voice of steel, its sonic qualities that in no small way now defines most of my practice and research interests. The aesthetic element of my practice comes from the tradition of steel/ metal sculpture of Pablo Gargallo, Julio Gonzalez and later Pablo Picasso, David Smith whose works and writings I find particularly resonant with my practice, especially in his handling of material, as well as the works of Eduardo Chillida, Richard Serra, Harry Bertoia and Anthony Caro, whose influences give my sculpture a very Modernist appearance. The idea of constructed assemblage from Smith and Caro as well as the kinetic assemblages of Jean Tinguely and Marcel Duchamp's concept of the ready-made, give the structural backbone of my physical, matter-based intervention in sculpture. From Constructivism, I borrow the relationship with space, the fascination with new materials, processes and technologies, as well as the lack of narrative and obvious subject matter.

Another integral component of my practice is the sonic element. Sound has been at the centre of my research and practice since my undergraduate years (Galea, 2013; Galea 2015) and has itself developed from my relationship with steel, but also from an understanding, perhaps from childhood, that sound, and music making is physical and tactile. I have always had a somewhat physical relationship with sound and perhaps through natural progression, sound and sculpture merged together in my practice. In the same manner that my 'physical' sculptural output is indebted to a number of practitioners from the past, similarly in sound, there are numerous influences that worked with sound in a more sculptural or physical manner such as John Cage and Harry Partch, Raymond Murray Schafer, Pierre Schaeffer, Alvin Lucier, Mark Appelbaum and Bjork. In media arts, the work of Lev Manovich especially "Soft Cinema" (2003) from which this thesis borrows its title, as well as Vince Briffa's "Playing God" (2009), were instrumental as examples to look up to when I was having problems with reconciling the physical and the digital nature of my work with regards to audience interaction and modalities of presenting and exhibiting my work.

My practice is also indebted to the ideologies behind expanded cinema and the contemporary discourse around expanded cinema, with concepts of 'cinema by other means' (Levi, 2012) and those of rematerialisation rather than dematerialisation (May, 2015). My practice and its relationship between digital media and sculpture can be thought of in itself as sculpture by other means, but also in a way music by other means or performance by other means, as well as equally fitting within the original notion of cinema by other means, all of which could fit a tentative description of my practice.

Of course looking at influences from others at different points in time is not what my practice is about. However, this does offer some kind of a theoretical and conceptual anchor

with which to ground one's practice and from which to build upon. Another important aspect of my practice is the intricacies and the characteristics of the materials, media, modalities and processes that I work with and how thoughts from these are transposed to sculpture, forcing me to think of sculpture with a totally different set of criteria.

Sound brings with it a whole range of elements that are traditionally alien to sculpture. In the same manner that a sculptural approach to sound-making practices also adds a whole spectrum of new possibilities to the production of sound. Sound has an intrinsic relationship with space and matter, as a medium and as a physical material in itself, however, it has been, bar a few notable exceptions, left outside of the reaches of the tradition of sculpture. Elements such as time and dual time, which is both relative and absolute are not traditionally associated with sculpture, however, these have had a significant impact on my sculptural practice. Through digital, software-based technology, certain processes of sound and also music production such as the application of looping, sampling, synthesis, the remix, elements of performance, improvisation, the relationship or feedback from the audience as well as the tools, interfaces and devices through which these processes are accessed and manipulated were all at one point or another transposed into sculpture and assimilated within my practice. Other elements have been explored, such as auditory illusions (Deutsch, 1974, 1975, 1986, 1991) and acousmatics (Schaffer, 1977; Smalley, 1991; Hallestrom et al., 2011) which I like to interfere with to create what I call aural surrealism, where the sound and its physical source do not correspond with what is expected, making use of memory, expectation and sound's relationship with physical matter. These auditory or aural phenomena have been explored through my investigations of sound's role in sculpture, resulting in the creation of

custom-built hybrid physical/digital interfaces that exploit these characteristics of sound and make them physically manipulable.

Digital technology also plays an important role within my practice as through it I have been able to transpose or translate information, modalities and processes between various media and sculpture and vice versa. Through software, I have been able to rematerialise images into sound, as well as colour, earthquake data and 3D scans into sound, image or moving image as well as three-dimensional models that are then printed by a 3D printer. Software behaves as the 'Rosetta Stone' of the twenty-first century and through it, I have been capable of accessing and manipulating multiple media and data sources, convert and translate them in order to intervene upon multiple modalities, within multiple dimensions, whilst simultaneously retaining my steel/metal based modernist aesthetic. This creates a hybridity between the physical and the digital, between the old and the new, between the permanent and the ephemeral, between the tangible and the intangible and most importantly between the ordinary and the extraordinary.

In the following pages, I shall be discussing in better detail how these elements work together within the particular contexts that they have been developed for. I shall be discussing the projects developed during this research and how these were conceived and created.

7.6 Soundwave Sculpture (2015-2016)

"Soundwave Sculpture" (Appendix 2) is a project that attempts to extend the idea of sound sculpture into a physical/material dimension. Making use of 3 axes, cartesian coordinate machinery such as CNC (Computer Numerical Control), Milling Machines and 3D printers, this approach makes use of volumetric space as an interface with which to manipulate sound

waves. This creates momentary spatio-temporal constructions in physical space which are augmented by digital technology, creating a two-way, back-and-forth motion between the physical and digital dimensions. Operations initiated within physical space trigger processes in the digital space, which in turn feed back into other processes within the digital space manipulating the sonic matter in physical space.

This approach allows for more complex and immersive procedures in hyperdisciplinary practices which could see artefacts being constituted of sculptural objects, sonic objects, digital and virtual (online) spaces, performance elements by human and non-human actors, audience interaction as well as the creation of 'static' imagery and moving image.

The structure of these sculptural situations or artefact systems makes use of continuous translation from one state to another going from physical to digital/virtual processes depending on the structure of the artwork, determined primarily by the software which becomes an integral part of the sculptural process. The sculptural process shifts from being and make-and-display process to one that is in a state of continuous creation, where the artist does not intervene sculpturally in matter but rather sculpts scenarios, constructions, similar to a musical composition in the same way that even though a composition has defined elements within it, multiple variants such as interpretation, arrangement, place and audience can alter the experience of the audience. These constructed scenarios are made up of multiple incongruent elements: such as objects, sensors, spaces, software, audience and actors which can be both human and non-human, living or non-living. Sculpture, therefore, becomes a continuous act, a continuous intervention and manipulation of multiple elements in real time, an intervention that occurs simultaneously in time and space, in all its current and future iterations.

By recreating this volumetric interface to engage with sound and re-approaching sound as a physical entity rather than a signal, one has the capacity to form a new relationship with sound and how one visualises it.

The ability to manipulate and articulate sounds in real-time is in more ways than one reminiscent of the musical instrument. However, unlike the musical instrument, this approach is not dependent on the physicality of the instrument, its materials, character or the physics underpinning it. Musical instruments are to a certain extent sculptural by nature, even if they are not necessarily spatial. A musical instrument occupies and is present in space, however, on its own, does very little to engage with it. Approaching sound as a series of motions in space rather than a combination of key presses or string runs creates a relationship or perhaps more importantly, an experience, akin to that of modelling in clay. What the digital process has helped in doing here is, to a certain extent, the facilitation of the removal of the idea of the instrument as an interface with which to engage with sound, and allows for a direct engagement with the sound itself, cutting out the middle man so to speak. The 'absurdity' of using industrial machinery, normally associated with different kinds of sounds, the immediate physical engagement, commonly associated with these tools and their relationship with matter, plays an important role in this process. Our social and cultural understanding and the traditional relationship we have with these tools, this 'functional fixedness' (Vaessen, 2012) we have with these objects creates a sense of detachment between what is being done, the user input and what is being experienced. To a certain extent, what is being created here is a spatio-temporal surreal moment, something that the human brain is not commonly accustomed to, which is why we cannot perhaps think of a milling machine as a 'musical instrument' for it already has a set role in our social and cultural understanding.

This 'anomalous relationship' that has been created between the machine and how it engages with sound, puts the sound perhaps more prominently under the spotlight. The combination or juxtaposition of two things that we are familiar with under different circumstances create a fusion that is capable of generating new meaning. Being familiar with both sound and the industrial machinery creates a very fast learning curve and one takes to manipulating the sound in this manner like a duck to water, rather intuitively with no real technique to learn or muscle memory to develop. Engaging with this constructed situation becomes more a process of exploration than one of learning or technique.

This process therefore allows one to think of sound in different terms than what one is commonly accustomed to. Tones are stacked on top of each other and beside and behind each other, rather than how we are accustomed to think about them, which is more in terms of linear scales, or musical patterns. Exploring sound as a three-dimensional object with multiple spatial planes offers a totally different experience of something familiar, and allows for new links and possibilities to be built. Most importantly it stops one from thinking about sound solely as a signal, a series of notes or in terms of waveforms on a screen. Another significant aspect that this approach supports in more ways than in other more conventional approaches to sound is that of simultaneity. Much like the way life is experienced on a daily basis, the aural, visual and tactile stimuli are seldom experienced individually. In the arts, at least in the visual arts and also to a certain extent in music, however, we tend to try and separate or rather address sensory stimuli individually.

A process that allows for the direct engagement of sensory stimuli or motions in simultaneity can be considered more physically grounded, more engaging and to a certain extent more inclusive, as there are multiple entry points with which to engage with the artefact and the artefact system. Other sensory stimuli, dependent on the way this project is

executed are also elicited, such as the smell of a mix of grease oil and metal from a CNC or milling machines and the smell of melting plastic in 3D printing which not only stimulates the sense of smell but also triggers response in one's tastebuds, as both senses are intertwined in our perception of flavour (Auvray & Spence, 2007; Small & Prescott, 2005).

"Sound Wave Sculpture", as a project, embraces the idea of fluid transitions between disciplines and modalities of art-making. Not only does this approach allow for an idea, an intervention, to be able to mutate from one modality to another but also for all modalities to be experienced and engaged with at once. This creates a hyperdisciplinary experience, as the artefact system can be considered simultaneously as sculptural, musical and performative (physical theatre, dance) and as such can be approached from either direction. This allows for multiple iterations of the same afteract, opening up possibilities for cross-disciplinary interventions and most importantly brings the audience, an active audience, which becomes the performer, closer to the art-making process (see Appendix 2.1).

This process is essentially a translation, one between space and sound. Translation, as a process, is rarely straightforward, even translating between one language and another presents numerous problems, as for instance, certain words exist in one language and not the other, certain phrases or expressions might make sense in one language but have no real equivalent in the other. The translations occurring here add further complications, as what is being translated here is expressed or measured in different metrics and the conversion is occurring solely through numerical data interpolated through software that has no real interest in the data it is processing. The approach employed here is to utilise software as a kind of universal translator, a universal language that is capable of connecting practically everything. This is not to say that any translation or conversion of this nature is 'accurate' or free from errors, or based on any form of rational thinking, quite the contrary. It is these

errors in translation that allow for the generation of new meaning and allows for going beyond the functional fixedness we have developed with media, allowing for new content and directions to be developed.

The method for creating these sculptural scenarios is relatively simple, in technological terms. Using data from commercially available wireless accelerometers, X, Y and Z coordinates are converted in real-time into MIDI Continuous Control data (MIDI CC) that allows for real-time modelling of specific parameters which are assigned in the Digital Audio Workstation (DAW). Motion initiated in the 3 axes directly manipulates the mapped parameters in the DAW resulting into the creation of sound that is modelled in real time according to motion in space, giving the ability for the user, be it audience or performer, to create sound with a physical basis. This becomes more interesting when this system is combined with automated machinery such as CNC or 3D printers as the sound created is a direct consequence of a tangible, physical form that is made up of physical matter and can be handled. Of course this process is not only limited to simple waveforms, one may have, for instance, Mozart's *Rondo Alla Turca* played through, or rather modulated through the form of a banana, or a model of the Eiffel Tower. By utilising MIDI one is also capable of initiation and articulation of multiple processes even in simultaneity. Processes that make use of MIDI such as projection mapping software, interfacing with DMX to control lighting, or effects on video, using software like Max MSP or VVVV to interface MIDI with the generation of text, or the initiation of software automation and processes as well as sending data to Arduino to move stepper motors, are all possibilities that this process can initiate and that have been experimented with.

Combining technology and software with sculpture opens up back and forth conversations with and within media and also within physical and virtual dimensions. In

more ways than one this can be seen as an augmentation of sculpture, in the same manner as augmented and virtual reality processes. What is however significantly different to augmented and virtual reality scenarios is that this process remains to a certain extent more grounded in the physical world, does not require screens, headsets or headphones which have the undesired effect of cutting off the audience from the place and the environment around them, which hinders the growth of a series of relationship both physical and digital that we form with the artistic intervention.

"Soundwave Sculpture" as a project and a process makes use of similar ideas to both electronic and digital audio synthesis and builds upon it, allowing to extract, as a separate entity, the shape and the form in volumetric space.

This separation between matter and form is significant as through this process the sonic object can now be split down to its basic building blocks and the relationship between these components can be remodelled and re-examined, which in turn allows for new approaches and understanding both in terms of sculpture and the study of sound.

Through a digital process, one is capable of separating matter from form. Using this process as a layer on top of conventional audio synthesis, where the source itself is devoid of any relationship between physical matter and form, allows for a new way of creating and experiencing sound: sound as a sculptural object.

The process developed in this project, apart from allowing sound to be created through direct physical intervention in volumetric, space also paved the way for new approaches and research projects through the instigation of a new set of possible relationships between sound and space.

This goes beyond the possibilities of creating sound physically, such as in the case of, for instance, a musical instrument or through audio synthesis, as the separation between

matter and form, which have been for long considered inseparable, is only possible through the technology brought about by the digital medium. The idea of timbre itself has now been split in half, creating two distinct elements out of which one is capable of making a new sonic object that can draw its characteristics from multiple and independent sources.

Essentially in "Soundwave Sculpture" sound is being dismembered from its source or rather separated into the timbral qualities of the source and its actions in space. The spatial information of the form is reconstructed as disembodied spatial information in time. This shifts the relationship between the sonic object and its source from a timbral one that is material, relating to matter, into a volumetrically spatial one. It is not the physical/electronic oscillations of the source that create or determine the tone of a sound but rather the arrangement in space of the source, the relationship between, or better the distance between two or more discrete points of the source expressed in spatial, non-material terms. This changes the relationship that sound has with space. Space is no longer unchanging in time, the realm of reverberation and echoes, but a space in motion akin to a trombone or the Doppler effect. Volumetric space becomes the engine, space becomes the motion and this spatial information is itself converted into data which is being processed in real time and converted in any direction the digital realm can make possible.

This translation concretised by the transcoding of spatial data and sonic objects, perhaps for the first time, allows for one to think in terms of material sonography, or more precisely, of the relationship between a sonic object, its source and its spatial qualities which rather than being outside, surrounding the source and propagating the sonic object, become the source itself.

This allows for a total reconsideration of space in a multi-layered, multi-dimensional manner, from a physical container where sonic objects bounce off and reflect, into a tangible

volumetric sonic generator which dictates sonance, irrespective of the source's (physical or electronic) matter.

This process turns volumetric data into sonic data, however, the translation is not as straightforward as a simple translation from one language to another, such as for example from English to French. Time retains a key role in this translation, as the way the volumetric data is accessed or observed across time creates an instance of the source becoming both the instrument and the notation in simultaneity, it could also create an instance of compressed sonic objects where potentially all the points can be interpolated at once creating a massive instance of black MIDI. This, however, differs from a piano playing all the sounds that can potentially be played on a piano at one go. It goes somehow beyond that, in a way where the order or structure in which the data is arranged also turns the data generated into a composition itself, turning space into yet another agent in the creation of sonic objects.

In "Soundwave Sculpture" the separation between the physical matter of the source and its form opens up a new direct relationship between sound and form which could offer interesting possibilities within the visual arts. Each element can be viewed independently as the spatial qualities of a sonic object are no longer dependent on the matter that constitutes the source. This takes the concept of a sonic object beyond a musical piece or a musical instrument or audio synthesis. This creates a 1:1 translation between sound and form by breaking down these elements to their simplest form, creating a very basic form of cross-modal abstraction that can be observed in an action-consequence manner.

This project was explored in multiple directions, across a number of variations both in physical and digital spaces.

The initial experiments made use of industrial machinery that was capable of motion across 3 - axes. A digitally generated tone in the form of a sine wave at 440Hz that was being

generated constantly was directly intervened upon spatially in three dimensions with the frequency changes depending on its location in volumetric space. Sound therefore, was not being changed through a linearly arranged scale, such as in a vibrating string or through the keys of a piano, but rather sounds were being 'stacked' spatially, not only next to each other but also behind and on top of each other. It is important to note how in this arrangement points in space are not absolute but relative and it is changes in distances and in direction that are generating data. In musical terms, this can be understood as a constantly evolving musical system, a constantly evolving series of relative distances (Appendix 2.2).

The next phase of experimentation involved combining elements from audio synthesis and other digital audio elements such as filters, effects, delays and reverberations in order to control the wave not only in terms of pitch but also by imparting timbral elements and spatial as well as temporal elements. In more ways than one, this becomes a kind of spatialised audio synthesis in volumetric space. This being a part digital process allows for both timbral (i.e. spatial and temporal) interventions to be imparted on each individual axis, thus creating an even more complex series of relationships. The physical dimension of this process made interacting with and operating this system very intuitive. As human beings, we are accustomed to movement in space, across multiple directions and at different temporal patterns, so there was no real learning curve, muscle memory to build up or specific techniques to memorise. The changes in the sound are easy to understand and if one wishes more or less of a specific element it is as simple as changing speed or direction.

Other iterations of this project were explored in order to explore the possibilities that this approach has to offer. These included adapting the process to work with a drone (quadcopter), a 3D printer and exploring performance-based work. These initial experiments led to further development in other areas in the creation of a number of artworks such as

"Sculptural Situation for Articulated Lamp" (2016) (section 7.8), "On the Rocks" (2016) (section 7.7) and landscape instruments such as the piece entitled "35 9322°N, 14 3516°E" (2016) (section 7.11).

Another interesting factor that comes as a direct consequence of the digital element utilised in this process is that the real-time data being generated (MIDI note on, Pitch and MIDI Continuous Control) can be utilised and mapped on a myriad of other processes, that in themselves may or may not involve sound. This translation of data across multiple formats allows for the potential to create an innumerable amount of sculptural interventions based on changes in spatial relationships within volumetric space. This project was a very significant one in this research as not only did it extend into a number of other projects and artworks but also to some extent set the tone for the whole research. The way that the digital, physical, sculptural and sonic elements combine, as well as the capability to apply the process developed in "Soundwave Sculpture", retrospectively to other projects and objects, makes is instrumental in the development of my understanding of combining software and sculpture into a single artwork. The project acts as a reference point, as it not only succeeded where I had previously failed, which is to physically manipulate sound as if I were manipulating physical matter, but also became a springboard for multiple ideas and directions, and a solid foundation on which my practice currently stands.

7.7 On the Rocks (2016) Constructed Situation for 3D Printer, Lamp and Frozen Confirmation of Civilisation (on an Over Populated Island). In Collaboration with Francesco Scialo

This project (Appendix 3) builds upon the legacy of processes developed for "Soundwave Sculpture" (Appendix 2) as well as older projects that were first conceived during my MFA research such as "Gong" (2014) and "None" (2014) (Galea, 2015). In more ways than one, this was an instance of what one could call a sculptural improvisation, as there was never a fixed plan of action, nor a specific aesthetic in mind. Borrowing from John Cage's process for his "Prepared Piano" pieces (c. 1940-1954), certain preparatory work was conducted based on the conversations I had had with Francesco Scialo, with whom I collaborated on this piece. It is beneficial at this point to provide a little context for how this collaboration came to be.

Francesco Scialo is an artist and Professor of drawing and printmaking at the Academy of Fine Arts in Reggio Calabria, Italy. He was in Malta on an Erasmus academic mobility scheme which was being hosted by Gallery Last Touch in Mosta, Malta between August and September 2016. Scialo works primarily in printmaking, photography and sculpture. His sculptural work involves the collection of artefacts and objects he finds during his trips to Aspromonte, a mountainous region in the south of Italy that is notorious for the amount of activity by the mafia in the area. In one of our conversations Scialo explained how a lot of people have disappeared on those mountains, never to be seen again, and how they leave behind traces of their existence: cameras, shoes, sunglasses, wallets, documents and keys, which he collects and preserves in the traditional Calabrian culinary manner - under oil, under sugar, under salt, and occasionally, under ice. We were introduced by the gallery owner

who happens to be a good friend of mine and over a couple of coffees, we discussed our practices and ideas on art, among many other things. Scialo had brought to Malta a series of prints and three of his sculptural works to be exhibited in the gallery at the end of his visit, however, he was also keen on producing a body of work on the Island. After our first meeting, Scialo asked me if I would be interested in a collaboration, inviting me to 'hack' his work and make it produce sound, more specifically he said that he always imagined his works making the sounds of violins, and asked if that was possible, the rest he said was up to me. A couple of days later, Scialo shows up with a rusted can of tinned meat, which he had found at Wied iz-Zurrieq, a popular bathing spot in the South of Malta. He asked the gallery owner if he could have this frozen in a block of ice for the exhibition, and he asked me if I was willing to work with this.

The idea of 'hacking' someone's work intrigued me. I had already contemplated on the idea in "Point and Shoot" (2016) where my sculpture was reacting to and reinterpreting paintings done by others. The link between 'static' conventionally displayed work and a more mobile or fluid, media-driven work sharing the same gallery space, with the sculptural intervention bridging between the old and the new (understood in terms of modalities of art-making), I find fascinating. What gets me nervous in these circumstances, however, is that my intervention should always be respectful of the original artwork being intervened upon or 'hacked' as well as the original intentions of the artist whose work is being intervened upon. Constructing a system around somebody else's work, in order to perhaps extend its capabilities of projecting meaning, should always, I believe, be sensitive to the original artwork itself. This requires a delicate balance to achieve a conversation between two

individuals, that also opens up to the audience and other non-human agents, and in my opinion, this should always be approached with a great degree of responsibility.

Based on my interpretation of Francesco Scialo's work I decided to 3D scan the artefact that he had collected before it was frozen, in a way to extend Scialo's idea of preservation into a virtual 3D model, that could be preserved and replicated indefinitely. From my end this was also a practical solution for carrying out tests that would not compromise the original artefact. By intervening upon another artist's work, my goal was to change its behaviour without compromising the identity of the original artwork.

Scialo's exhibition, together with my contribution to it was to be held on the 2nd of September, which gave me a day to figure out the workings of my intervention. This was one of the main reasons why earlier I referred to this artwork as an improvised sculptural installation. By improvised, however, I do not mean a patch, or a quick fix, where the results are dependent on the amount of available time, but rather in a manner that is more akin to a musical improvisation, a real-time interpretation of the situation and environmental stimuli over a foundation of prepared elements, which is also dependent on years of preparation, practice and experience. I had been thinking along the lines of constructed and sculptural situations, transposing ideas from the performing arts - music, theatre and dance into sculpture. Elements such as time, improvisation, choreographed motions and designed sets. I saw in working with Francesco Scialo on this collaborative project an opportunity to put this into practice. The restriction of time had no real influence, except that perhaps for giving little room to overthink and encouraging me to take the plunge into what for me, at that point, were unchartered waters.

The reason why I am taking my time and going into details that I would usually overlook and never mention when documenting and retrospectively reflecting upon any project I undertake is because I believe the circumstances and the build-up towards this project were as important, if not perhaps more important than the 'final' outcome. This project was the first time that I felt that I had successfully reconciled the theoretical and ideological elements of my research with my practical output in a concrete manner. This was the first instance where I felt my ideas had moved beyond the experimental/prototype state and could be repackaged in a manner that is relatable to an audience, in a manner that is interactive, and where technology, whilst present is not 'the star of the show', allowing for brief instances where the audience is unsure of what is going on, a kind of deceptively simple 'semi-magical' instance.

I was initially drawn to the idea of the ice melting slowly to reveal the found artefact in Scialo's work. I was interested in how this change across time works on such a simple idea. In response to this, I decided to reconstruct the artefact by 3D printing the virtual model I had scanned earlier, by building it at the same time that the ice was melting, with one being revealed as the ice goes down and the other being revealed as it was built up. I tried to reconcile both reveals to occur around the same time and calculated around three and a half hours were needed in the heat of the Maltese summer for the ice to melt completely, and modified the g-code (the g-code is a set of coordinate data that the 3D printer uses to build the model) for the 3D printer so that it would take the same amount of time to construct the model. The motion of the 3D printer's stepper motors, that move the printhead across the X, Y, and Z-axis whilst in operation generate sound of very distinct pitches as they are moving forward and backwards along the individual axis. I decided to amplify these sounds, through

a microphone and later converted the amplified audio signal into MIDI information, utilising a modified process that had originally been developed for "Gong" (2014) (Galea, 2015). The MIDI data was then utilised to trigger notes on a software sampler that had been previously loaded with audio samples from a violin, as Scialo had originally wished for. The resulting sound was played through the gallery's 5.1 surround system (Appendix 3).

To include the audience in the equation, I made use of an articulated desk lamp, mounted onto a stand, that gave the audience room to intervene both upon the ice-melting process as well as the sound being produced through the construction of the 'replicated artefact'. For this I made use of a simple light bulb, that allowed the audience to shine a light on the block of ice, that increases the heat and consequently the rate at which the ice melts. Moving the lamp also modified the sound in real time. This was achieved by using a modified version of the process developed for "Sound Wave Sculpture" (2016) (Appendix 2), making use of an accelerometer that was wirelessly streaming data, that in turn was being converted into MIDI CC (Continuous Control) information, with the resulting values being used to alter panning, articulation and filtering of the sound, each parameter being mapped to changes in acceleration along the X, Y, and Z-axis. By moving the lamp the audience was in control of the motion of the sound in space, generating data changes that were assigned to sending the sound around the gallery's 5.1 surround system. The audience, through the lamp, also controlled a high-pass filter that filters the sound by allowing sounds above a threshold to pass whilst attenuating frequencies below the threshold that the audience was setting in real time. The other parameter that the audience had control over, through the lamp, was the articulation of the violin samples, cycling through legato, staccato, marcato and pizzicato.

The audience interaction with the lamp also determined the angle and the direction in which the light was shining on the melting ice block.

The constructed situation lasted the planned three and a half hours and successfully reached the projected outcomes. A number of elements immediately came to light, that were, I feel, instrumental to the direction that my practice took afterwards. A constructed or sculptural situation stems from the idea of the sculptural artefact as a relational system. In this project, the way that the data or information flows, is generated and translated allows for a number of sub-systems to exists simultaneously. These systems communicate between themselves, however are also capable of operating independently to some extent or another. The relationship between Scialo's artefact and the rematerialised replica that was being simultaneously built, plus the information that this was generating, which in turn was itself being converted into sound can be seen as an independent sub-system as it could operate independently without outside influence. This was important as this project was part of an exhibition that consisted of predominantly hanging work and as such had to co-exist with these works in a relatively small space. The shape of the canned meat tin that was being reproduced by the 3D printer, is essentially an extrusion of a rectangle with rounded corners, resulting in a looped sound pattern that was gradually increasing in pitch. The loop is due to the shape of the object being printed and the repetitive motions that the 3D printer goes through whilst building up the replicated artefact. The repetitive nature of the sound was instrumental in not letting the collaboration between Scialo and myself overpower the rest of the exhibition, as the effect was that of a drone sound that could easily fall in the background without taking over the rest of the show. When interacted with however, the sound and its motion around the gallery space, open up a previously 'closed' system to include the

audience, giving the audience immediate feedback, and real-time response to the audience's actions. Once the interaction stops, the system returns to its 'closed' self-sufficient state, assimilating within it any changes that the interaction with the audience has put in effect.

An interesting facet of this constructed situation was that the technology involved, where visible was simultaneously behaving as it was supposed to (the 3D printer printing and the lamp shining light) as well as behaving in a manner that was not expected or anticipated by the audience (the 3D printer creating a sound piece and the lamp controlling the sound's dynamics). The situation also, quite surprisingly, started to regulate itself to the environment. When ambient noise was low - i.e. there were fewer people in the gallery the sound was noticeably quieter. The higher the ambient noise in the gallery, a result of more people in the gallery space, the louder the sound produced. This was due to the audio to MIDI conversion being velocity sensitive, which means on a conventional MIDI interface, the 'harder' the note is played, the louder it will sound. I initially assumed that this was due to the ambient noise in the gallery being picked up by the microphone. I had set up a noise gate and equalised the audio input to be as close as possible to the 3D printer's motor's range of sound, in order to minimise false triggers. The microphone obviously still continued to 'listen' to everything, however, the sound that was eventually being utilised for the conversion to MIDI was being filtered to be within a specific range. The extra information that the microphone was capturing rather than altering the pitch, somehow ended up controlling the velocity, which is something that, to be honest, I was not expecting. This gave another mode of engagement, perhaps what could be seen as a passive or indirect one, as a crowd cannot help but talk during an event. As this was a 'visual art' event, no silence is either expected nor observed by the audience. Nobody was in 'listening mode'. This created a rich dynamic exchange

between the audience and the artwork itself. The artwork had indeed become gallery sized and the audience had become part of it.

This project was an important step in my research. The idea of the artwork as a relational system later evolved into the concept of a sculptural ecology. Elements from music and the performing arts as well as elements from cinematography that I had not previously explored as part of my practice such as duration, improvisation, the physical motion of sound and a continuously mutating visual element, together with the inclusion of light as a sculptural element, worked very successfully in this project. The collaborative 'hacking' element and the coexistence of traditional, and the more experimental modalities of art-making in the same space without one overpowering the other was echoed in the tension between the 'low tech' and 'high tech' modes of preservation, that met in the middle from opposing directions, gives this project a richly layered poetic element.

The main reason why I call this work a constructed situation, rather than the more commonly utilised term 'installation', is because whilst it borrows a lot of elements from installation art, it also makes use of elements from generative art, kinetic art, ephemeral art, musical performance and composition, expanded cinema, tra-digital art, appropriation, code art, assemblage, the notion of the readymade, human-computer interaction and participatory art. Whilst the term 'installation' is an umbrella term which may refer to a lot of things, the vastness of areas that it covers can, perhaps, compromise the specificity of its multiple variants and iterations. The process of shaping information by adding and removing is sculptural, and through this process, meaning was created in line with Francesco Scialo's initial preoccupation with preservation and documentation of objects left behind by others.

7.8 Sculptural Situation for Articulated Lamp (2016)

This project (Appendix 4) was initiated through an invitation by the organisers of the International Conference for Stereo and Immersive Media held in Lisbon at the end of October 2016, to create an artwork to be exhibited in a satellite venue for the duration of the conference. After receiving a technical rider with the facilities and the equipment that was available, which essentially dictated the format of the artwork, I decided to opt for a documented performance in the form of digital video with 5.1 audio. The space for the artwork to be displayed was the audio studio at the Universidad Lusofona de Lisboa (Appendix 4.1). The organisers also suggested a duration of approximately 5 minutes, after reviewing my initial proposal. The project was exhibited as a single channel video installation, running on a 27-inch iMac with 5.1 audio that consisted of five near-field audio monitors and a subwoofer arranged on stands in a hemisphere around the monitor, in a dark acoustically treated room.

This project has a somewhat dual existence which stemmed from my interest in investigating how sculpture that is part physical/part digital and which changes over time through user interaction, can be exhibited, presented, and documented. Is the documentation of a sculptural situation an artwork in itself? Is it always the same artwork, remediated through different media? Is it a documentary or a video piece? And does it make a difference? To be quite frank, I never took a decision or a position on this particular work, and because of this, it continues to exist in two states - A video with 5.1 audio and a physical object with its own specific software package. Even though this piece has only been exhibited on screen, and the sculptural situation has only to date been constructed once, there is technically no

constraint for it to be exhibited physically. Nor for both versions to occupy that same space simultaneously.

"Sculptural Situation for Articulated Lamp" builds upon the ideas, software and hardware from "Soundwave Sculpture" and "On the Rocks", sharing with the latter the articulated lamp and the manner with which this is engaged. Whilst I was tempted to create another sculptural improvisation in Lisbon, the reason for working with video, apart for its obvious logistical advantages, was, in retrospect, an opportunity to explore performance from a comfortable distance. The relationship between sculpture and performance, perhaps not in a choreographed manner, opens up interesting avenues, most prominently as it includes the audience, the artist or any other performer or performance device as part of the aesthetic, going beyond human agency solely explored as an instigator or initiator of some form of activity. In terms of aesthetic, not only the physical human attributes are considered but also the motions, and how these relate to the motions, or rather the range of motions allowed by the lamp, which are also directed by the performer's aural aesthetic that is directly bridged with the performer's motion of space.

The sculptural situation in itself consists of a red articulated desk lamp, mounted on a red metal stand that puts the lamp within the range of human height. A wireless accelerometer is attached to the lamp, streaming data changes corresponding to changes in motion along an X, Y and Z axis. The data from the accelerometer is converted through a software process into MIDI CC (Continuous Control) that allows for real-time control of 3 parameters in a Digital Audio Workstation (DAW): Reverberation, Pitch and Panning. These parameters act directly upon a 3 note motif that is constantly being looped. By moving the lamp around in

space, the pitch, amount of reverberation, the direction and the spread of the sound is altered in real time.

The video and audio that was exhibited in Lisbon is a little over 5 minutes in duration and is visually composed of myself and the lamp in front of a white background (Appendix 4.2). The camera angle never changes with the shot being set in a manner that crops most of my head out of the frame, as an audience is naturally inclined to focus on faces, an evolutionary characteristic developed by humankind (Ramachandran and Hirstein, 1999). This uncomfortable crop, enhances a somewhat anthropomorphic trait in the lamp, that now occupies centre stage. The lamp itself is somewhat reminiscent of John Lasseter's "Luxo Jr." (1989), more commonly known as the PIXAR lamp, which adds to the lamp's perceived anthropomorphism. This cultural reference was not initially intended, at least not on a conscious level. The light which is accessed through the lamp's capability of making light is also used as a sculptural/compositional element. The goal for the version of this project as exhibited in Lisbon was to attempt to re-create the sculptural situation through the visuals on the screen and the physical motion of the audio on the 5.1 system that was recorded as an automation from the data that was being streamed in real time during the sculptural situation itself as it was captured on camera. The automation data and the recorded audio was being simultaneously captured during the video capture, with the two being merged together in post-production.

The way that this project was set up in Lisbon was very effective in conveying a sense of motion through the space. This element relates directly to the practice of expanded cinema, however, I believe it also goes a bit beyond expanded cinema's conventions, in the manner that this project relates to sculpture. As Manovich (2001) describes, or rather, as I interpret

Manovich, what I am attempting to produce here, is a series of spatial and temporal montages, brief and transient episodes of sculpture, a physical motion across time that creates a continuous stream of sculpture. The remediation in the form of video, makes the stream adhere to video's inherent sequential time format which is why I previously expressed concerns about the actual nature of this project and have grown to accept its dual existence. In its physical format, time understood as the distance between one event and another can be manipulated in a manner that is, like in music, relative. In video this does not really occur, what is recorded is recorded and time becomes absolute. Perhaps combining the two could be interesting, with a live stream viewed on a screen and the physical motion conveyed through the surround sound.

This project was the first instance where I developed the concept of a sculptural situation, evolving from the idea of a constructed situation. Once again it is not the term or indeed the terminology utilised that is important, but rather the approach to sculpture. In a techno-cultural society, where software and our relationships to it offer possibilities to extend one's practice into areas that were previously outside of sculpture's reach.

A sculptural situation, as an ecology that creates the possibility for sculpture to occur as a stream of events, in multiple media, later became the foundation for a number of projects and artworks. Creating sculpture by physically intervening upon sound developed in "Soundwave Sculpture" (2016) (Appendix 2), and later culminating in "Sonic Objects" (2017) (Appendix 14) was strengthened through this project, and was also combined with an aesthetic value or sensibility that I had to a certain extent previously lost. The visual presence of the red lamp drove my practice towards a reconsideration and a reintegration of the visual element as a central component in my practice.

7.9 RGB Sculpture (2016)

"RGB Sculpture" or "Video Sculpture" is an intervention in RGB colourspace that allows for direct manipulation of the building blocks of video. The work revolves around creating a physical interface that an active audience can engage and build content with through video. The process makes use of live streamed imagery that interpolates the RGB colourspace and changes it into a digital signal which can be used to control video, audio and other processes such as stepper motors, lighting and any other conceivable process that can be initiated digitally.

Other conceptual but also to some extent physical spaces that digital technology has brought about, which relate especially to the moving image are colour-spaces, more specifically, this project focuses on RGB colourspace, the building blocks of video. RGB as a space is a series of relations between the colours red, green and blue and how different blends, ratios or distances between these colours build up the moving image, the digital moving image pixel by pixel. As a sculptural practitioner, this is a very fertile area of artistic enquiry and research.

The way we relate with content, matter, be it physical or digital and the meaning-making process which we utilise to make sense of our environment is essentially a continuous translation between stimuli and our social and cultural understanding of them. Sculpture in itself is more an act of remediation or reconsideration of matter rather than the physical intervention upon it. Thus as mentioned previously sculpture is more of an intervention in society through the organisation of information, rather than one in matter. The digital technology, including both the software and hardware elements of it, like sculpture, are social and cultural artefacts, however, software has an interesting facet to it. Software has

the ability to translate virtually any kind of stimulus into another, converting everything at the lowest level in a series of on and off pulses, thus enabling us to connect things or rather create connections or equivalences between things that perhaps should have never been connected. By looking at video from a sculptural perspective and deconstructing it to its building blocks which are then translated, even though somewhat artificially in a more spatially capable media, such as sound, allows for a new understanding of both media in entirely new manners.

In the project entitled "RGB Sculpture", RGB data streamed in real time over a wireless network through a cell phone is digitally interpolated and broken down into data which is then reconstructed into MIDI information that is physically output as sound. The wirelesses nature and portability that the cell phone provides allows for an artefact that is spatially agile and can freely roam different environments, which is extended through the perhaps theatricality of the physical sculptural devices that carry the phone around in space. This process of course lends itself to a large variety of artistic interventions, as RGB sculpture in itself is more of a tool-making process rather than a sculpture within itself. The various iterations of the process such as "Point and Shoot" (2016) (Appendix 7) and "Landscape Instruments" (2016) (Appendix 8) both make use of the process of "RGB Sculpture" with separate, albeit analogous intentions. Tool-making, as described by Clarke (2008), is a powerful cognitive process, it is a mental scaffold that helps one make sense of the outer world by simplifying it. To a certain extent, the way that tool making is employed here is by rather than simplifying the moving image, this is transformed into spatial media which in themselves are engaged with through physical motions in space, that have the capability of going back in the digital space and out again in more formats. The conversion that occurs from RGB data into MIDI not only has the ability to produce sound, but also to

control, trigger and manipulate other media through continuous software processes that form and shape events in the physical world.

In this regard, the process of sculpture in conjunction with software creates potentially a new paradigm in understanding and engaging with a spatial practice. Detaching sculpture from its dependency on physically tangible matter and utilising software somewhat as a simulation or stand in for the matter that sculpture is usually accustomed to operating with, and by expanding the notion of space beyond that which sculpture is accustomed to operate within, we enter in a new extended and expanded model of sculpture that is perhaps more adapted to the twenty-first century and the unavoidable relationship with media that this era has brought with it. The sculptural situation makes it very adept to intervene both within and upon an artistic paradigm. The construction of situations, as a sculptural process is an extension of the idea of the artwork as a relational system. It is simultaneously an act of sculpture and composition, a performance and spatio-temporal collage between multiple modalities, spaces and dimensions which to some extent goes beyond Manovich's (2001) idea of spatial and temporal montages formed with media. This is due to the way that this constructed situation goes not only beyond but also across the idea of media. To a certain extent the intervention here is not sculptural, in conventional terms, producing objects or artefacts, and perhaps not even self-contained artefact systems that act with and within themselves, but rather constructing the conditions for these to happen and occur. To a certain extent, it becomes sculpture of sculpture where sculpture becomes this self-propagating flow of structures and connections that has the ability to keep expanding and extending itself. Sculpture hence manifests itself as a singularity, a state in itself capable of not only modifying and manipulating space-time but capable even to a certain extent of creating it.

7.10 Point and Shoot (2016)

"Point and Shoot" (Appendix 7) is a sculptural situation that makes use of the process developed for "RGB Sculpture" and repackages these into an interactive artwork that is aware of its surroundings and capable of reacting to it. In creating this artwork, I wanted to make use of the degree of spatial freedom that the process for "RGB Sculpture" offers in order to create a sculptural artefact that is mobile, capable of motion in space, propelled by the audience around a space, capable of adapting to most situations and not tied down to a specific location. The title "Point and Shoot" is an obvious reference to its physical shape and to the modality of its engagement, with the term point and shoot utilised to describe cameras that are quick and easy to operate, as well as the conventional manner in which firearms are operated.

The physical elements of this artwork consist of a steel structure, built out of found metal parts, assembled in the form of a large anti-tank or anti-aircraft gun on wheels. The wheels allow for full mobility both inside and outside of a gallery space, whilst a universal joint that connects the wheels to the 'gun' allow for the gun to swing up and down left or right with ease. On the software side of things a phone is used to stream live video to the computer using a phone app called "Epoch Cam" which through a Syphon Server streams the resulting image in real time in a custom built patch on Max MSP that converts the RGB data from the video converting it into MIDI data that is then sent to Ableton Live and used to control a whole range of digital synthesisers in order to produce sound. A wireless accelerometer, the same one that was used for the "Soundwave Sculpture" project was used to stream wireless MIDI CC (MIDI Continuous Control) data into Ableton Live that controlled the volume when moving the gun up and down (zero volume at rest and full

volume when the gun is fully extended) and the panning balance when moving the gun from left to right thus positioning the location of the sound within a stereo field by essentially pointing the gun (Appendix 9.1).

Aesthetically the gun looks dangerous, powerful and heavy. When one engages with the gun however, this is totally inverted, by pointing the gun, sound is made rather than shots being fired, and the gun for its size is surprisingly easy to move and handle. The sculptural situation was set up in a gallery space to test it and take it through its paces. The main reason for choosing a gallery space was to somehow create a scenario where within the same gallery space conventionally displayed wall-hanging artworks in the form of painting and a more experimental sculptural intervention could co-exist and feed off each other. It is a somewhat surreal experience to see someone move a large gun-like contraption in a gallery and for this to be pointed at painting, making sound in the process that is derived from the colour of the painting.

A recorded performance of the same situation was recorded at the Gateway Studio, at the University of Malta which was presented at the November 2016 Sound/Image Symposium held by the University of Greenwich in London (Appendix 9.2.2). The same situation of having the artwork react to a painting was recreated, and perhaps this time round I was somehow more conscious about the sound being made, as to be quite honest, the first time round that the sculptural situation was set up I was more excited that it was actually working, and spent little time thinking about the sound that was being produced. I have to be once again honest in stating that I was initially disappointed by the sound being produced. I kept trying to determine whether I had some sort of software problem until I realised that the sculptural situation was indeed playing with my head, with my expectations. What if all that was written on the equivalency of colour and music from Pythagoras to Kandinsky, all that

was assumed was not really there? More specifically, what if there is no real equivalency between vision and audition? Something that is considered 'harmonious' visually might not necessarily be so aurally.

The more I thought about this, the more it started to make sense. Colour and music have no real denomination between them. I now feel a bit foolish for expecting Debussian music coming out of an abstract painting. I can do that through software, I can force the software to modulate the sounds in this manner, however I had decided to go for a clean 1:1 translation between the two, and it sounded horrible. In retrospect, there should be no surprises. Music is artifice, it is built on man-made systems and perhaps no visual equivalent to it exists, in terms of actual equivalence.

The sound coming out had no real structure, worked on a different timing and rhythmic structures to the structures of Western music and what we are accustomed to listening to, and that is why I initially concluded that it was horrible. It is also true that the software has its flaws, I am by no means a software engineer, and my eclectic composition of hardware does have several limitations, however, perhaps for the first time I made a realisation that I have been looking in the wrong direction, and perhaps at least as far as that situation was concerned, the paintings actually sounded that way, in terms of the relationship between the intervals of the colours and how this was transposed to pitch.

7.11 Landscape Instruments (2016)

Another artwork that derived directly from the "RGB Sculpture" project, making use of the same software processes, was a series of experiments entitled "Landscape Instruments" (Appendix 8). These were initially tied to the "Point and Shoot" (Appendix 7)

artwork where I started 'scanning' the landscape outside my workshop/studio and converting the 'image' into sound in real time. The idea being considered here was what if I could play the landscape as a musical score, what if I start making use of the "RGB Sculpture" as a compositional device, to produce sound pieces?

Using the "Point and Shoot" 'gun', was not really practical, because of its size and the logistical problems involved in carrying it around. The form and its resemblance to an actual gun also makes it a bit of a tricky to use in public.

What is interesting in this project is that essentially there is no difference between "Point and Shoot" and "Landscape Instruments", apart from the manner in which I was looking at the two ideas. The data signal is identical in both projects, however they behave in a completely different manner. "Landscape Instruments" cuts off the audience, in a way it behaves more like a painting, something created by the artist and then displayed to the public.

"Landscape Instruments" as a project took an identity of its own once I reimagined the data flow to work with a drone quadcopter. By changing the hardware and consequently the mode of engagement, the project took a whole new turn. Whilst the original idea remained unchanged, the drone quadcopter offered a whole new viewpoint, a whole new take on the landscape, which also resulted in a distinct change in the sound being produced.

The drone quadcopter utilised was a DJI Phantom 4 with an extra HDMI out module that I used to connect to a 7-inch field monitor to which a webcam was pointed at. The rest of the patch is identical to the one used for "Point and Shoot" resulting in a real-time interpolation of the video stream from the quadcopter into sound. Moving the drone around in space, in a manner which is as spatially unconstrained as one can imagine also creates certain variations in the sound as can be experienced in "35 9322°N, 14 3516°E" (2016), a recorded "Landscape Instrument" performance, that was recorded live in Għajn Tuffieħa in the North

West of Malta's Coast (Appendix 8). The sheer scale and magnitude of the landscape as a musical score or as a musical instrument is a perhaps indescribable experience which does not translate well into video. As a result of this, the project was not explored much further, and perhaps its true potential never discovered. The Landscape occupies an interesting role in sculpture, the relational distance between the landscape and the observer, its relation to the sculptural artefact and its dual nature of both environment and sculptural matter places it perhaps at the limits of human comprehension in terms of magnitude and scale, perhaps not on the conceptual, but most certainly in physical terms. The manner in which the landscape is both 'natural' environment, implying the absence of human intervention, and the space in which human intervention occurs at the same time. Also one cannot really observe the landscape whilst simultaneously being part of it, at least not from the individual's point of view. The drone quadcopter however turns this on its head, as it offers a totally different viewpoint and position to take in relation to the landscape. The camera angle turns the familiar into the unfamiliar and the higher vantage point somehow makes it seem as if technology has somehow domesticated the landscape in its immensity. The same feeling is somewhat echoed in this project where the landscape has been converted into data, data with which to make sound, converting what can be perhaps considered the largest and most dominant predominantly visual (in terms of how it is generally perceived) element we experience on a daily basis, reducing it into a sound piece, one that lasts as long as the drone runs out of battery. Technology perhaps takes its time to physically alter a landscape, however the manner in which the landscape is viewed and perceived, and the manner in which we relate to it can change instantaneously.

7.12 Sound Painting (2016)

> The root word "image" need not be used only to mean representation (in the
>
> sense of one thing referring to something other than itself). To re-present can
>
> be defined as the shift in referential frames of the viewer from the space of
>
> events to the space of statement or vice versa. Imagining (as opposed to
>
> imaging) is not a pictorial preoccupation. Imagination is a projection, the
>
> exteriorizing of ideas about the nature of things seen. It reproduces that which
>
> is initially without product. (Bochner, 1970 as cited in Lippard, 1973, p. xv)

This project (Appendix 9) consists of a body of work that investigates the relationship
between sculpture and painting as (re)mediated by technology. The project consists of a
number of sound paintings, mixing the formats from one modality of art-making to another.
Sound paintings were developed in parallel with a series of works that I call "Singing
Sculptures" (2016-2017) (Appendix 5) that make use of the same technology. In this instance,
technology was perhaps the main instigator that drove me towards a complete rethinking of
what makes sculpture a sculpture, and painting a painting.

The direction that this project springs from is a very simple, even simplistic premise:
If one were to stop thinking of painting in terms of image and start to reconsider it in terms of
object, would this be sufficient to therefore consider this as sculpture? Whilst this idea is easy
to dismiss, technology does in some way provide a pretext for it. A smartphone or a tablet is
considered more of an object than an image, and yet most smartphones and tablets are flatter
and more two-dimensional than most paintings. Would it be perhaps the continuously
changing content, or perhaps the way we interact with the interface, in terms of touch that

makes us consider a smartphone or a tablet as an object rather than an image? How can this be applied to painting? These were the initial points from which this investigation departed.

The technology that this series makes use of is a very simple device, aimed at children, in order to learn, engage and interact with computers in a fun and creative manner. Commercially known as a Makey Makey built by JoyLabz LLC, this device is essentially an Arduino that is programmed to behave like a computer keyboard. Through conductivity, programmable computer input key presses are activated by closing the circuit. Using jumper cables, anything conductive such as water, metal objects, fruit, graphite and so on can be turned into a computer keyboard key (Appendix 9). I had been eyeing this technology for a couple of years, since its release in the consumer market, but never had any real application for it as previously my practice was more focused on camera and optical based interaction. The politics of touch in a gallery space can be quite daunting and after observing a great reluctance towards engagement in tactile experiences within an art exhibition context for works developed during my undergraduate research (Galea, 2013), I had sought for contactless interaction, at times even in an attempt to 'ensnare' audiences in non-voluntary or passive interaction. In my MFA research (Galea, 2015) I developed some sort of compromise, as I observed how certain materials such as light are deemed acceptable to touch. This also extends to smooth polished surfaces like buttons and screens, that have an obvious ingrained cultural function. Touching a painting, on the other hand, is perhaps directly at the opposite end of this scale. What if perhaps, I could somehow convince the audience that this is not a painting but an object? This is how the idea for "Self Portrait in 5.1" (2016/2017) developed.

7.13 Self Portrait in 5.1 (2016-2017)

"Self Portrait in 5.1" (Appendix 9.3) grabs two elements that are measured or better, that operate on different platforms and merges them together. The idea of a self-portrait belonging to painting whilst the idea of 5.1 surround belonging to audio. The aural element also extends the physical, spatial and temporal nature of the artwork, moving it closer to the sculptural realm. The artwork consists of an acrylic painting on an engineered wood panel. I have to admit that I am not much of a painter, however, and this is not an attempt to cover up my painterly deficiencies, it is not the pictorial representation that is being sought in this artwork. After the painting process was over, I drilled holes into the panel, later driving in nails into the panel from the painted side, in strategic points, mainly where I have, or have had, facial piercings, as well as dark areas of the painting, so as to partly conceal the nails. The nails were driven right through the panel, jutting out from the rear side. Electrical wires were attached to the nails from the rear side, and these were later connected to the Makey Makey board, with the use of jumper cables. The Makey Makey connects to the computer via a USB connection, and in doing so effectively turns the painting into a computer keyboard, where by touching the nails on the surface of the painting, key press commands are sent to the computer, typically 'W' 'A' 'S' 'D' 'F' 'G' (although this is entirely extendable, customisable and programmable). The key presses were then converted into MIDI note on commands, where with each key, by touching a specific nail, triggers a specific sample on a digital sampler instrument. The software utilised for this process is Ableton Live 9, a Digital Audio Workstation (DAW) that natively accepts keyboard keypress input as MIDI triggers (Appendix 9.3).

Samples were recorded in Ableton Live and arranged into a 'drum rack' that is a digital instrument native to Ableton Live that behaves like a sample based drum machine, across six separate audio output channels, as to date Ableton Live does not natively support 5.1 surround, and the outputs have to be configured manually. This was achieved by spreading the output for each sample across 6 channels, preconfigured to output audio from separate speakers, through the use of a USB powered 5.1 external sound card, with each nail corresponding not only to a specific sample but also to a specific speaker and therefore to a specific point in space.

The recorded samples consist of vocal samples in three scenes, one talking about the self, the other questioning it as well as the act of representing it and the final scene questioning the relationship between sculpture and painting.

7.14 Minor Works - Self Portrait with Self Doubt, Fat Face, Short Hair No Beard and Exploded Minor Chord (2016)

7.15 Major Works - Mildly Inebriated Self Portrait with Green, Larger Forehead, Vodka and Arpeggiated Synth (2016)

The mixing of modalities and formats was extended in the development of two other self-portraits in the sound painting series - "Minor Works - Self Portrait with Self Doubt, Fat Face, Short Hair No Beard and Exploded Minor Chord" (Appendix 9.2). and "Major Works - Mildly Inebriated Self Portrait with Green, Larger Forehead, Vodka and Arpeggiated Synth" (Appendix 9.1). These works whilst playful in nature, as suggested by their titles also consider elements of portraiture or self-portraiture beyond pictorial representation. The major and minor references are related to musicology, as are the references to sounds, synthesisers

and manners of making music. Other elements such as self-doubt, distorted self-image, imaginary features or the lack of them as well as mental states and chemical agents (alcohol) are all perhaps valid components or elements to consider when trying to (re)construct an 'image' of the self. These elements are seldom thought about, let alone utilised in painting. Some of these elements would perhaps be better suited at being (re)mediated through the moving image, literature and in some instances music and the performing arts. These self-portraits attempt to go beyond a pictorial representation of the self, understood as a mirrored reflection, that might perhaps be coloured in a certain direction through being remediated through painting.

The manner in which these media/modalities of art-making in these sound paintings are capable of making use of these 'unpaintable' or 'non-painterly' elements is through their development across time. Perhaps the fundamental difference between painting and sculpture is the manner in which the narrative, in the loosest sense of the word, is structured. In order to bridge between painting and sculpture, building upon common neutral ground, which in this instance is time, introduced through the use of sound, might be a step in the right direction. These works operate and behave on multiple levels, behaving visually like painting whilst the manner in which one has to move around in a non-linear physical motion to trigger the sound is sculptural, as is sound's nature of delivering content across time.

This hybrid instance between painting and sculpture falls well within the rationale of a sculptural situation and that of a sculptural ecology. Essentially in these self-portraits, montages are created consisting of specific instances of time and space. Whilst this might sound complex, we do experience this phenomenon on a daily basis, not only through smart, latest cutting edge technology but even through something as simple as a remote for a DVD,

TV or a VCR player which gives the user the capability to access specific points in time and arguably space. The major difference between a sculptural situation and a device's remote is that we are not accustomed to thinking about painting and sculpture in this manner.

7.16 Singing Sculptures (2016-2017)

"Singing Sculptures" (Appendix 5) are a series of experiments and artworks that were developed in parallel with the "Sound Paintings" (Appendix 9), with different ideas, having separate goals and motivations, but essentially making use of the same technology. The progress in the sound paintings however, ended up influencing the outcomes and the direction of this project, making the two projects very closely related, beyond the technology that they share.

The project initially was intended to take another look at sculpture and sound, building upon previous research (Galea, 2013, 2015) in the light of newly available technology and a new mental framework that I was employing to approach sculpture as a 'sculptural situation'. The plan was to look into the merging of a sampler instrument and a collection of metal sculptures, understood in the conventional manner of the term sculpture. This concept was later mashed together with the notion and format of a 'musical album' within a sculptural exhibition held within the conventions and modalities of a gallery space. The bridging of formats and modalities of art-making, I believe is an area that is very rich and ripe for sustained investigation. The link between a musical album and sculpture comes from the idea of a 'concept album', commonly associated with Rock music since the 1960s where the musical album has a central theme or narrative, that all individual tracks build upon. In more recent times, the musical act Daft Punk released *Interstella 5555: The 5tory of*

the 5cret 5tar 5ystem (2003) an animated film that was the music video of their 2001 album Discovery, with each music video for each track building upon the previous one, so that when played one after the other, they act as single animated film. The initial idea for "Singing Sculptures" was to create a body of work that is simultaneously a musical album and a series of sculptures. This was intended to be extended by utilising the sculptural elements themselves as both the instruments for making the album as well as the interface through which the album is played, a platform through which the content is not only accessed but also created. A music-sculptural album that is composed of itself. Whilst I believe this idea to be valid, it never really got off the ground, further than a couple of prototypes made out of wire and a collection of small moving mechanical devices, collected and modified to conduct electricity only in specific positions. This experimental series was entitled "Electrocute" (2016) (Appendix 16.4) and consisted of around ten, aesthetically very interesting artefacts for which however the audio content was never really finalised, and at the moment exist in a state of limbo. This particular project is currently archived, awaiting the right opportunity for it to be revisited at a future date.

As described before, the developments in the "Sound Painting" project opened up new areas of inquiry and consequently the "Singing Sculptures" original ideas were refocused in new directions.

7.17 Karrotti (2016)

The idea of creating a specific instance in space and time or rather recreating it by other means was explored through "Karrotti" (2016) (Appendix 6), an interactive sculptural situation that is based on a particular event that had occurred some six months before the date

of the artwork's creation in Valletta, Malta. On that day a group of supporters of the opposition political party gathered in front of the law courts in Valletta in a demonstration of solidarity for a political person of the same party who was being arraigned in court. The interesting quirk in this event, to what is otherwise daily background news in Malta, is the way the media covered this event. The insults and taunts hurled by the supporters of this politician directed toward the government somehow made their way on the evening news on television channels and online news portals. Another quirk that made this event memorable is that one of these supporters whilst calling the government corrupt, somehow, unknowingly started calling the government carrots instead. In Maltese, the word for corrupt is "Korrotti" when referring to a group of people and "Karrotti" when referring to a group of carrots. The amusing insults do not end there with pseudo-Latin terms and obscenities peppered in for good measure. The word "Karrotti" which this artwork borrows as its title, literally meaning carrots, became associated with this event, ending up as the subject of numerous memes that went viral on social media.

The artwork in itself consists of three metal anthropomorphic figures that were assembled out of rusted metal offcuts, giving a very modernist appearance to the work. The three metal figures are mounted on an old, found plywood box, that concealed the wiring that connects each figure to the Makey Makey. By touching each individual metal figure, samples are played in the same manner and utilising the same hardware and software processes as developed for the "Sound Painting" series. The major difference, however, lies in the manner that the audio content is structured and delivered.

In Ableton Live, two scenes are set up with two separate 'drum racks'. Scene one and two each have different samples however one of the figures always triggers the "Karrotti"

sample. This work to date has always been set up in stereo and with two distinct scenes. A variant that was experimented with was to have two 'drum racks' - one that constantly triggers "Karrotti" and a separate 'drum rack' that through Ableton Live's native 'random' plugin cycles through samples at random when the other two figures are interacted with, offering a more unpredictable, non-repeatable scenario (Appendix 6).

The idea behind "Karrotti" was to recreate an instance, the atmosphere and experience of being in the middle of a protest/demonstration. Making use of an episode that went viral and that most people in Malta have some kind of recollection of, creates an interesting relationship between the artwork and the event itself. The manner in which the narrative is rebuilt, structured in a sculptural manner, which has no obvious or linear/sequential order to it, allows for a constant access and rewrite, or overwrite of the audience's memory. In a certain manner "Karrotti" becomes a sort of memory machine that allows for access to, but also the distortion of memory and the creation of 'new' and 'imaginary' ones.

On the technical side, a couple of interesting aspects were brought about by "Karrotti's" execution. Two major problems concerned me, the first being the Makey Makey's need for an earth-grounding, where one would need to touch the earth as well as the conductive elements in order to trigger a key press. The other 'problem', which applies to most artworks and projects that make use of technology is that the presence of the computer, kind of gives the game away. Also requiring a two thousand euro computer with a seven hundred euro software product for every artwork to be exhibited was, at least in my case, financially prohibitive.

I started researching embedded technologies and how to make hardware and software that is specifically designed to do a specific function. These kinds of artworks that rely on a computer have problems that are inherent to computers. Computers crash, overheat, do not like to be switched on and left idle indefinitely and ideally would require to be shut down properly, rather than switched off by cutting the power. I also wanted to create standalone and self-contained sculptural artefacts that from the user's end would only require switching on and switching off, and where the computer is nowhere to be seen. I started working with a Raspberry Pi and a Phyton code originally developed by Joseph Ernest who runs Yellow Noise Audio. The Phyton code was extensively modified in order to accept keyboard key presses, rather than MIDI over USB as in the original version. Ernest (2016) had originally built and compiled a code called "Sampler Box" that effectively turns a Raspberry Pi into a sampling synthesiser that boots up immediately and switches off without consequence. Furthermore, samples are loaded via USB, making them simple to change and load, as long as one adheres to the sample naming protocols. By modifying this code in order to accept keyboard input, the "Sampler Box" code could now work with the Makey Makey (Appendix 9.5.1.2). Alterations were also made to the synthesiser itself as this was initially designed to play musical instrument samples rather than vocal samples. This solution works relatively well, is more cost effective, costing less than a hundred euros, but does come with some trade-offs. The audio quality of the Raspberry Pi's built-in sound card is not that great, and an external sound card over USB creates conflicts within the code itself, and by using audio over HDMI, whilst fixing the problem, drastically increases the cost, putting the whole setup in the range of more powerful (than the Raspberry Pi) low, spec Windows-based computers, which essentially defeats the whole purpose of the exercise.

The problem with the earth-grounding, whilst fixable, again presents a situation where the cost of fixing the problem ends up being too high compared to what is being achieved, with the cost in question not being a monetary one in this instance. An idea that was explored was making use of a 'capacitive touch hat' a module built to clip on to a Raspberry Pi and act like a Makey Makey without needing an earth grounding. The problem with this solution lies in the amount of software required for this to work effectively, slows down the Raspberry Pi dramatically, making it hard for the original code to work properly. Most alternatives to this require having a version of Raspbian (Raspberry Pi's operating system) with a GUI (Graphical User Interface) that not only slows down the computer with unwanted processes but also removes the advantage of a consequence-free kill switch and instantaneous boot up when switching on. As of the time of writing I have not succeeded in modifying the "Sampler Box" code to work with the capacitive touch hat and the modifications that I had added to the original code in a stable manner. This pushed me into looking for solutions in other directions that later resulted in "(Re)Diffusion" (2016/2017) (Appendix 11) and a re-evaluation of my position with regards to the grounding 'problem'. I considered looking at other solutions, such as incorporating the earth ground as part of the aesthetic. I still believe that embedded technology shall play an increasingly important role in future artistic practices. However one must keep in perspective the cost of embedded technology in relation to what is being achieved, as it becomes very easy to lose sight of the true goals of art-making, replacing these with a goalless pursuit of technological prowess.

7.18 Crosstalk - Imaginary Arachno-Christian Cruciform Reliquarium, Brazilian Amethyst and Sonic Fragments from 90s Pop Culture (2017)

This project (Appendix 10) can be considered the equivalent to the Major and Minor self-portraits (Appendix 9.1, Appendix 9.2) in the way that multiple elements, from multiple dimensions, media and modalities converge in a single sculptural instance. As an artwork, it is composed of real, physically tangible elements as well as imaginary and intangible elements that exist on different levels within the socio-cultural spectrum. This sculptural assemblage gathers pieces from various spaces and places and projects them in the here and now. Like its predecessors, this artwork makes use of humour as an integral structural element. Humour and playfulness, I believe, are important but mostly overlooked elements in art-making. An artwork that makes use of humour, as in the case of this particular work, is aimed at the audience on a level that facilitates their engagement with the work. Most audiences will engage more readily on a humorous level, than in a perhaps more serious context.

This work departs from an idea as proposed by the American sculptor David Smith who in his numerous writings once stated that "Everything imagined is reality…the mind cannot conceive unreal things" (Smith, n.d., as cited in Grey, 1989, p. 66). This falls in line with what was previously discussed (sections 6.1, 6.2) by Anders and Sheridan (2001) that virtuality is a real state/space as an imaginary scenario exists in the brain which is real, making virtual and imaginary states by default 'reality'. What I interpret from Smith's earlier statement is that the imaginary is created from elements of reality, the familiar arranged in a different, unfamiliar manner. New data, as it were, cannot be created, but data can only be reorganised in new forms, which is why when, for instance, we try to create an alien, we

always end up 'borrowing' elements from here and there like, for example, the animal kingdom, human physiognomy or technology and reorganising them in an unfamiliar manner. Hypothetically speaking, if we were to dissect every element from our alien and indeed any alien that mankind has ever attempted to depict, we might realise that our extraterrestrial friends are indeed of this earth, composed of multiple elements that we are already familiar with.

This project works on similar lines and is composed of an assembled welded metal structure that makes reference to Christian symbology, albeit on an imaginary level, in an amalgam with an arachnoid. Other elements consist of an amethyst stone that also brings geography and location into the equation, together with audio samples from Mike Judd's "Beavis and Butt-Head" (1993-1997), an animated series from the 1990s that aired on MTV, more specifically from Beavis' alter ego "The Great Cornholio", a dormant persona that comes alive when Beavis consumes large quantities of caffeine, sugar or other chemical stimulants. Interaction with the sculpture through touch results in the triggering of eight random samples, extracted from a Youtube compilation of the Great Cornholio (BCRJC45, 2008), loaded in a 'drum rack' in Ableton Live (Appendix 10).

This project comments on multiple social and cultural levels and values, acting like an inter-dimensional, light-hearted sculptural experiment. The artwork is also a comment on fabricated societies and social artefacts that humankind has been creating for centuries, now accelerated by the ease of propagation and technology brought forward by technology, that facilitates the merger and collision of these cultural artefacts in order to create new ones.

7.19 (Re) Diffusion (2016-2017)

"(Re)diffusion" (Appendix 11) is a sculptural situation that draws analogies between agents of mass communication and firearms.

Mass communication has a long history of being weaponised and in some cases can cause more harm than firearms. Sculpture in the digital age is perhaps an intervention in society rather than in matter and makes use of space as an agent that connects everything to everything: objects, sounds, software, machines, people and time.

"(Re)Diffusion" attempts to create a sculptural situation that has the ability to distort space around meaning and modify it in real time. Sculpture can go beyond simply being looked at and "(Re)Diffusion" investigates this by reconsidering how sculpture is engaged with, across multiple levels and modalities.

"(Re)Diffusion" as an artwork has a very strong sense of image which is perhaps uncommon in my practice, at least when done intentionally, and as such adds elements and dynamics that derive from the idea of image-making. The gun and the speaker cabinet, considered purely for their physical and visual elements, obviously strongly indicate a front and a back. Especially in the case of a gun, there is a totally different significance to where one stands in relation to the gun. Essentially the gun has a back and a front, and there is a whole level of power structures and struggles which shift as one shifts his or her position in relation to the gun. Sculpture in its traditional form has no real concept of a back and a front. Although this is a gross generalisation, it is also a significant one. In this work, through adding multiple layers of meaning which are accessed through different modalities of interaction and temporary structures or relationships built between the artefact and its

audience, numerous questions on sculpture and its nature in the twenty-first century are raised.

Through the addition of sound, and an invitation and illusion of touch coupled with technology, elements which are usually alien to sculpture extend its range into further spatial and temporal directions. Time which is usually absent in sculpture is integral to sound-related practices and gives the ability to sculpture to create temporary montages and meaningful, or rather intentional relationships with the audience. This reflects on the personal relationship we somehow build with mass media which is made to target the masses, however is always perceived as directed to its receivers in a personal manner.

The spatial qualities attached to sound and the tactile qualities of this artwork also aim to re-establish sculpture as a three-dimensional object, in terms that it is not thought of visually, in terms of images, but rather as an object. Material qualities also play an integral role in the artwork, as the physical matter was selected for its relationship with technology.

The technology is based on a modified Theremin, which is one of the first electronic instruments created. The steel which the gun is made of was selected for its electronic resistance qualities which in turn produces a deep growl, giving a feeling of aggression, as if the gun is angry at the audience for attempting to touch it, at the same time it also behaves like a musical instrument which is usually not aggressive in nature. Both however share the notion of intention, action-consequence, as integral to their use. This seemingly aggressive nature in the artwork is further echoed in the choice of visual aesthetics, materials and obviously the symbology attached to the work. The gun itself exudes aggression, it is very angular, made out of steel which is somehow inherently both macho and masculine, and demands respect through fear. It behaves like some sort of talking stick, an object which gives immediate power to those who wield it. This however, is totally turned on its head

when one engages with the artwork, as it is very playful, bringing out child-like behaviour from those who interact with it (Appendix 11.1.2, 11.1.3).

Sound and its relationship with the gun itself extends this idea of an assertion of power through fear. On hearing a gunshot one immediately ducks for cover, the sound of the cocking of a gun is perceived as a threat, and the artwork plays with this expectation, which is obviously never fulfilled. The sound starts too early before it is expected, which negates the idea of sound as physically depending on matter to be initiated and propagated. There is also a temporary detachment between action and consequence until the brain recalibrates and reconsiders how this new relationship works. The sound is furthermore unexpected, having no real relationship with the gun.

Touch is illusory as the level of interaction is contactless, mimicking the wireless nature of the radio signal, and nodding towards the wireless everything world we live in today. Essentially the technology employed here is old technology behaving or rather mimicking new technology. The inclusion of digital technology through the delay module is a comment on how digital technology has the ability to warp time and space around sculpture, deeply affecting its nature, behaviour and relationship with meaning. The delay also works on another level with the gun itself, an echo of consequence, a repercussion of a decision, and an endless propagation of intention which ties back into the nature of sculpture and its traditional relationship with timelessness.

The gun sitting on top of the speaker, essentially acting as an antenna to a now-defunct means of mass communication, which has a whole range of nostalgic and romanticised connotations attached to it, particularly on a local level as the 'Rediffusion' cable-radio service was very popular with its subscribers between 1935 and 1975, (Sant, 2016). This work comments on the socio-cultural use of mass media as a weapon of

destruction, through distraction. This deceivingly playful play with words introduces a whole range of links between sculpture and the creation of meaning and how meaning shifts across time through real-time interactive processes brought about by new (and not so new) technology.

"(Re)Diffusion" was exhibited in "IN TRANSIT" a digital art travelling exhibition curated by Professor Vince Briffa in Dusseldorf Germany, Leeuwarden Netherlands and Feldkirch in Austria from February to July 2017. It was also nominated as one of the finalists in the Premio Nazionale Delle Arti at ISIA, Faenza, Italy where it was also exhibited between September and October 2017.

7.20 Earth Machines (2017)

Performance art creates temporal montages between the object and the space that it is occupying. In a sculptural situation, media merge into transdisciplinary and multi-modal experiences. A sculptural situation goes beyond a prepared situation as in the Cageian idea of a prepared piano, as a sculptural situation is not a performance or a happening. The concept behind sculptural situations is to have semi-autonomous sculptures that react to their environment and the elements that from time to time share the same space with it.

"Earth Machines" (Appendix 13) as a project consists of sculptural situations that make physical contact with the earth, engaging with the elements - and charting its interaction with humankind. These can be considered as physical landscape works, that measure the intervention of humankind on the landscape, where a prong is inserted into the

earth, measuring vibrations caused by construction, vehicles, heavy machinery and foot traffic within the vicinity.

This project makes use of undetected, or ignored vibrations, in a way amplifying 'noise pollution'; mechanical and other man-made vibration in the landscape. The idea of a landscape as an ecosystem drawing, listening and playing itself.

"Earth Machines" is a collection of what could be best described as metal structures that are sensitive to movements of the earth. The metal structures are built in a manner that makes them light, slender and very unstable, making contact with the ground on a very small surface area so as to detect any vibration or movement from the earth, which includes both seismic activity (which is usually very minimal in Malta) as well as man-made vibrations: cars, trucks, construction, excavation, quarrying and so on (which, on the other hand are very present on the island).

Some specific "Earth Machines" are constructed in a manner that makes them also sensitive to the environmental elements, more specifically to the wind and the rain. The main concept behind this project is to listen to and through the earth, building a collaborative relationship with the environment.

Contact microphones are placed on the earth machines in order to capture the vibrations running through the earth, which are amplified through the steel structures before being further amplified in an analogue, and later digital, manner. Once the earth machines start streaming data to the computer, the audio signals are digitized, split and converted to MIDI. Once in the computer, the MIDI information, as well as the amplified acoustic signal, are utilised to create tracks sound pieces that are entirely generated and manipulated (by assigning parameters that the MIDI controls) by or rather through the earth, as most of the

activity that the earth machines are generating is human initiated, and not generated by the earth itself.

Sculpture in this manner is being created through the manipulation of natural and man-made phenomena and instances that are filtered through the earth or/and shaped by environmental elements. This is achieved by shaping the vibrations, the data which is being collected and generated, which is essentially a pressure wave, a sound wave that is moving and is being remediated through physical (the steel structures), electronic and digital processes. This creates numerous possibilities for engagements and interaction both with and within the earth machines in themselves as well as between the audience and the earth. Performing everyday tasks, like walking, dragging furniture, and for some particular machines even talking, generates enough vibrations to cause a discernible change in the repetition rate of the frequency (its pitch). Of course touching the earth machines themselves will also cause a reaction. By passing the sound through a subwoofer, a controlled feedback loop keeps the situation or scenario going on indefinitely as the vibrations from the subwoofer, combined with the vibrations that the earth machines are picking up from the remaining environment will generate more vibration, resulting in more sound being output from the woofer and the speaker, again generating more vibration, again and again in a continuous cycle.

This project was developed from another project where I had developed a patch in Max MSP to convert recorded seismic data in ASCII format into MIDI, which resulted in a number of sound pieces that followed the rhythmic structures of an earthquake such as the August 2016 earthquake in Amatrice in Italy and the 2016 and 2011 Fukushima earthquakes. From a sonic point of view the patterns and structures created are unlike anything I had

previously experienced, and somehow, and this is perhaps unexplainable unless experienced in person, one may feel the sheer power and magnitude of these motions. In simple terms, these recordings, sound like and feel like (through a large enough subwoofer) an earthquake. "Earth Machines" as a project departed from this idea and sought to reconcile human activity with the environment.

Through a sculptural process humankind and the earth become co-authors or co-creators of their own 'soundtrack' brought together by technology. The sound pieces created can be considered, at least to a certain extent as a recording of humankind's engagement with the earth and vice versa.

"Earth Machines" can be considered as expanded instruments or hybrid physical/ digital compositional devices; non-digital, generative (sound is not generated through digital algorithms, but rather through physical processes) sound producers and semi-autonomous sculptural artefacts that are aware of their surroundings and are capable of reacting to this. "Earth Machines" act as a bridge, an interface between humankind and the earth (Appendix 13).

The overall aesthetic of this series of works, at least in visual terms, rests on the metal structures that capture and convey the vibrations. These are built of steel offcuts and found metal parts, assembled and welded together, that gives them a very raw, industrial and archaic visual feel, again echoing a Modernist aesthetic. The overall aesthetic is primarily dictated by the function of these structures. However, there are myriad ways to assemble the metal components that make up these structures, in some cases perhaps functioning even more effectively. What I mean to point out by this is that there are always aesthetic considerations

in my practice that push towards a certain handling of the material, that has become an integral component of the look, the feel and approach to my practice.

In terms of sonic or auditory aesthetics, this is mainly dependent on the digital processes that the MIDI data is assigned to, how much of the analogue signal is mixed in the 'final' mix that the audience hears and of course the nature and amount of vibration being generated at any one time. Certain rhythmic structures are very interesting and with enough time, in a live scenario, repeatable patterns such as a periodical passing of a large truck can be identified. Moreover, even the direction that the truck is travelling to and from and the distance can be determined when one gets accustomed to the patterns that this creates.

"Earth Machines" were never designed with a specific exhibition or mode of exhibiting in mind. In a way, they function as an ensemble of musical instruments, in the manner that they are not tied to any specific place, genre or function. This project could work just as well in a gallery space, within a specific site or in a live performance. The resulting sound pieces in themselves are also interesting, and if recorded these could be easily exhibited as artworks in their own right, making the "Earth Machines" also potentially a set of studio instruments with which to create 'musical albums' and audio recordings.

A couple of samples of the "Earth Machines" were recorded and combined with electronic music, more specifically a beat laid down by a drum machine. The resulting recordings were unexpectedly very musical. This process and its results also drove me to ideas that echo Pierre Schaffer's work in "Muisique Concrete" carried out in the 1950s. This resulted in the idea of sculptural music, or perhaps more fittingly, "Electronic DADA", which can be described as a sonic assemblage, as pioneered by Pierre Schaffer, John Cage and

Harry Partch - sonic artworks that combine multiple modalities of art-making, time, movement and digital culture with analog and digital hardware and software utilised for audio production. In the spirit of 'sculpture by other means' "Electronic DADA" or sculptural music can be considered as a sonic snapshot of a sculptural situation.

"Earth Machines", as earth-powered sculptural situations and constructions allow one to investigate the landscape from within rather than externally. A landscape is never in stasis, any apparent stillness is still buzzing with activity, be it man-made or natural, human or machine instigated. In more ways than one the landscape, or at least our idea of a landscape is an image. The physical distance between the observer and the observed, somehow dilute the immediacy of time and slow down the pace at which movement is perceived. In a way, the landscape is a slow-moving image. Think about Douglas Gordon's 24 "Hour Psycho" (1993), for instance, where the motion is there, the viewer is aware of it but the element of time is stretched in a manner which takes it out of human scale. A landscape is an image in the sense that it might share the same sky with another landscape. Of course the sky is not really part of the actual landscape. However if we try to imagine a landscape, actual, virtual, reproduced or experienced and try not consider the sky as part of it we would find that this is not as simple as it might initially seem, as because we tend to think of the landscape in terms of image, the sky can never be really omitted from the equation. One does not think of sculpture in terms of sky, or horizon. Sculptural work's borders are always somehow defined and measurable on a human scale. The image however is perceived as potentially infinite. Horizon lines, depictions of the infinite and vanishing points always work better in terms of image than in other aesthetic terms.

7.21 Sonic Objects (2017)

Sound as discussed in the previous chapters is a physical force, an energy wave that is continuously present in the world, an intrinsic part of our daily lives.

Our predisposition to process the visual first, make it at times problematic to consider the sonic element as physically tangible. In sculptural terms sound can be approached in multiple ways. The concept of sound sculpture in itself is the basis of audio synthesis where the sound wave is shaped or formed. Both audio synthesis and sculpture share similar methods for shaping matter such as additive and subtractive processes. However, as discussed before, our reconsideration of sound as a signal in the middle of the previous Century (Thompson 2002), always makes the idea of audio synthesis two-dimensional and flat. The sound wave which is usually visualised as a wave plotted against time, which flows in a single direction, typically from left to right is in itself a direct consequence of the Western world's manner of reading. Even in audio synthesis the signal path and modifiers are arranged in a linear fashion and whilst this is obviously practical in music-making, it can perhaps feel counterintuitive to sculpture. In my previous research I had looked at the idea of shaping sound by investigating the relationship between sound and form (Galea, 2013) and at the idea of physical, non-linear and perhaps non-musical ways of engaging with sound (Galea, 2015). Whilst to a certain extent I had conceptually devised numerous approaches for intervening sculpturally in sound within the traditional or conventional use of the term sculpture, where matter is physically manipulated in real time, in practice however, this has always been somewhat elusive.

Stemming from the ideas on the relationship between form and time that were developed during the "Soundwave Sculpture" (Appendix 2), the idea behind "Sonic

Objects" (Appendix 14) was to find ways of compressing all the volumetric data into a single instance, what I have previously referred to as 'time zero', where all the volumetric data in terms of distances are recreated simultaneously, creating a physical object made out of sound.

The approach for "Sonic Objects" also borrows elements from previous research and interest in the areas of holography, audio holography and physical sound visualisation. The project in itself, in the initial phase, looked at creating and controlling sounds in order to create imagery on an oscilloscope. This direction had been previously explored during the initial stages of this thesis when working with the notion of 'interactive holograms' (Appendix 1). However, the visual patterns that were being created whilst fascinating to look at for a while, appear too arbitrary. There was also no real way to demonstrate that these were not being randomly generated by the computer. This problem kept rearing its ugly head repeatedly throughout this project. After building patches with Max MSP and making use of VST oscilloscope plugins, my research directed me to the work of Hansi Raber, and Jeroboam Fenderson (Visnkic, 2016) musicians who make what they call 'Oscilloscope Music' which is music that when played through an oscilloscope, creates visual imagery. Raber and Fenderson also developed a software program that reverse engineers the process by inputting the images as vectors, that in turn result in sound. The interesting thing about this program is that it also processes object files (.obj), meaning that three-dimensional data and their resulting models can also be processed in this manner. Immediately the immense sculptural potential in this process became evident and a number of experiments and artworks were developed in this direction.

The program was further modified and also coupled with software-based sculptural processes developed for the "Soundwave Sculpture" projects (Appendix 2). Through these modifications three-dimensional data was being processed in real time and streamed through

Blender, a program where one can view, create and manipulate 3D models, directly generating both sound as well as graphical vector images in an oscilloscope (digital version) in real time. The 3D nature of the .obj files also allows for real-time physical and gestural interaction through MIDI Continuous Control (MIDI CC), making use of the same process developed for "Soundwave Sculpture", resulting in an interactive object, made out of sound that can be manipulated and acted upon in real time through physical action.

The major problem with this process, however, is that the sonic objects created, can only be 'seen' on a screen. Our relationship with the screen gets in the way of what it is that we are being confronted with. Irrespective of whether the screen is analogue or digital, what we have come to expect out of a screen goes beyond what can be safely considered bad, low resolution, vector graphics. The image created is nothing much to look at, and although the object being created here is not visual but sound-based, without the visual element the observer can never access what is being manifested. There is also no real way to relate the sound to the imagery on the screen. The sound itself is very unpleasant and this combined with the low-quality vector graphics make the artwork pretty underwhelming, even though in terms of sculpture and technology what is being achieved is very exciting. Through the screen, there is no way of understanding that the resulting image is made out of sound and even though there is a direct action-reaction brought about by the interactive nature of the artwork, there is little if anything to indicate what is being intervened upon through the screen.

This problem and the desire to overcome it pushed this research in more physical directions. Experiments were conducted with a wide range of loudspeakers in order to create a physical and tangible relationship between the sound and the form of the sonic objects. It is important to stress that the sonic object in itself is made out of sound and as such does not

really need visualisation. In this case the visual element is utilised for confirmatory purposes, in order to understand what is being created. As we have no real understanding of the difference in terms of sound between one sonic object and another, for instance between a cube or a pyramid, visualisation of some sort is sought in order to give the observer something to measure against, a point of reference. Placing a screen takes away the attention from the auditory and makes it hard to determine the relationship between the sound and the form that the sound itself is creating.

By making use of large subwoofers one may actually feel the changes occurring in terms of sound. The motion can be clearly felt and physical effects on objects can be observed, for instance, panes of glass vibrate and rattle, following the sound from side to side. Through physical engagement with the environment, one may feel the presence of the sound, and through interaction, even though the pitch does not really change, one can definitely feel the motion, the rotation, which is due to the differences in phase.

The way that these sonic objects work is similar to how a laser works. Being a pressure wave, sound is constantly radiating from the source in the same way that a laser beam radiates from its source and is only made visible through hazing or fogging or when there is something physical to stop it and make the laser visible as a point or a dot (or whichever shape the laser is being projected with). For sound however, this does not work in a similar manner as having something to block the sound would either make the object blocking the sound vibrate or create more reflections. There is also the issue that the sound is being created as two signals, a stereo field as the oscilloscope or the vectorscope plots the signal in an X-Y configuration. This configuration was repeated with a pair of loudspeakers that were arranged in an X-Y configuration at 90 degrees to one another. On the cone of the speakers, a small mirror was attached, and a rig was created where a laser pointer hits the first

mirror, reflects on the second mirror than bounces the resulting imagery on a wall or on a screen. The resulting image, although a physically recreated, does not really correspond to what is being shown on the screen. Oscilloscopes and vectorscopes allow for finer tuning of multiple parameters of the image, and the number of variables that I was working with are perhaps too large to point at a specific reason why the image on the screen and the physically recreated image do not match.

The setup aimed to recreate the way that commercially available lasers work, where the laser beam bounces off a mirror on a stepper motor that allows lasers to generate vector imagery. My idea was to recreate this, replacing the stepper motors with speakers, making use of the speaker cone's travel up and down as the sound passes through them. I had initially carried out an experiment using one laser and one mirror that had produced promising outcomes. A latex glove was stretched on a PVC tube used for water drains in plumbing. A mirror was glued on the stretched glove and a laser pointer was fixed to point directly at the mirror. By speaking into the tube or placing the tube in front of a speaker, the glove, acting as a membrane vibrates, this resulting in Lissajous-type images being projected from this contraption onto a wall (Appendix 14.3). Whilst creating interesting imagery, akin to John Whitney's experiments in motion graphics (Yongblood 1970, p. 191; Paul, 2016, pp. 11-12) this experiment did not recreate the imagery that I had been aiming for.

Further research and development in this area, also by other individuals on Hansi Raber's and Jeroboam Fenderson's original work resulted in a number of variants such as Ted Davis' X-Y scope, which is a processing library which allows to render graphics on a vector display (Visnjic, 2017) making Raber and Fenderson's original work open source and more manipulatable on the more open Processing software platform. By modifying these Processing libraries and sketches I was able to create real-time imagery on the (digital)

oscilloscope through a live camera feed (Appendix 14.2). This opens up new possibilities for the directions that the "Sonic Objects" project could take, that will most definitely be explored further in the future.

In the piece entitled "Sharp Shooter" (2018) (Appendix 14.6), I combined the idea of a sonic object with the aesthetic direction that I had previously taken for "Point and Shoot" (2016) (Appendix 7) and "(Re)Diffusion" (Appendix 11) where firearms and mass media were being looked at for their similarities. "Sharp Shooter" completes a trilogy of sorts by tackling the relationship with the television, whereas "Point and Shoot" looked at the camera, and "(Re)Diffusion" looked at the 'rediffusion' that perhaps, to a certain degree stands in for the radio.

"Sharp Shooter" consists of an old Sharp CRT flat screen television, on a stand opposed by a power washer gun, that had been sprayed black to look more menacing, mounted on a stand. On the screen a simple form like a cube or a torus (which is a doughnut-shaped solid) was constructed from a 3D model .obj file and recreated in a stereo field utilising the process developed for "Sonic Objects". A wireless accelerometer, similar to the one that was used for "Soundwave Sculpture" (2016), "Sculptural Situation for Articulated Lamp" (2016) and "On the Rocks" (2016) was utilised. Being an object made out of sound, parameters from the 3D model were mapped to separate axes on the accelerometer via MIDI CC (Continuous Control). The resulting sculptural situation is to some extent a reversal of the roles as experienced in "Point and Shoot" and "(Re)Diffusion" where it is the means of mass communication, the television that is at the receiving end of the gun's perceived aggression. By pointing the gun at the television, the motion in 3D space, observed on the screen and also through changes in phase and direction in the stereo field through the television's speakers is controlled. Pointing the gun at the screen results in a change in motion across three axes,

corresponding to the motion in 'physical space' as initiated by the user. In a way the sculptural situation acts as a mirror with added depth, the motion on the screen and those initiated by the user are tethered, and feed back to each other with the resulting changes being determined by the previous changes and so on (Appendix 14.6). The television, traditionally a one-way communication system is converted into a two-channel communication stream, a two-way conversation with the audience and its surrounding environment. "Sharp Shooter" is in more ways than one, an open-ended project and as such only exists as a proof of concept, a prototype that tests the technology. Another layer of content, meaning and relationships with the audience through the form of the sonic object displayed on the screen can add more depth and layers to the sculptural situation, and the next step for this project is to go beyond the neutrality of the imagery presented by the cube and the torus.

7.22 Final Thoughts

I would define my practice, as previously stated, as a product of its age, a progressively expanding amalgam of odd bits and pieces that were coloured by the context and the environment that I inhabit, as well as the experiences assimilated over time within this environment. What I find fascinating, is that even though my area of research and practice is not what one could call mainstream, even within the arts, and under the umbrella of the digital arts, many works, at different points in time, produced by others under different conditions, ideas and contexts share very striking similarities. Grau (2016) remarks that the digital arts have not even come close to 'arriving' to society (2016, p. 31) even though they are indeed products of society. As Pollock (1944) remarks, certain preoccupations are perhaps universal, and perhaps this might be extended to our relationship with technology (Huhtamo,

2016). This results in scenarios, where if indeed one looks hard enough, one may discover that even in the most obscure of practices and research interests, stunning similarities in technologically inclined artwork occur, even if developed entirely independently from one another, perhaps in different times, in a different place and through different methods.

Through this research I became aware of numerous practitioners with whose work I find tremendous similarities in my practice, even though these works preceded mine, at times even by four decades, and were developed in completely different contexts; temporally, technologically and geographically. I was never aware of these practices until I researched technological precedents or theoretical frameworks with which to approach the work that I had developed.

The interesting thing that I seem to share with these artists is their influences: John Cage, Harry Partch, Pierre Schaffer, Nam June Paik, Steina and Woody Vasulka, Marcel Duchamp, Jean Tinguely and others. Both Grau (2016) and Huhtamo (2016) comment on how we have practically lost the last fifty odd years of development in 'new media' art, which Manovich (2013) attributes to a frenzy of technological acceleration, that puts 'older' technology in obsolescence well before its limits or potentials have been explored. For the past ten years, we have been witnessing a renewed interest in older technologies (e.g. video, tape, vinyl, analogue photography, analogue synthesisers amongst others), that many practitioners feel have met their end prematurely and have a lot left to offer. Perhaps my own practice is in the direction of a natural progression of this momentary pause, or a re-discovery of directions lost in this developmental stasis, where technology has indeed moved forward, but only in terms of producing smaller, more efficient and more interconnected versions of the previously available technology. Globalisation and internationalisation play an important

role in being able to start asking these questions and observing this situation. The internet as an archive of human knowledge, achievements and its questions was essential in order to individuate the practices of the artists I shall discuss briefly. The internet was also instrumental for the development of my practice, acting as a hypermediated repository of interlinked knowledge that cultivates a strong sense of 'learn it and do it yourself' which is an integral part of my approach to art-making.

With this comment, I do not mean to suggest that we have somehow stopped developing, or that I have (re)discovered some unfinished path, quite the contrary. My observation is that some ideas that we have on an artistic practice which is dependent or co-dependent on technology have hidden links that are or could be more meaningful than the ones previously attributed to it. It seems as if our relationship with technology has developed into some sort of cultural form that is beyond the specifics of any individual technology and that is capable of permeating across multiple levels of society.

Many key writers that deal with technology and history within an artistic context such as Burnham (1968), Youngblood (1970), Manovich (2001, 2013), Gere (2008), Paul (2016), Grau (2016) and Huhtamo (2016) emphasise technology's roots in military application and the Cold War as the context that the avant-garde at the time responded or reacted to. Both Youngblood (1970, p. 191) and Paul (2016, pp. 11-12) mention the work of John Whitney in the late 1950s who utilised a WWII M5- Anti Aircraft Gun to build an 'analogue computer', later combining it with a more modern M7 to build a monstrous 12-foot device that Whitney built in order to experiment in multi-axis motion graphics. Whilst it is perhaps inevitable to find links between military technologies and Whitney's work, I would argue that this might not be the sole driving factor that led Whitney to produce such work. Other cultural factors

such as how man relates to technology might have played a more central role. In my work "Point and Shoot" (2016), which on paper might sound very similar to Whitney's work, practically almost an inversion of Whitney's work, as he dismantled a gun to build a computer, whilst I somehow do the opposite. When it comes to my work, however, all nuances that have to do with military and the Cold War do not really hold much water. I was born at the end of the Cold War, in a country that was so far out of the conflict that the treaty that effectively ended the Cold War was signed in the waters off its coast due to its perceived neutrality. Before I had been aware of Whitney's work, I had developed even more remarkably uncanny aesthetic similarities to his work through the "Sonic Objects" (2017) project and earlier through the experiments in interactive holography (2015). In "Sonic Objects" I was looking for analogue/mechanical ways of rebuilding the generated imagery, as the digital platform, I felt, diluted its purpose and impact, which essentially led me to the neighbourhood of where Whitney had arrived with his experiments in multi-axis motion graphics.

Perhaps it is our imagination, in terms of how we understand technology's power to act as a universal denominator that allows us to build the new, by assembling from different unrelated parts that technology and more specifically computers allow us to access and manipulate from a single standpoint.

This is further echoed in the relationship between my practice and that of Toshio Iwai and Paul De Marinis, two artists that Huhtamo (2016) identifies as pioneers in the recent history of audio and visual 'new-media' practices. De Marinis' "The Edison Effect" (1989-1999) and the "Edison Effect Fragments of Jerhico" (1991) both make use of lasers and sound to produce work that is part fictional, and part real, or rather plausible.

"Firebirds" (2004) by the same De Marinis, makes use of technology under a concealed 'low tech' aesthetic guise. Similarly, Iwai's body of work mixes the old and the new, the ordinary with the extraordinary apart from merging modalities of art-making. "Music Insects" (1990) for instance, is part game, part computer animation, and part musical instrument. In this piece Iwai creates an interactive, visual and tactile musical interface that eventually led to Iwai's development of "Electroplankton" (2005) for the Nintendo DS console and the "Tenori-on" (2007) a musical instrument developed in conjunction with Yamaha (Huhtamo, 2016, p. 90).

Huhtamo (2016) uses interesting terms to refer to Iwai and De Marinis' practices. He quotes Masato Shirai in referring to Iwai's work as "astonishment art" (Moriyama and ICC, 1997, p. 16, as cited in Huhtamo, 2016, p. 91) where Huhtamo looks to the idea of 'natural magic' "…a cultural phenomenon dedicated to demonstrating human ingenuity through technological marvels" (Huhtamo, 2016, p. 93).

Perhaps more than other fields and areas of human enquiry and activity, art has the power of changing the ordinary and the mundane into something extraordinary, and this has always been a prime motivating factor in my practice. Huhtamo (2016) continues by referring to De Martinis as a 'thinkerer' a kind of artist-inventor whose practice and interests go beyond the idea of 'circuit bending' understood as "Software and hardware hacking and media activism" (Huhtamo, 2016, p. 96). The use of the term 'thinkerer', here implies an approach to thinking through doing, again linking to Clake's (2008) idea of toolmaking as a cognitive scaffold, a manner of understanding one's world by simplifying it, by breaking things down and looking at how the individual pieces are coming together, so that they can be modified and transformed, in order to make the leap from ordinary to extraordinary.

This, however still does not shed light on the similarities between practices and practitioners that develop similar or at times practically identical work without being aware of each other's work. I have found this initially frustrating and problematic, albeit somewhat being expected. The problems start to arise in relation to the perceived validity of one's practice, even though most of the time that I encounter work that is disturbingly similar to mine, I do so by accident. As Grau (2016), Fritz (2013) and Huhtamo (2016) mention, most of the historical records of 'new media' work of the past fifty years are long gone, living perhaps only in the memories of those who made them or witnessed them first hand. When these do surface from time to time, they usually do so through channels other than those usually utilised for academic research and/or artistic practice.

Technology and its relationship with the arts, as discussed previously, is not a race. Iwai's development of "Sound Lens" (2001) does not reduce the validity of my own "Point and Shoot" and the drone-based "Landscape Instruments" (2016), even though they are perhaps ideologically identical in what they set out to do and what they achieve, albeit through different means. With such reasoning, there would be no oil painting after Van Eyck and no marble sculpture after antiquity. Earlier I have written that this felt somewhat expected. Whilst working on certain artworks I often get the feeling that someone must have already thought about this, sometimes the ideas and the technology involved are so simple, that one cannot imagine a scenario where these thoughts would have not occurred to someone else in another place and another time. Huhtamo (2016) explains this phenomenon as 'topoi' which he describes as culturally transmitted formulas.

Topoi are used deliberately with specific goals in mind (for example by advertisers and politicians), but they can also appear "accidentally," as if

automatically retrieved from shared cultural archives. The Internet, in particular, is a huge topos storage area and accelerator. Not only are many forgotten ideas and artifacts more easily accessible today than ever before; the speed and extent of their circulation within networked culture have been boosted as well. Simply typing a few words in Google Image Search often reveals unfamiliar associations, even from the distant past. These are recycled for cultural products, not always with awareness of their historical referents. (Huhtamo, 2016, p. 98)

Through culturally transmitted formulas, therefore, one's practice shall always be inevitably linked to the past, not necessarily in a cyclical self-referential motion, but rather as a means of traction. As cultural forms are passed down, they are not immune to the contextual temporality under which they are being (re)viewed. In a certain way new media practices are never really new. Perhaps the media does not really change, it is what we do with it and how we do this that does. Once again it is how we look at things that determines our actions.

8. Conclusion

Soft(ware) Sculpture cannot be considered as a definable genre or movement within either sculpture nor software studies. Like the media it references and the approaches to art-making that the various ideas that constitute it are made of, it belongs to multiple disciplines simultaneously rather than specific disciplines and modalities seen apart. By its very nature a software approach to sculpture is fluid and malleable and is capable of many forms, formats and guises. Concurrent to this research, a practice that makes use of sound as the bridge between software and sculpture was developed. Soft(ware) Sculpture, or the sculptural body of work developed during this research that gives this thesis its title is an instance of sculpture by other means, or on the flip side of the coin software by other means. As described earlier there are no real differences in conceptual terms between software and sculpture as they are both acts of organising information in a manner that is meaningful. The major differences in conventional terms is the data pool from where these processes of creating and making extract the information from.

Information has many forms, our environment is constantly bombarding us with information from multiple directions. Technology aids us in being capable of accessing this information more efficiently, by seeing, listening and feeling beyond what our senses can gather. The processing of information and the structuring of it is what is central to the act of creating, the act of making. The combination of both allows us to understand the idea of sculpture as a sequence of events, a sculptural situation that behaves as an ecology, where everything becomes interconnected, through the assistance of technology that is capable of creating a common ground for a sculptural system to operate, grow and produce multiple versions of itself. Software is what makes sculpture in the twenty-first century alive, sentient

and aware of its surroundings. The process of art-making, in turn, is what combines human, action and machine into a single artwork - the sculptural situation.

Sarah Cook makes a remarkably acute observation on how art and information, or rather the (re)organisation of information relate to one another.

> Tinder, Facebook, match.com - all of these web applications use complex systems to parse and interpret the information we provide in order to sell us back new connections. An artwork…is both a way of lodging and releasing information about something - what is known at a particular moment - and nailing down the possible applications of that information into future ideas and applications. (Cook, 2016, p. 19)

Kac (1992) speaks of art before the information age as unilateral, and with a change in how media operates, the way that art is engaged with changes, resulting in a cultural shift. The contemplative notion of the beholder is replaced with the experiential notion of the user or the participant (Kac, 1992, p. 28).

In the 1960s the arts adopted concepts deriving from cybernetics, specifically the idea of feedback. The way that technology operates, and the reason we know it is operating, and operating correctly, is through feedback, instantaneous feedback, an acknowledgement that our request is being attended to. This develops a degree of expectation in the contemporary art audience, a culturally developed expectation that derives from the devices that we make use of on a daily basis. The arts have recognised this shift and for the most part aim to fulfil, or challenge these expectations. This essentially means that the very nature of art-making has been altered significantly across the ages, and as such whilst art in the manner of the past is still valid within a contemporary scenario, the art made nowadays operate in a different modality. Sculpture, as an area of artistic practice, has developed new modalities, new

formats, and a new relationship with the audience, one which is based on these culturally constructed expectations. The relationship that software has with sculpture therefore, goes beyond the similarities that both have in the way that they conceptually handle information and (re)organise it. Software runs the technology we utilise on a daily basis and as such sculpture is subject to the manner in which software runs our lives. Sculpture has to make adjustments that are imparted by software in order to remain relevant in contemporary times.

Software and its relationship to sculpture understood as a series of interconnected relationships between matter, time, space, technology and audience, has broken sculpture out of its mould. This relationship has brought sculpture down from its pedestal, quite literally, and has forced it to reconsider its own nature. It is somewhat easier to think of software in terms of systems, as sculpture has inherent relations to materiality and the idea of the object that acts within a perhaps unavoidable framework of self-referentiation. All art is inherently self-referential, building upon ideas of the past and on what came before, and as a consequence of this certain ideas are difficult to shake off, or perhaps temporarily suspend, in order to look at things from different viewpoints. Maithani (2013) makes reference to the idea of an aesthetic of failure; glitches, noise and errors that are easier to think of in terms of software, or the digital media, rather than in sculpture. Whilst Cage introduced concepts of chance and indeterminacy, building upon the DADA and Surrealist ideas of automatism and 'happy accidents', failure, in aesthetic terms is not an idea that sits comfortably within the conventional notion of sculpture. Considering that in the past sculpture dealt mainly with physical matter, this could always be patched or fixed, any holes or imperfections filled, seams could be concealed or removed, and if that did not work, one could always start over. Software however within an artistic context thrives on the idea of errors, and glitches. Maithani (2013) remarks how contemporary visual and sonic practices utilise the glitch as a

generative tool in the creation of artworks (Maithani, 2013, p. 105). A software glitch or an error creates space within the medium. Glitches and errors are temporary, time-based, and are unpredictable and continuously threaten to compromise the stability of the system.

> Error or glitch is a break providing a space on which various expressions can be projected…failure confronts the medium with its limitations. It destructures the systems of power and control behind the medium by exposing its gaps and faults. (Maithani, 2013, p. 105)

Within the practical component of this thesis, the glitch and the error became a structural part of the body of work developed, creating a continuous tension between the expected and the unexpected between expectation and 'reality'. In more ways than one, it felt as if the sculptural situations that were being constructed were continuously struggling to stay afloat, errors could occur from multiple factors, from software, hardware, human agency as well as spatial and environmental factors. What is fascinating however, is that these sculptural systems very rarely collapsed, in fact, the few times that this did happen was when everything was behaving as it should have. The glitch within a sculptural situation can be interpreted as the relational system trying to balance itself out, attempting to find a way to stay alive, failing as many times as required in order to succeed in doing so. In more ways than one these errors became what kept the sculptural situation in motion, almost like a hybrid human/digital/mechanical desire to live. Sculptural situations become as a result of this, continuously mutable across time, with no real or correct form, the error is absorbed within and becomes an integral part of the aesthetic. If this were not the case, a sculptural situation would behave like a light bulb, every time it is activated it repeats a function, or some kind of spatialised UI (User Interface) that allows for accessing the contents of software in physical space. This is the exact opposite of how these sculptural situations work. Whilst

their form and behaviour is predictable to a certain degree, the way that every component

transfers information from one end to another is riddled with flaws, errors in translation

brought about by the incongruence of the components that compromise a sculptural situation.

This of course brings to the notion of sculpture a whole new level of relationships to not only

time but also perhaps circumstance. Much has been written about sculpture and its

relationship to the conception of object and materiality, as well as that of dematerialisation.

With the error or the glitch, these ideas are taken to a whole new level as by their own nature

errors and glitches do not necessarily reside either in time or in space and simultaneously

cannot be considered to be totally physical or virtual in nature. These reside in the act itself,

in the process of (re)organising information, in the creation of meaning.

Meaning, or rather the process of meaning-making is based on interpretation;

information is passed from one state to another, or from one point to another, and I would

tend to, or better be more inclined to think of meaning-making as the process of encoding and

decoding such information, a process of translation that becomes embodied, temporarily

perhaps in another format. The medium might not be the message after all, or to be more

precise, the medium can be the message but the meaning of that message is not related to the

medium but rather located both in the sender and in the receiver, as well as the noise which

inevitably gets added onto every time information is passed from one place to another as

originally observed by Claude Shannon in his *Mathematical Theory of Communication*

(1948).

In Shannon's model the information source and the destination are separate from the

transmitter and the receiver. In sculptural terms, the transmitter and receiver can be thought

of as the media, or rather carrier media be they physical, digital, virtual or other. These

inevitably colour or alter the information as it passes from one stage or state to another. The
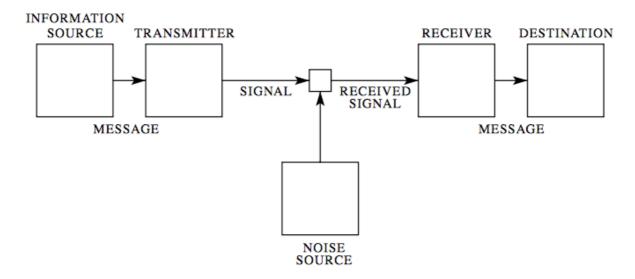
Fig 1: The Shannon-Weaver mathematical model of communication. Reproduced from: Shannon, Claude, and Weaver, W. (1949). *The Mathematical Theory of Communication.* Urbana, IL: University of Illinois Press.

noise source can be considered the artistic intervention, a temporary manipulation or interception of information that sends the signal off-kilter, into another registry of reality. Other sources of noise can be attributed to other factors, such as spatial and environmental noise but also hardware, software and a myriad of other factors that are dependent on the specifics of a time and place. By the time that information reaches its destination, it has been altered significantly. It is the process of decoding the information which is essentially the manner in which meaning is, or at least half of it is ascribed to the information received is informed by the information added or removed through its multiple changes in state. This is also where the glitches and errors most frequently occur, the 'misinterpretation' of information, or information that has been altered to a point where the original content is too distorted to be reassembled in a manner that is understandable by the receiver or destination. In a sculptural situation, hundreds if not thousands of these transfers of information are

occurring simultaneously. Information is 'streamed' in real-time creating a constantly changing network of interconnected transfers of information.

The sculptural situation whilst composed of elements that are physical in nature does not have a stable form or a shape. Behaving like other forms of audio-visual media, the sculptural situation changes across time. However, unlike these media, the sculptural situation expands and contacts as necessary both in physical as well as virtual space, and its relation with time can be considered somewhat arbitrary, with no real notion of duration, linearity or sequentiality. This brings about another challenge to the nature of sculpture, its relationship with the concept of the object and materiality. Hudek (2014) speaks of the idea of the object as something that refuses to go away. Whilst there has been a considerable amount of philosophical debate about the concept of the object and how it relates to that of the subject as stated by Adorno (1969) and whilst ideas of de-thingifying the world have had their fair share of consideration and contestation in the art world, the object Hudek (2014) observes, in many of its forms persists to this day. It is not within the purposes of this research to examine the dialectic between the subject and the object in semantic terms, this has been discussed at length and perhaps can be epitomised in a mail art project entitled "Manipulating the Self" (1970-1973) by the Toronto based artist collective known as General Idea.

> The head is separate; the hand is separate. Body and mind are separate.
>
> The hand is the mirror for the mind - wrap your arm over your head, lodging your elbow behind and grabbing your chin with your hand. The act is now complete. Held, you are holding. You are object and subject, viewed and voyeur. (General Idea, 1970-73, p. 31)

Both Kristeva (1987) and Brown (2001) put forward the notion of the 'thing' over that of the 'object'. The 'thing' as Brown (2001) describes it is the 'the sum of the world' more than an object, a thing is a 'specific object-subject relationship', hovering between the namable and the unnamable (Brown, 2001, p. 58). The thing exists, or rather is or isn't, existing but in no phenomenal form (Brown, 2001, p. 59). The idea of the object perhaps can never really be examined without looking at that of the subject as in order to understand something, we would need to have some form of relation to it. In sculpture this has little to do with the form or material qualities of the artwork but rather on how it is comprehended or perceived as being. Objects can be considered as things that people care about (Miller 2008) working on an axis of familiarity that is defined in terms of knowledge as well as in terms of possession (Roelstraete, 2008, p. 65). Appadurai (2006) proposes the analogy of the gift, as something that contains elements from both the sender and the receiver, something that just is, for an external observer but with different intrinsic value to the parties concerned. The sculptural situation can be considered in this framework as being without essentially being itself and composed of transfers of information that are coloured at both ends. No audience can perhaps fully comprehend all the process occurring simultaneously within a sculptural situation, not in terms of cognition, but rather in that the audience does not have the sensory ability to decode all the individual transfers of information, and is more inclined to comprehend them as a whole. In that manner, the sculptural situation is composed of both things and objects based on the audience's relation to them if the thing and the object are to be considered as equal in terms of what constitutes them (Miller, 2008), and only different in how we relate to them.

One of course cannot speak about object in terms of sculpture without going into the concept of usefulness (function) and uselessness, and of the Duchampian idea of the

readymade that behaves at least conceptually, as an object composed of its own physical material which within an artistic context, stops being a 'real object', becoming its own doppelgänger (Kelley, 1993, p. 80). These definitions come about due to the intrinsic material nature of sculpture. In this thesis sound was utilised as 'primary' sculptural matter, that turns on their head the discourses around the idea of the object and its materiality within sculpture. Interest in sound within the visual arts gained ground through the dematerialisation of the art object. However, as discussed earlier, the notion of sculpture and sound acts on the capability to re-materialise the transfer of information, and aid in its translation from one format to another. In terms of software, sound is easier to convert from one format to another, (through MIDI) and can make intangible processes tangible due to its physical presence and mobility within space and across time. Sound behaves as a carrier vehicle between the physical and the digital dimensions as it moves between both with ease, in a manner that perhaps no other material can. In conventional terms sound carries no perceivable form, however it has close ties to both form and matter. As an act, an event or a motion in time, sound has relations to both the idea of the subject and that of the object, acting as the verb between them, in a way completing the sentence. Similarly, sculpture as an act could be re-considered in a manner where it is neither subject nor object but rather the binding force between the two. Sculpture as software, understood as the organisation of information in order to create the new, to create meaning, and does not work as some sort visual language which is parallel to spoken or written language, and as such should not be considered in these terms. Sculpture, like software, is an act of transformation, an act of modifying the world and finding new meaning within it, rather than simply a means of transcoding data from one point to another. The reasons and motivations for utilising one or the other vary considerably, depending on how each act is employed. Within an artistic context however, both software and sculpture create

meaning rather than pass it on. Utilised in conjunction, software and sculpture have the ability to not only replicate but extend one another into continuously changing new territories that they themselves have the capabilities of creating.

8.1 Limitations and Recommendations for Further Studies

It is beneficial to put in perspective the conclusions drawn within this research and the implications that these might have in further studies. This research was conducted in parallel with a number of practical research projects and experiments that play an important role in the rationale behind this research. My practice as a sculptor with a background in Fine Arts places my approach as one that derives from a very specific angle, and whilst I was conscious of the biases that this could, and indeed undoubtedly has, coloured my research, such biases are intrinsically intertwined with the very nature of the research question. My approach to sculpture is, like that of any other practitioner within the arts, a personal one, and my understanding and approach to sculpture play an integral role in how this research was conducted. The context under which this research is conducted also undoubtedly forms the outcomes and the deliverables of this research. As a relatively geographically isolated small island nation, Malta has a small and often limited arts scene, and whilst a number of ideas developed during this research and a number of artworks were presented abroad, it has been hard to receive feedback and share ideas other than with my supervisor and a small number of artist peers.

The area within which this research is conducted has virtually no representation in the local art scene and it has been hard to concretely gauge my progress. Whilst through the Internet and through attending conferences overseas I am capable of remaining abreast of any

development within my area of specialisation, the nature of the work through its relationship with technology makes it very fast paced, and also difficult to document in its entirety, therefore hard to get a grasp of when viewed solely through documentation. The area within which this research has been conducted is also an ambiguous one. As described by both Grau (2016) and Huhtamo (2016) most of the work within this field has been lost, due to obsolescence in the technology under which such research and the resulting artworks have been created. Technological obsolescence comes at an alarmingly fast pace and it is to be expected that most of the technical work carried out within this research, as well as the platform upon which the resulting artworks work on, shall become obsolete, or rather shall be considered as such within the next five to ten years at best, based upon the current pace of changes in technology.

Other limiting factors that have to be acknowledged have been monetary and resource constraints. A number of artworks with good potential had to be shelved, either because of budget constraints or lack of resources and facilities needed to develop these further. Whilst it is true that when dealing with technology the sky is the limit in monetary terms, it is however unfortunate that certain projects had to be left undeveloped for such reasons. A number of potential leads were also archived in order to focus my resources and time better. A number of ideas that were beyond my financial and resource capabilities I could have added significantly to the outcomes of this research both artistically as well as conceptually. It is my intention to secure funding in order to continue developing these ideas in the future.

The conclusions drawn from this research are for the most part theoretical, derived mainly from reflections upon the (re)adaptation of ideas developed previously in this area, combined with the sculptural body of work that have empirically placed theoretical discourse of software and its relationship to sculpture in practice.

Throughout this research it has been observed that whilst the area under focus is still vastly unchartered, it has been touched upon by many, albeit in a patchy manner that has never received the sustained amount of focus that it deserves. Certain ideas and approaches have been around since the early twentieth century, and whilst a number of individuals have attempted to unify these ideas in a coherent ensemble, the multiple overlapping disciplines involved or rather touched upon at least partially within this area of visual arts practice make it exceedingly complex to navigate. It is recommended that further research of this nature from different angles and approaches - sound studies and musicology, the performance arts, software studies and the social and cognitive sciences be conducted in tandem to obtain a more unified, and balanced understanding of the subject at question. A holistic approach can perhaps be beneficial in understanding how to better conserve and preserve such artworks. By adding an element of temporality to sculpture, one also inevitably adds the notion of a life-span, both of which are supported by the ephemerality of current digital technology. Whilst I am personally not against the 'death' of an artwork, and see it as an inevitability that comes with its newly constituted nature, in order to progress, in order for there to be material for art to reference itself, a concrete method(s) of preservation or perhaps a theoretical framework for one to exist should be developed.

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Appendix (USB Drive)

A USB flash drive is attached to this thesis. The following appendices incorporate audio-visual documentation of all the projects and experiments carried out during this research as well as other supporting material in digital format. Should the USB flash drive get lost, or corrupted, please contact the author for a new version.

Appendix 1 Optically Triggered MIDI Generated Visuals

> **1.1** Developed Software

> > **1.1.1** Simple Audio Visualizer

> > **1.1.2** Generative Audio Visualizer

> > **1.1.3** Generative MIDI Visualiser

> > **1.1.4** MIDI Drawing Generator

> > **1.1.5** RGB Audio Synth (Optical Theremin)

> > **1.1.6** Gesture Controlled Video Mixer

> **1.2** Screenshots From Software

> **1.3** Video Documentation

Appendix 2 Soundwave Sculpture

> **2.1** Audio-Visual Documentation

> **2.2** Screen Videos

> **2.3** Audio Projects

> > **2.3.1** Drone Project

> > **2.3.2** 3D Printer Project

Appendix 3 On the Rocks

> **3.1** Exhibition Poster

14.9 Sound casts

14.10 EEG Experiments

      14.10.1 Audio-Visual Documentation

      14.10.2 Data Files

14.11 Other Projects and Experiments Description