SCULPTING SOUND WAVES

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Abstract

Sculpting Sound Waves is a project that attempts to extend the idea of sound sculpture into a tangible physical dimension. Making use of 3 axis, Cartesian coordinate machinery such as CNC, 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 augmented by digital technology, create a two way, back and forth motion between the physical and digital dimensions. 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 way that multiple variants such as interpretation, arrangement, place and audience can alter the experience as experienced by the audience. 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.

Keywords: Sound Sculpture, Hybrid Interfaces, Software & Sculpture, Constructed Scenarios, Real Time Sculptural Interventions.

Introduction

Sculpture is a social and 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 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 rather 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.

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 a rejuvenated level of sustained activity and progress. It is important to note how reference is being made 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 media and has recognised its position as a socio-cultural artefact, a process, an intervention in meaning and reality, rather than an intervention in matter. This dematerialisation between the process and its medium is what makes sculpture a key processes for the first part of the 21st century, 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 in terms of image, even though one usually interacts with software through images on a screen, which acts as some kind of 'dimensional window', 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 within the artefact, becoming part of it.

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 make 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'.

Sound as Sculptural Media

Sound, as a sculptural media presents a unique set of relationships between space, time, the audience and the artist. Sound unlike traditional sculptural media is measured against time, it can expand and contract in space as needed, can bounce against walls and go around corners and essentially occupies any volumetric space it is set in.

One my also talk about the aesthetics of sound and its physical characteristics, however manipulating sound or rather understanding it sculpturally posits a different set of problems that as visual artists, we seldom think about. One may modify the shape of the wave, however sound is much more than a pressure wave. The way we understand, visualise and interact with sound is dependent on graphical user interfaces and visualisations that has perhaps permanently tainted the mental image/construction one has with sound as a volumetric media.

Thompson (2002) remarks how sound has, through analog circuitry, been reconcieved as a signal. Sound however is not a signal, it is a force, a form of energy which, albeit possessing no perceivable mass, and therefore not at first glance, the prime candidate for sculptural matter, has the ability to affect objects and volumes made up of physical matter around it.

This approach requires a modified perspective on artistic intention and intervention, the idea of the artefact as well as the relationship between the audience and the artwork. The artefact, the sculptural object can no longer be considered as a static object, set on a plinth or a pedestal in a galley, public space or an artist's studio. The artefact resultant from sculpting sound is a system of relationships between a number of elements that come together in space and time to form a spatial and temporal

montage as described by Manovich (2001), resulting in an artefact that is fluid and constantly changing, an artefact that to a certain extent determines its own presence and appearance.

The structure of these artefact systems make use of continuous translations from one state to another, going from physical to digital/virtual processes depending on the structure of the artefact. This is 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 sculpt in matter but rather sculpts scenarios, constructions, similar to a musical composition in the way that even though a composition has defined elements within it, multiple variants such as interpretation, arrangement, place and audience can alter the experience as experienced by the audience. These constructed scenarios become relational systems are made up of multiple incongruent elements; objects, sensors, spaces, software, audience and actors which can be both human and non human, living or non living (Gaudenzi, 2013). 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.

Digital technology has opened up numerous possibilities within the arts, allowing for a multitude of incongruous elements that are located in multiple points in space and time and that engage with the world around them using different scales and measures to come together in a single experience that can be manipulated and articulated in real time.

Software and Sculpture

The idea 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 or artefact 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 analog 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 idea of ploy media within the visual arts comes from the dematerialisation of the art object, the dematerialisation of the artefact, a direct consequence of visual art performances in the 1950-60 and later through video art 1960-70s. (Meigh-Andrews, 2014) This dematerialisation or rather detachment from the idea of having to create an object, whilst not new in any way (music, theatre, literature) changed the visual arts profoundly. As a process sculpture took more time to break with matter, and to this day one may argue that most sculptural output is entirely dependent on matter. I would tend to disagree on this point; sculpture is an intervention in time and space, where apart from sculpture many other things reside including obviously matter, however sculpture is not necessarily matter dependent. Through digital technology and the dematerialisation of the art object, sculpture is no longer just spatial, present in space but static in time, but rather spatio-temporal. As stated before I look at 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. One must also address the idea of space and how the integration of physical and digital spaces modify our relationship with media.

The Idea of Space in a Digital Age

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' or digital/virtual space, 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)

Anders and Sheridan's (2001) idea 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, or perhaps limit, the individual's concept of space. Cyberspace, therefore can be understood as a dimensional environment or perhaps a dimension within the idea 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. (Anders & Sheridan, 2001, pp. 2-3)

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 (2001, 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).

Spatial Practice and Narrative

Audio visual media are to a certain degree, at least in the way that they have been traditionally utilised, 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 traveling in the same direction, at the same speed though 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. This approach to audio sculpture challenges the idea of a continuous flow of time, as whilst time is - by conventional standards flowing in a single direction, sound as a temporal medium is being spatially manipulated and its time is being modified. Tempo changes, reversal of the playback, elongation and stretching of time as a whole and in parts can be directly and physically intervened upon.

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

Deleuze (1986) speaks 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 Mc Luhan (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, it's 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)

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. In simple terms the audience experiencing an artefact system is capable of weaving their own individual narrative, which is not necessarily media dependent, the intervention in itself can be devoid of narrative, however the relationship formed with the artefact system will always in some way or another be of a narrative nature.

The space itself is also crucial when one thinks of aural interventions. 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 no imply that aural based artefacts are always created with a particular space in mind, but rather 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 of the creation of a specific 'place' within space and time. (Anderson, 2012)

Bal (2008), observes how the audience's movement through space and the temporal sequentiality involved in a gallery visit, makes 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 rater 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), or, as described by Herman (2003) *"making sense of stories" and "stories as sense-making"* (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.

Soundwave Sculpture

Sculpting Soundwaves is a project that attempts to extend the idea of sound sculpture into a physical/ material dimension. Making use of 3 axis, cartesian coordinate machinery such as CNC, Milling Machines and 3D printer, this approach makes use of volumetric space as an interface with which to manipulate soundwaves. Combined with software and digital processes, this creates momentary spatio-temporal constructions in physical space which are augmented by the digital technology, creating a two way, back and forth motion between the physical and digital dimensions.
Operations initiated within physical space trigger process in the digital space which in turn feeds back into the digital space manipulating the sonic matter in physical space.

This approach allows for more complex in 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 imagery and moving image.

By recreating this volumetric interface to engage with sound and reproaching sound as a physical entity rather than a signal, one has the capacity to form a new relationship with sound, or perhaps how one visualises sound.

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 behind it. Musical instruments are to a certain extent sculptural by nature, however, they are not necessarily spatial. A musical instrument occupies and is present in space, however, does very little to engage with it. Approaching sound as a series of motions in space rather than a combination of key presses or strings 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 removing 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. The ‘absurdity’ of using industrial machinery, associated perhaps with different kinds of sound, 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, or rather 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 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 of it.

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 creates 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 rather 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 besides 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 perhaps supports in more ways than in other more conventional approaches to sound is the idea of simultaneity. Much like the way life is experienced on a daily basis, aural, visual and the 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 perhaps considered more physically grounded, more engaging and to a certain extent more inclusive, as there a 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, 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 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)

Sculpting Sound Waves, 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 artefact, 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.

This process is essentially a translation, a translation 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 to this, 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 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 however, that allow for the generation of new meaning and allow 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 perhaps 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 automations and processes as well as sending data to Arduino to move stepper motors, are all possibilities that this process can initiate and that the current author is currently experimenting with.

Combining technology, or rather software with sculpture opens up back and forth conversations with and within media and also within physical and virtual dimensions. In more ways then one this can be seen as an augmentation of sculpture, in the same manner as Augmented and Virtual reality processes. What is hoverer 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, the environment around them, which hinders the growth of a series of relationship both physical and digital that we form with the artistic intervention.

What is being attempted here, through this project, is to create rather than sculpture itself, as intended in the more conventional understanding of the term, scenarios for sculpture to occur. Sculpture as intended in this manner is a spatial moment evolving across time, continuously fed and manipulated by the same structure that supports its existence. It is perhaps the manifestation of a sonic body, or sonic matter which is brought in evidence, rather than through its effect on space, by the way that motion in space engages with it.

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