THE UNIVERSITY OF
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Wave form, wave function.

Michael Petchkovsky.
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Statement

This volume is presented as a record of the work undertaken for the degree of Master of Fine Arts at Sydney College of the Arts, University of Sydney.

Abstract

The project *Wave form, wave function* is conceived as an examination of the relational dynamics of form and function in contemporary implementations of electronic media in the visual arts.

Creative work comprising installation of digital and analogue media equipment, projection of live rendered and pre-programmed immersive computer graphics, high energy kinetic and video sculpture - in relational configurations, leads the research.

The electronic media being intrinsically signals based, consideration is given to a broad definition of the signal encompassing electronic analogue waveforms, digital encodings, programmatic flow control structures and semiotic and language based signal exchange. The electronic media are considered as rhetorical devices that use an expanded language of visual and procedural rhetoric in their processes.

The project is premised on a position that considers scientific realism to be a questionable basis for understanding. Quantum physics has demonstrated the entanglements of matter and energy, of object and observer, as relational and transmissible, somewhat magical processes. In this context aspects of form and function in the produced artwork are discussed as poietic work, the process of engaging in ongoing cultural discourse that is world building. A poetic license is allowed in translating between the literal and literary as Scientific Realist and socially constructed models of reality are compared. Noesis, knowing and being in the world, is examined for how contemporary artists employ technoesis, that is cultural production through technological media.

Such work is considered as sympoietic, evoking symbiotic, hybrid modes of poiesis. Working with contemporary electronic media in the visual arts entails a grasp of the nature of the medium that extends to the metaphysical.

Underpinning the project is software based in open source.

Acknowledgements

My heartfelt thanks go out to Joyce Hinterding my academic supervisor for this research project, and to Robyn Backen for associate supervision, to Sarah Buick for encouraging me to attend art school in the first place, to Sylvia May my mother, to Scott Barnes for encouraging me to undertake postgraduate study, to David Haines for his friendship, to Liz O'Rielly a fellow traveller, to Derek Carter a partner in crime, to Alex Gereg a collaborator and a good schemer, to Rachel Petchkovsky for the dreams of flight, and to Anne Noonan for the cups of tea and yarns.

Foreword

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/* This document has been produced, laid out and
    * typeset with LaTeX, http://www.latex-project.org
    *
    * I would like to acknowledge the role that open source
    * software has played in meeting the digital production
    * needs of this research project.
    */


\begin{document}
   \frontmatter
   \title{Wave form, wave function.}
      \author{Michael Petchkovsky, MFA candidate, Sydney College of the Arts, University of Sydney.}
      %\date{\today}
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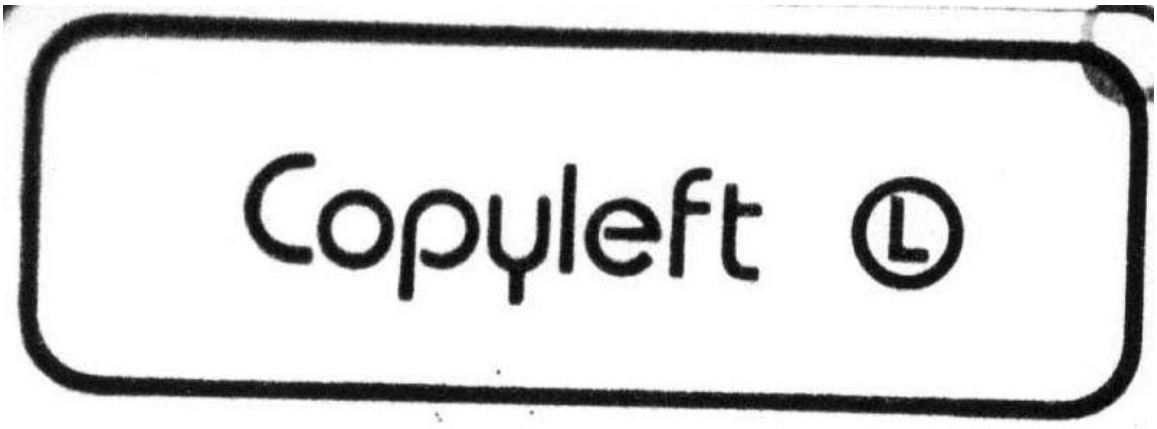
"In the long run, making programs free is a step toward the postscarcity world, where nobody will have to work very hard just to make a living. People will be free to devote themselves to activities that are fun, such as programming, after spending the necessary ten hours a week on required tasks such as legislation, family counseling, robot repair and asteroid prospecting. There will be no need to be able to make a living from programming."

Richard Stallman, *The GNU Manifesto*, 1985, accessed September 26, 2015, http://www.gnu.org/gnu/manifesto.html.



The copyleft sticker,[http://www.gnu.org/graphics/copyleft-sticker.en.html] obtained from a science fiction convention[cf. Sam Williams, *Free as in Freedom* oo*(2.0): Richard Stallman and the Free Software Revolution*, (Boston, MA: Free Software Foundation, 2010), p 129.] by Dan Hopkins and placed on the back of an envelope that inspired Richard Stallman in describing "a general method for making a program (or other work) free" by reversing a conventional attribution of intellectual property rights.[http://www.gnu.org/copyleft/copyleft.html]

Contents

Introduction

"If you think you understand quantum physics, then you don't really understand quantum physics."
Richard Feynman, apocryphally quoted.[1]

It is a fundamental tenet of quantum physics that the substance of the universe exists and behaves both as particles and as waves. Particles are understood as discrete pieces of solid matter at the smallest possible scale of subdivision, that interact according to their properties in their paths through space, that collide and clump together to form the macro-scale stuff that surrounds us and that we ourselves are composed of. Waves are vibratory energetic phenomena with structure (crests and troughs, frequency and amplitude) that propagate through space, that may merge in additive and subtractive interactions and that can form standing wave patterns that are localised in relation to one another and persist over time - this patterning constitutes macro-scale structure, and again corresponds with the stuff that surrounds us and that we are composed of, built of energy rather than built of solid particulate building blocks. A cognitive dissonance occurs when we attempt to reconcile this wave particle duality. Waves and particles are irreconcilably different things, and yet quantum physics definitively demonstrates[2] that all things that exist and that we experience in the universe are both of these irreconcilable things

[1] The physicist Richard Feynman is often quoted for his colourful and layperson accessible public speaking on complicated matters of contemporary science. I have heard this quote attributed to him on many occasions, in high school science classes, from pop cultural sources and during casual conversation. Whilst in some discussions it is taken to mean that one should not even attempt to understand or discuss quantum physics, it more properly encapsulates ideas about the inherent uncertainty about the universe that quantum physics demands. It speaks to cognitive dissonance and knowledge claims in general as well. Enigmatically, when I went to properly reference the quote I discovered that although the words are bandied about and indeed are commonly attributed to Feynman, there is no definitive public record of him actually writing or saying them. In the spirit of setting out with an open mind to uncertainty, and an ear to science-ficto-criticism, I include the quote epigraphically here as apocryphally attributed to Richard Feynman.

[2] The classic dual-slit experiment in quantum physics, described as the 'most beautiful experiment' by readers of *Physics World*, in 2002, (cf. Robert P Crease, "The most beautiful experiment", *Physics World*, (September 1, 2002), accessed December 10, 2015, http://physicsworld.com/cws/article/print/2002/sep/01/the-most-beautiful-experiment), has light, or in the case of Young's most beautiful version single electron matter waves, passing through a pair of closely spaced knife blade slits. The way in which the light behaves on encountering these slits, on passing through them, and on subsequent arrival at suitable detector equipment, demonstrates *without doubt* that the light is simultaneously particular in passing through one or other slit, and waveform in passing through the two separately placed slits at once.

at once. The wave particle duality is not a binary opposition as things are not either/or but one and the other and each at once. The quantum paradigm is therefore suggestive of plural ways of understanding the interconnected, and mutable, nature of things. And that plurality is deeply embedded in the nature of reality and is unavoidable.

There are analogies to be made between the quantum and the contemporary digital. For example a quantum wave function (a particular mathematical description of a quantum wave phenomenon) and its 'collapse' into a localised particle description could be likened to notions of virtual and 'real' reality. The relational coupling of virtual and real being of interest. Such analogies and other literary devices reveal language based, fictive, and procedural, structural descriptive, rhetorical methods of understanding and using the contemporary media. In this paper *Wave form, Wave function* a pun on modernist ideas of the relationships of form and function is made with the sense that in contemporary media one is not bound to follow the other - formal and functional elements are seen to be in interplay, quantum entangled and encoded together in the production and understanding of artwork. In the scope of this research project the construction of virtual worlds, or vignettes thereof, is understood as a way of examining aspects of relational dynamics, through the implementation of technological media, as a process of knowing and being in the contemporary world.

The project looks at contemporary implementation of electronic media. The artworks produced in this project attempt to draw together threads of understanding in the interplays between science and art, technology and art, culture and art that the electronic media present. The electronic media being intrinsically signals based, consideration is given to a broad definition of the signal. Types of signal examined include: Electronic analogue waveforms - where for example I have generated sound tones that are transformed into complex figurative graphic images on analogue waveform display equipment; Digital encodings - where detailed three dimensional representations of landscape scenery has been scanned in the field and reconstructed as live-rendering textured mesh data for interaction; Programmatic flow control structures - where the routines of OpenGL live rendering, the text software code that makes the transformation from digitally encoded mesh data to visual representation, become a foreground visible feature overlaid on computer graphic projections; and Transmission of information as sign in a semiotic sense - where links between language and the device are explored. The electronic media are considered as rhetorical devices that speak to and through experiential, relational, material, rhetorical and aesthetic matters.

This research project is premised on a position that considers scientific realism to be a questionable basis for understanding. Quantum physics has demonstrated the entanglements of matter and energy, of object and observer, as relational and transmissible, somewhat magical processes. Where the paradigms of quantum physics are referenced within this project the intention is that these physics notions be read allegorically, in the sense of literary devices, as much as that they inform our physical worldviews. Similarly I make reference to the field of neuroscience, where our brains are understood to function like computer analogues, with synaptic circuits

running programs between brain areas and central nexus systems. Barbara Maria Stafford[3] talks about neurological models of mirror neurons as running processes that are computed on the hardware of our brain synapses to synchronize and pick congruencies, to make associations in a recursive and feedback enriched manner as we go about being, feeling, saying.[4] Stafford places this neurological paradigm as a contemporary expression of a "general theory that human self-modelling consists in running mostly unconscious and automatic internal simulations"[5] and compares it with Enlightenment notions of "associationism"[6] - our sensory and conceptual engagements with the world.

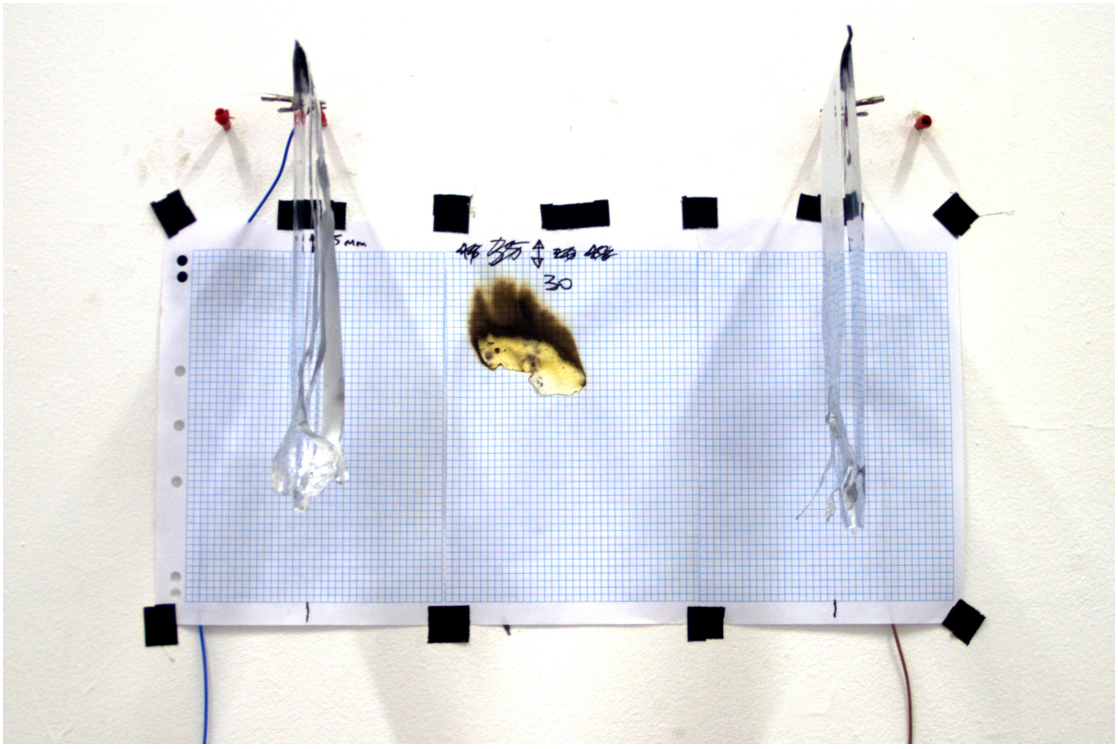


Figure 1: Study for *The Regard of a Motive Force*, Michael Petchkovsky, 2014.

The paper is comprised of three chapters. The first chapter on *Measurement, Sense and Response* takes as its launching point another tenet of quantum physical understanding. That is, that any measurement taken of a real world phenomenon under examination will influence the behaviour of the phenomenon by the presence and application of the measuring device. This

[3] Barbara Maria Stafford, "Hedonics", in *Sensorium: Embodied experience, technology, and contemporary art*, edited by Caroline A. Jones (Cambridge, Massachusetts: MIT Press, 2006), pp 149-153.

[4] Ibid., pp 151-152.

[5] Ibid., p 153.

[6] Stafford identifies the philosophers John Locke, George Berkeley, Henry Home Lord Kames, Thomas Reid and Archibald Alison amongst others as British Associationists, "philosophers of an embodied reality" who contended that sensory engagement with the world is a primary method of knowing and sharing experience and knowledge of the world. Stafford describes this process as "hedonic" and as finding expression for example in the Romantic poetry of William Blake, in her essay "Hedonics", pp 150-151.

relational coupling between subject and object, and between consciousness and physical reality, is ingrained in quantum reality.[7] I present artwork that measures forces of electrostatic attraction and distance of separation for arc initiation at high voltage in free air, installed in such a manner that the audience interactively adjusts the measurement device, by varying the voltage applied with a large dial - to vary levels of electrostatic force and corona arc displayed - a study for which is illustrated at Figure 1. Further the electroscope device is housed for exhibition in a cut-away black box, as seen with Figure 2, and viewed as time-shifted video footage when not in live voltage mode.

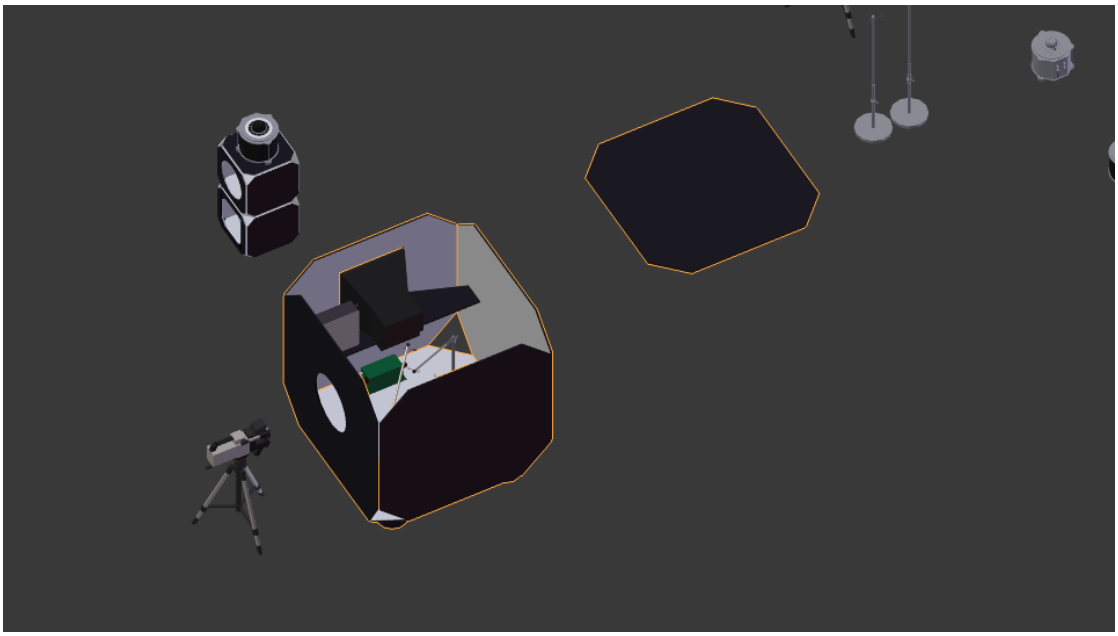


Figure 2: Pre-production 3D modelling for exhibition of *The Regard of a Motive Force*, Michael Petchkovsky, 2015.

The second chapter *Whirred, Whirled* takes a poetic approach to the electronic media. Electronic devices, a sequencer/sampler, a waveform displaying oscilloscope, an amplified speaker, as visualised in Figure 3 are driven by signals that exhibit figurative animation when viewed as the waveform, and that are functionally produced by audio sampling and playback equipment. The term technoesis is explored as it is used to describe ways of knowing and being in the production of art with technological media. The work of contemporary artist Denis Jaromil Roio, who has released software source code as viral poetry, is referenced to demonstrate the terrain of

[7] In quantum physics it is when a measurement is made that the transubstantiation between one nature and another, between wave and particle happens. This is defined as a *wave function collapse*. Also there are limits to what we can know about real world phenomena by taking measurements, the science term *observer effect* describes the taking of measurements altering the qualities under investigation. The *observer effect* has a number of quantum mechanical interpretations that are unresolved and revolve around the nature of the *wave function collapse*, how it occurs, and various implications this has for measurement causing action at distance, entangled particles influencing one another's measured qualities for example even if separated in space by great distance.

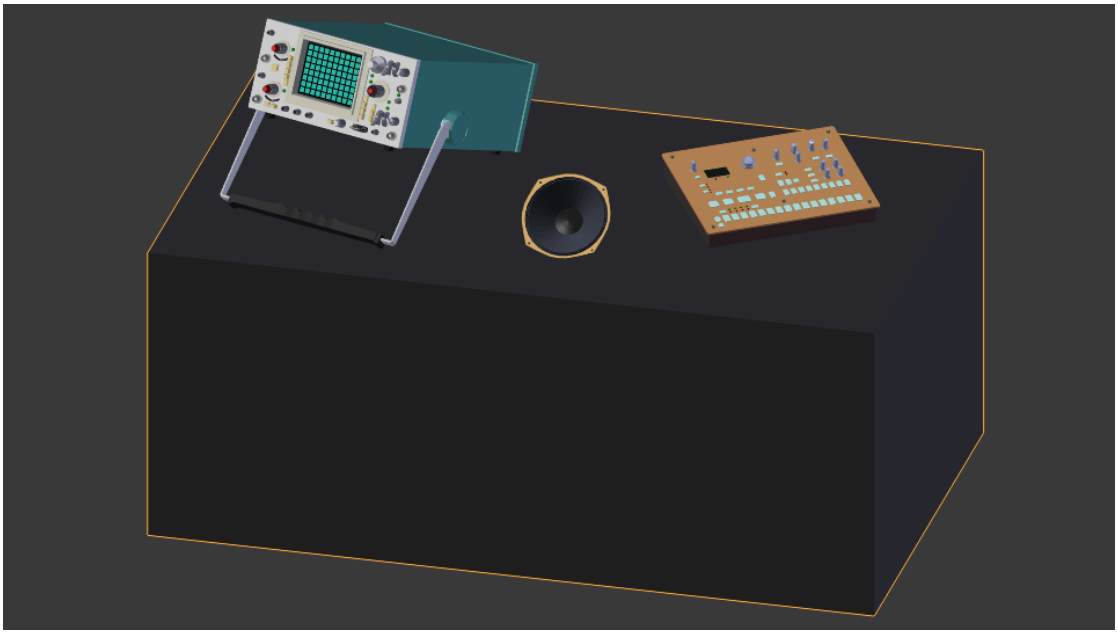


Figure 3: Pre-production 3D modelling for exhibition of *Willy-willy*, Michael Petchkovsky, 2015.

expanded frames of material that the electronic arts allows for. Feedback, iterative processes are seen to operate in the signals looping through the artwork *Willy-willy*. Feedback and iterative processes are also discussed in terms of dynamics between viewer and artwork, between medium and art making, and in the historical development of cross-disciplinary artwork collaborations between artists and technicians with reference to Stephen Jones' *Synthetics: Aspects of Art and Technology in Australia*.[8] The work *Willy-willy* is allowed to spin out associative poetic devices as the signals displayed on the screen present an animated bird inside the waveform viewer of the oscilloscope, and as the composition itself is compared to the phenomenon of a whirlwind.

Then the third chapter, *On Just Doing It*, examines implementations of the electronic media, particularly through the lens of artists' use of computer software. As well as the acts of coding and programming, the bespoke writing of software for functional effect and for art's sake, a broader social context of the use of free or open source software is considered. *Forest, Fracture* is presented as an original artwork that makes use of an open source game engine *fluxus* - Figure 4. *Forest, Fracture* presents a scene of a pine plantation forest glade that I have scanned in 3D and re-presented as mesh geometry in the framework of the *fluxus* game engine. The artwork is rendered live. Each projected frame of a game engine display is calculated in real time, and takes account of user and environmental input such as ambient and induced sound levels in the space, audio received at a microphone in the room triggers the mesh geometry of the forest scene to stir and split apart.

[8] Stephen Jones, *Synthetics: Aspects of Art and Technology in Australia, 1956-1975*, (Cambridge, Massachusetts: MIT Press, 2011).

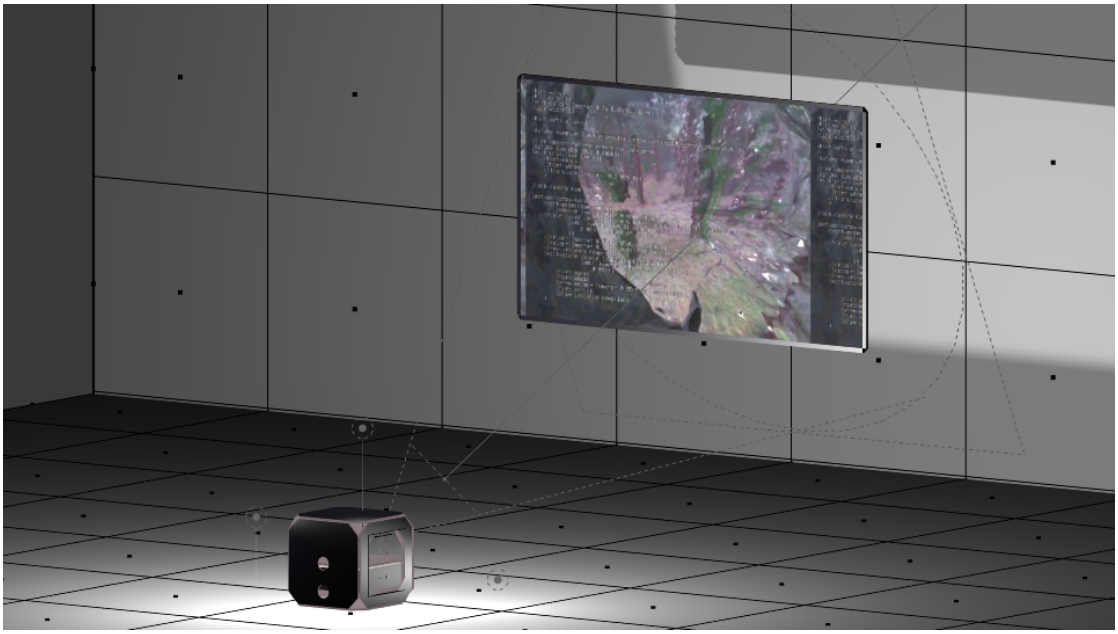


Figure 4: Pre-production 3D modelling for exhibition of *Forest, Fracture*, Michael Petchkovsky, 2015.

In the ways contemporary artists implement the electronic media in an age of electronic reproduction, by teasing apart the strands of what makes the media, by noticing and making warp and weft connections and pathways, and other directions too, they are following and inventing cultural procedures as much as technical ones. I would like to highlight the immediacy of presence and rhetorical potential that contemporary electronic media hold. The first chapter begins with a closer examination of electricity, and ways of looking at electricity.

Chapter 1

Measurement, Sense, Response

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"and, to avoid hereafter tedious disputes, and have the truth of the Phænomena's of Cœlestial Bodies more exactly known, commanded the Bear-men, which were her Experimental Philosophers, to observe them through such Instruments as are called Telescopes, which they did according to her Majesties Command; but these Telescopes caused more differences and divisions amongst them, then ever they had before,"
Margaret Cavendish, The Description of a New World, Called the Blazing-World, 1668.[1]

Electricity is clearly apparent to us. It is tangible when our hair raises in response to a build up of charge - a frottage of fabric, fur and skin - and its tangibility is right there in the composition and interaction of solid, liquid, gas - in touch and contact between the molecules and atoms of matter as electrostatic inter and intra molecular forces. It is audible as it crackles and thunders. Smelled as ozonised air, in fact our sense of smell is understood to rely on these same intermolecular, electrostatic forces when the complex distribution of charge across one molecule

[1] Margaret Cavendish's ficto-philosophical writing includes the classic *The Description of a New World, Called the Blazing World* (London: A. Maxwell, 1668). This *Description* is regarded as a germinal published work of science fiction in the english language, cf. Dale Spender, *Mothers of the Novel* (London: Pandora Press, 1986), p 43. *The Blazing World* contrasts competing notions of science and philosophy around nature that were contemporary to Cavendish's period and critiques issues of gender and power, in the setting of a romantic utopia. Cavendish was an active correspondent and commentator on 17th-century early modern philosophy and she engaged directly with the thinking of her contemporaries - the likes of René Descartes, Thomas Hobbes and Constantijn Huygens, cf. Nadine Akkerman and Marguérite Corporaal, "Mad Science Beyond Flattery: The Correspondence of Margaret Cavendish and Constantijn Huygens", *Early Modern Literary Studies*, Special Issue 14 (May, 2004). The full text of the *Blazing World* is available at http://digital.library.upenn.edu/women/newcastle/blazing/blazing.html.

or another fits to or modifies the shaped distribution of charge on an olfactory sensor/receptor as a key fits into a lock.[2] Electricity is seen (and felt again) in the glow of spark discharge, light and heat production, and in the motion it generates.

Accounts of the 'history' of electricity commonly refer to human encounters with electric eels and the triboelectric effect of static charge buildup when natural materials such as amber and fur are rubbed together causing sparking and electrostatic clinging effects.[3] These encounters with electricity are presented in such histories as precursors to the scientific development of machines of sulphur and glass (which like the amber and fur develop charge when rubbed together) and instruments for the measurement and further understanding and control of electric phenomena. Enlightenment figures including Franklin, Maxwell, Galvani and Kelvin developed instrumentation and experiments and hypotheses placing electricity in the schema of scientific method. Franklin famously experiencing the spark jumping to his hand from a key attached to a wet (and conductive) kite string during a storm in order to directly study the electrical nature of lightning associated phenomena. Galvani applying electricity to a dissected frog[4] and observing that not only do animals (like the eel) make, store and utilise electricity - but that our nervous and muscular systems utilise and respond to electricity in the way they work, actuating our movements and quickening our thoughts and sensations. There is an inherent electricity inside the animal. The occult notion of galvanism,[5] that we are motivated in our spirits by an animal electricity, served as inspiration to Mary Shelley in the formulation of her *Frankenstein* - an experimentally created organism, brought to life electrically.

The electroscope is one of these instruments of Enlightenment development that is immediately responsive to the presence of electric charge. Electroscopes use the effects of electrostatic attraction and repulsion to visibly move lightweight materials. We are familiar with electrostatics in the way a comb run through hair will charge enough to cling to and lift lint or paper scraps, or to spark and crackle. We conceptualise electric charge as a localised excess or deficit of electrons, or as atoms, ions in liquid or plasma that have more or less electron shell orbits activated than the neutral state of proton and electron equivalence in uncharged matter. A quantum in physics is defined as the "smallest possible, and therefore indivisible, unit of a given quantity or quantifiable phenomenon"[6] and the electric charge of a single electron or proton has been measured as the smallest indivisible value of charge. Electrons and protons contain stable discrete indivisible quanta of charge in their energy configurations, they are the quantum units

[2] The lock-and-key model of olfaction which visualises odour molecules and olfactory receptors as shaped charged particles can be contrasted with an alternate model where it is the vibrational frequency of the molecule that interacts by electron exchange with the senses, cf. *Vibrationally assisted olfaction*, on the research pages of the website of the University of Illinois, accessed December 10, 2015, http://www.ks.uiuc.edu/Research/olfaction/.

[3] See for example A. D. Moore, *Electrostatics: Exploring, Controlling and Using Static Electricity*, (New York: Doubleday, 1968), Chapter 2, "Frictional Electricity", pp 7-16.

[4] Luigi Galvani performed the experiment of motivating the muscles of dead and dissected frogs by electrical stimulation in 1780, which we now understand as demonstration of the biological effect of muscle contraction stimulated by electric current, galvanism. The term galvanism is also used to describe a bringing to life by electricity.

[5] Mary Shelley, *Frankenstein; or, The Modern Prometheus. (1831 Edition)*, (Zorba Press, 2002), p 43.

[6] As defined by the wiki-based Open Content dictionary Wiktionary https://en.wiktionary.org/wiki/quantum.

of electric charge phenomena. And charged matter propagates attractive and repulsive motive forces through space, the magnitude of the charge determining the strength of the force. We can move electric charges around, the movement of an electric charge being understood as a flowing current of electricity, electrons along a wire, ions across a synaptic junction, lightning along a kite string, fragments of tissue paper towards a statically charged balloon. Charge can be transferred by touch and induction so that when a charge is brought near to an electroscope the instrument attains a charge and indicates this by its lightweight parts moving against gravity which holds them still.

There is a sensuous quality to the electroscope in operation, in that its lightweight moving parts (traditionally of gold leaf or pith and silk) are gently yet vividly and immediately animated by the principle under observation (charge). There is the physical movement and placement of this thing called charge, which is present but otherwise invisible, as the quality is generated by one means (such as the scuffing of one's feet across a carpeted floor) and then transferred by touch to the electroscope conductor.

To the extent that we are seeing electricity produce motion in the electroscope's indication of charge, this is a representation of electricity through the instrument. In introducing her essay *Meeting the Universe Halfway* Karen Barad wishes "Einstein, Rutherford, Bohr, and especially Mach, could have seen" the representation of individual atoms in the crystalline lattice of graphite under a Scanning Tunnelling Microscope (STM) as she has been able to in the physics lab of the late 20th Century.[7] She is making the point that the screen display of the STM, which visualises quantum tunnelling current between the instrument's fine pointed tip and the surface of a sample under investigation at atomic scale, represents the finest yet measurement of microscopic detail that is technically possible, and that this technical possibility arises directly from, and entirely in accord with, the scientific life work of the mentioned theorists. The STM instrument in operation is demonstrating an exceptionally fine congruence between contemporary scientific theory and the composition of matter that would have been pleasing and wondrous for the thinkers who conceptualised modern understandings of atomic structure to see, and that is pleasing and wondrous for us to behold and ponder on. And yet we are not literally seeing graphite atoms on the screen. (Actual graphite carbon atoms are too small to be seen). The situation described is an encounter, between sticky tape and graphite,[8] Figure 1.1, between graphite sample and microscope, between student technicians and a lecturing theorist of scientific knowledge and social constructivism. Barad uses this description to illustrate her willingness to acknowledge the paradigms of scientific realism, the measurements of the structure of fundamental particles of matter appear on screen just as theoretically described, by following established and repeatable

[7] Karen Barad, "Meeting the Universe Halfway: Realism and Social Constructivism Without Contradiction," in *Feminism, Science, and the Philosophy of Science*, ed. Lynn H. Nelson and Jack Nelson (Boston: Kluwer Academic Publishers, 1996), p 161.

[8] The 2010 Nobel Prize in Physics was awarded to Andre Geim and Konstantin Novoselov "for groundbreaking research regarding the two-dimensional material graphene" which they famously cleaved from graphite in a layer one atom thick, using sticky tape, accessed December 10, 2015, http://www.nobelprize.org/nobel_prizes/physics/laureates/2010/press.html. Barad describes this same process of graphite sample preparation by using sticky tape in the introduction to her essay *Meeting the Universe Halfway*, p 162.

scientific procedure with finely calibrated devices. She insists though that scientific knowledge is socially constructed and "the fact that science 'works' does not mean that we have discovered human-independent facts about nature".[9]

Figure 1.1: Sticky tape, graphite and graphene transistors as used in the experimental work of 2010 Nobel Prize winners Andre Geim and Konstantin Novoselov. From the collection of the Nobel Museum, Stockholm. Image released to the public domain by Gabriel Hildebrand (Nobelmuseet), via Wikimedia Commons, accessed December 10, 2015, https://commons.wikimedia.org/wiki/File:Nobelpriset_i_fysik_2010.tif.

Barad argues for what she terms Agential Realism reading from the philosophy|physics of quantum theorist Niels Bohr. Bohr was one of the principal authors of the Copenhagen interpretation of quantum mechanics which is held to be the current best understanding, the most widely agreed one available. The Copenhagen interpretation attempts to enunciate a conceptual framework to understand the paradigm break quantum mechanics introduces where it is incompatible with earlier Classical Newtonian and Einsteinian Relativistic physics models. Bohr had argued strongly that Einstein's criteria for describing physical reality rested on "an ambiguity as regards the expression 'without in any way disturbing the system' "[10] when taking measurements of real world phenomena. Bohr and Barad describe a physical reality in which we are enmeshed

[9] Barad, *Meeting the Universe Halfway*, p 162.

[10] Niels Bohr, "Can Quantum-Mechanical Description of Physical Reality Be Considered Complete?", *Physical Review*, Volume 48, Number 8, (October 15, 1935), p 700. As referenced in Barad, *Meeting the Universe Halfway*, p 176.

in interactive engagement, entangled. There is an element of enactment to physical reality itself, as Barad says "what is being described is our participation *within* nature" and this Barad terms "agential reality".[11]

Importantly this notion of Agential Realism places the deduction of knowledge claims as activity that is embodied within the objects and any system under discussion. This questions the scientific realist assertion that there are objective and detached true single and correct facts being determined as universal laws, and opens the window to a plurality of congruencies between cultural practices and the material world. She argues that meaning is made within the specifics of encounters. Barad is not trying to erase boundaries between the cultural and material, but is pointing to their location as being intimate sites that "are necessary for making meanings... [and that]... are interested instances of power, specific constructions, with real material consequences".[12] In terms of our ways of knowing and being in the world, meanings are understood here as arising from dialogues between parties in active zones of engagement.

Figure 1.2: *The Regard of a Motive Force*, Michael Petchkovsky, as exhibited at Black Modular, MAP Lawson, curated by David Haines, June 2014.

The Regard of a Motive Force, (Figure 1.2), is a high energy kinetic and video sculpture, artwork produced for this research project, that implements an electroscope arrangement. As

[11] Barad, *Meeting the Universe Halfway*, p 176.
[12] Ibid., p 182.

mentioned an electroscope demonstrates the presence of electric charge by the movement of metal foils or other lightweight materials such as plastic or pith balls on silk strings under the influence of electrostatic force. In *The Regard of a Motive Force* hanging strips of aluminium foil are arranged such that attractive and repulsive forces act in concert. The classic electroscope has a single terminal to which charge is brought, and gold leaves attached to the terminal spread apart as the buildup of charge repels its own presence. Like charges repel, and opposite ones attract. These are scientifically understood qualities of electricity. *The Regard of a Motive Force* utilises two terminals that are connected to opposite poles of a neon sign transformer, and thus equally and oppositely charged. The neon transformer is energised through a variac, a variable alternating current transformer, that is a piece of electronics testing equipment with a large dial allowing the user to attenuate the input standard household 240V AC to an output between 0 - 240V AC. The neon transformer then bumps the variac output up by two orders of magnitude, so while 0V is still 0V, 240V is transformed up to 24,000V. As the dial is manipulated the magnitude of charge conducted to the two terminals of this electroscope is apparent in the immediate response of the hanging foil strips which repel and spread from their rest positions and mutually attract towards the central point between the two oppositely charged poles. Because air itself is conductive over short distances and at high voltage levels an arc is struck between these leaves when oppositely charged ones get close. The plasma arc breaches the potential difference (high voltage charge differential) from pole to pole. The spark between the foils completes a circuit and allows a current to flow and dissipate the charge buildup. A cycle of charging, repelling, attracting, sparking and relaxing is developed, its tempo and intensity adjustable at the variac dial. Metaphorically, science-fictively, this electro-mechanical sculptural work speaks with a nervous quickening, about flashes of inspiration, character difference and likeness, finding ones tempo, invisible forces and their material manifestation, wonder at a state of matter transformation[13] when air turns to coloured plasma and a fragment of aluminium streamer brightly ignites and falls to ground. This in the context of an encounter, a compound phenomenon whose character and reading would be different again with calculated boundaries differently placed.

Dealing with electric fields and high voltage electric charge, the fields and charges interactions with material elements of metal and air, and affective elements that speak back as we view and engage, it is clear that this is a measurement apparatus, a sensitive machine operating in expanded space, that senses and responds. *The Regard of a Motive Force* moves light weight metal foils by the interactive application of electric charge and arcs over at a certain point of high potential difference and proximity. The individual foils closeness together is in direct relation to the level of voltage, the degree of charge applied (which is set and varied by the viewer), and

[13] The commonly encountered three states of matter being solid, liquid and gas, where atoms are more or less tenuously held together. Plasma is a fourth state of matter where beyond certain heat induced or electrically excited energy levels the electrons of atoms of matter separate from their close association to the atomic nuclei. The matter becomes electrically conductive due to the ability of unpaired charges to conduct current, and coloured light photons are emitted as electrons jump between variously stable quantum energy configurations. Plasma is familiar to us in the phenomena of lightning flash, of stellar luminescence, or of arc welding for example.

which above a certain threshold will generate a glowing plasma arc, the presence of a fourth state of matter. The electrostatic attraction and repulsion, the spark of close contact, that is present live in this setting is immediately metaphoric to our own changing emotional states.

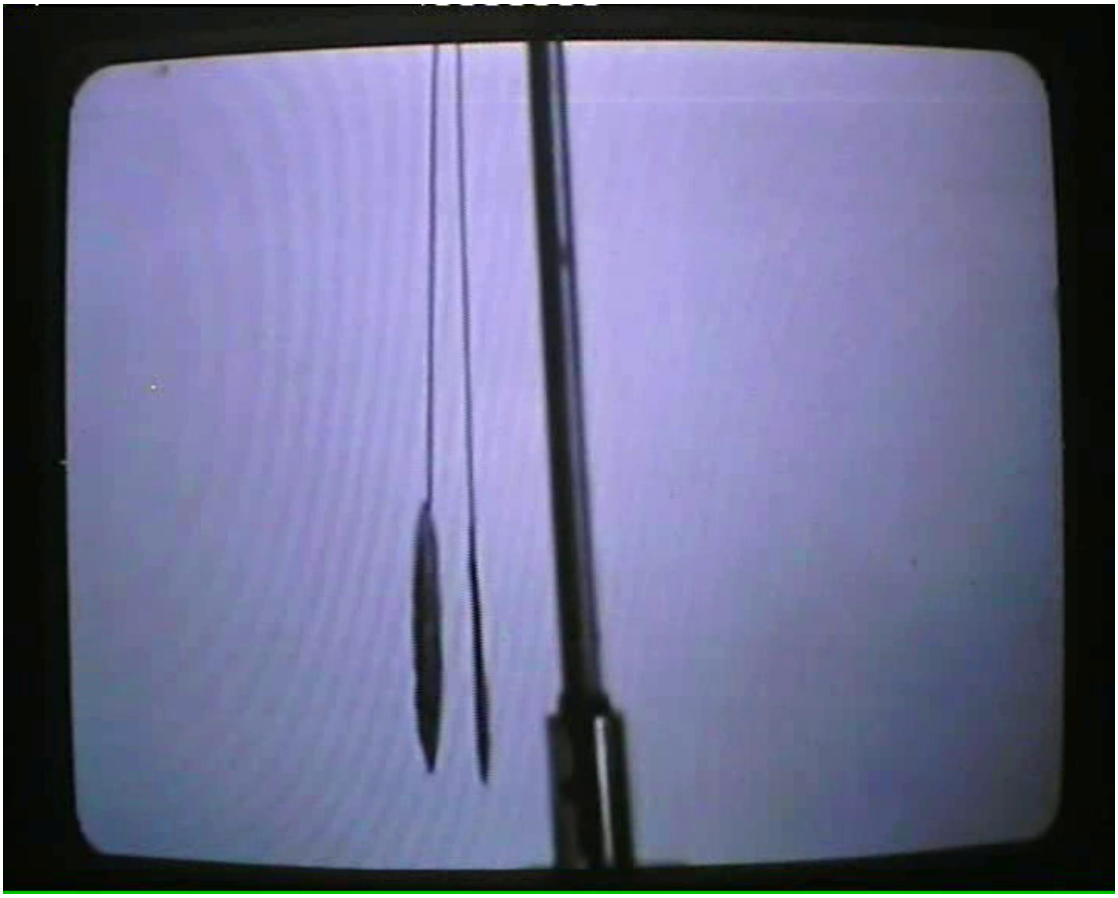

Figure 1.3: Still from video footage, *Electroscope Arrangement*, study for *The Regard of a Motive Force*, Michael Petchkovsky, 2014. See the section Links to Online Material to access the full video file.

It is by examining the device itself - looking back at the electroscope, and regarding the action of invisible forces, scientistically and also prosaically, literarily - that the work functions. There is a feedback quality to the work which literally turns a video camera on itself. Figure 1.3 is a still of the live video camera view of an earlier electroscope arrangement, conducted in 2014 to see electricity and the galvanic principle in action. Norbert Wiener characterises the present age as one of "communication and control"[14] to differentiate it from earlier ages of clockwork development, of steam power, or galvanic animation. Wiener is the originator of the term 'cybernetics' by which he refers to processes and understandings of "control and communication in the

[14] Norbert Wiener, *The Human Use of Human Beings: Cybernetics and Society* (London: Free Association Books, 1989, first published 1950), p i.

animal and machine".[15] And feedback is a process fundamental to cybernetic concepts. The networked, and rhizomatic, plural, and reciprocally acting, hybrid, and cross-boundary, agentially real qualities of such systems of control and communication are fertile and chaotic grounds for signal process, and feedback is a signal process that involves re-iterating a signal through a discursive pathway with varying levels of signal modulation and amplification or attenuation along the line. Stephen Jones describes the video signal as both live,[16] insofar as it is an immediate record of an image that is available in real time, and as a type of memory system that is able to turn around its content, to re-play it, for use "as a reflection on both itself . . . and on its content and its users . . . in social feedback situations - for example as used in performance training and in social analysis and activism".[17] And he goes on to describe the feedback process, in relation to memory, as "a holding on to the current conditions for comparison with future conditions or for further analysis".[18]

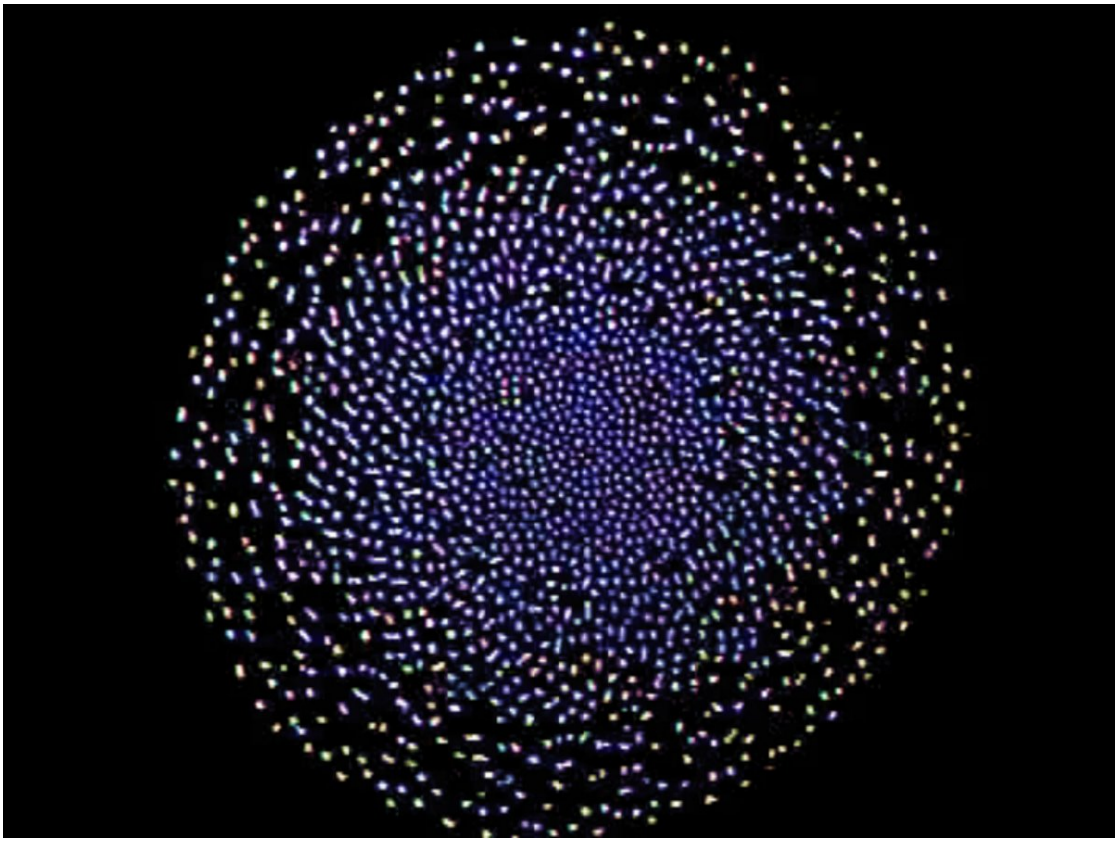

Figure 1.4: Stephen Jones, *Feedback*, 1987, image retrieved from http://scanlines.net/sites/default/files/imagecache/large/stephen_jones_feedback_1987_0.jpg.

[15] Ibid., p i.
[16] Stephen Jones, *Synthetics: Aspects of Art and Technology in Australia, 1956-1975*, (Cambridge, Massachusetts: MIT Press, 2011), p 205.
[17] Ibid., p 207.
[18] Ibid., p 207.

Jones' art practice includes work in the medium of video feedback, an example of which is seen in Figure 1.4, and he identifies the medium as a generative one.[19] The process of feeding a video signal, for example from a live camera, back onto itself, for example by pointing the camera at its own output screen, introduces time shifted and additive and subtractive, and multiplied and recursive modifications to the signal content. The signal is also influenced by the holdings, comparisons and analyses that are occurring both at the machine level - in circuits, display units and the signal's routing around these machine systems - and at the social level where the equipment operators adjust position and placement of the cameras and screens to alter the forms and figures being generated, and where observers may become part of the process by intervening between camera and screen.

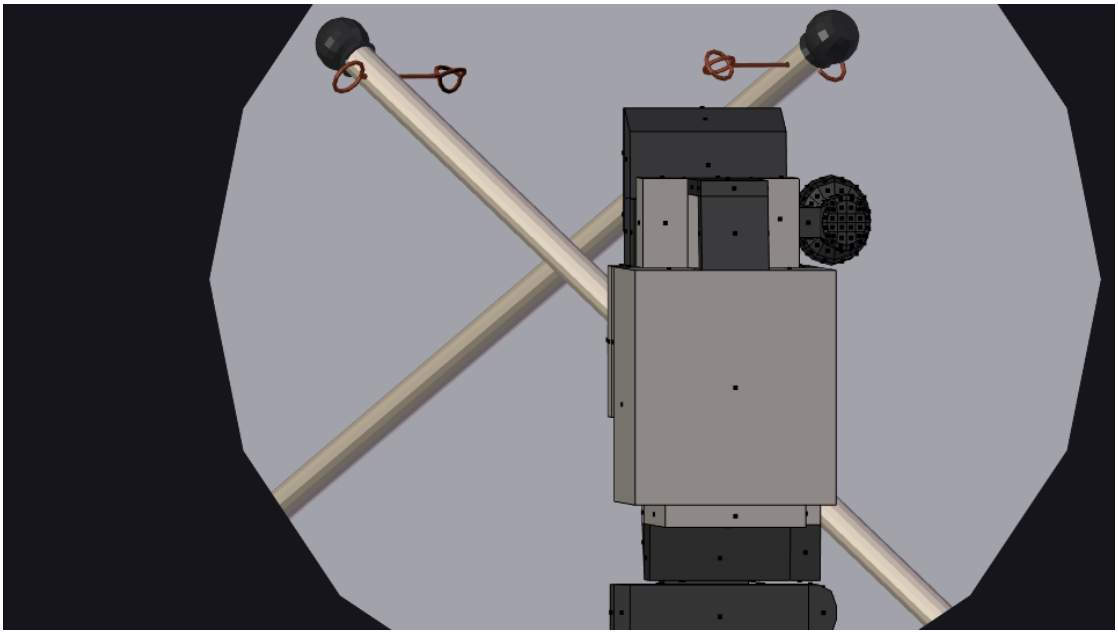

Figure 1.5: Pre-production 3D modelling for exhibition of *The Regard of a Motive Force*, Michael Petchkovsky, 2015.

Figure 1.5 models the electroscope component placement and the use of a live camera as a visualisation of the artwork installed in a gallery setting as part of *The Regard of a Motive Force*. The energies active in this interactive kinetic and self-reflexive sculpture explicitly acknowledge feedback loops in their generation, modulation, and communicative intra-actions. In the following chapter poetic devices are used to open up these kind of loopings of bits and quanta, of vibratory frequencies, to spin out allegorically.

[19] Ibid., p 256.

Chapter 2

Whirred, Whirled

"In considering a source code as literature, I am depicting viruses as though they were the sort of poems written by Verlaine, Rimbaud et al., against those selling the net as a safe area for straight society. The relations, forces and laws governing the digital domain differ from those in the natural. The digital domain produces a form of chaos - which is inconvenient because it is unusual and fertile - on which people can surf. In that chaos, viruses are spontaneous compositions which are like lyrical poems in causing imperfections in machines 'made to work' and in representing the rebellion of our digital serfs."
Denis Roio aka Jaromil, Forkbomb, ou de la bohème digitale, 2002.[1]

As Chapter One has set out, set and setting are of importance when it comes to sensibility, encounter and exchange. Insofar as Jaromil describes computer software source code as literary, he is using a literary device (on a number of levels) to step outside of one framework, and to enact another. Firstly by drawing an analogy between lines of source code and the writings of Romantic poets he disrupts the notion that a computer program is a thing of pure logic, an artificial language structure, with a fixed function to perform. He identifies a 'chaos' that is a live place in the machine world, and he places, he releases as a virus, his poetry, his own code within that chaos to act. In so doing, he reveals a détourne[2] and takes it. He has set a different

[1] Denis Roio aka Jaromil, *Forkbomb, ou de la bohème digitale*, (Dyne.org Digital Press, 2002), http://jaromil.dyne.org/writings, p 5.

[2] Détournement (a French language term literally translating as rerouting or hijacking), as described by

stage, considers the machine's designated function in terms of broad socio-cultural relations, and repurposes the medium of the machine, the software code that drives the computer, to represent a powerfully rebellious agency.

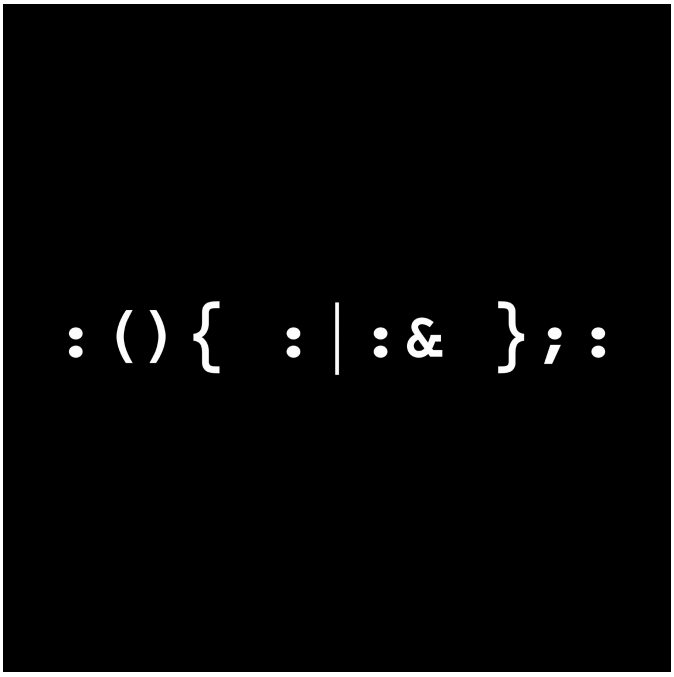

Figure 2.1: *Forkbomb*, 2002, Jaromil, "I LOVE YOU [rev.eng]" exhibition, http://www.digitalcraft.org/iloveyou/, image retrieved from http://www.digitalcraft.org/iloveyou/images/press/code_poetry_jaromil.gif.

In this chapter I move on from discussion of the establishment of the place of agency in regard of realism, to look inside the machine, and at the setting of the machine. And as does Jaromil, I look for poetic devices to expand repurposed machine media. To spin out from the way the machines work into literary realms suggestive of alternate narratives around the relational dynamics of data. Generative feedback systems emerge within the machine media, which are ideal media for the implementation of iterative looping procedures. Jaromil's *Forkbomb*, 2002, consists of a single line of computer code, a looping function, :(){ :|:& };: Figure 2.1, which when run as a program will ceaselessly spawn new instances of itself on the processor, bringing the computer on which it is run to a maxed out state of memory and processor overload. A miscreant loop, a poetic sabot, the virus exists conceptually and has affect by its representation in the visual form of ASCII characters, a line of concrete poetry, and by its imagined or actual

the Situationist International in the mid-to-late 20th-century, is a propaganda technique that takes pre-existing cultural elements (in this example the computer virus and the lyric poem) and combines them with fresh context for social commentary, expanding the scope of the original elements and suggesting radically alternative social readings and outcomes, cf. Guy Debord and Gil Wolman, "Mode d'emploi du détournement", *Les Lèvres Nues*, #8 (May 1956) and Ken Knabb editor and translator, *Situationist International Anthology* (Bureau of Public Secrets Press, 1981).

functional implementation on running computer hardware.

Cultural production, such as the throwing of a metaphorical sabot into place between moving cogs to modulate their functioning, is poiesis.[3] The term technoesis, as used by Roy Ascott in the preface to abstracts from the 1997 Centre for Advanced Enquiry into the Interactive Arts, University of Wales conference *Consciousness Reframed*[4] has significance here.

The term technoetic refers to cultural production through technological mediation, like poiesis, techno-poiesis... and to noesis, ways of knowing and being.[5] Stephen Jones, discussing technoesis, suggests "we open up the concept of language to include any of the possible means of showing that we are using information from the world in ways that are useful to ourselves. We can report this use in many ways: making art or otherwise demonstrating our consciousness of things about us".[6] Stephen Jones is an Australian video art practitioner who makes use of electronic processes in hardware, machinic implementations, for technoetic ends. He developed early analogue video sythesiser equipment for use in music video production in the 1980s. He is a writer and curator specialising in the culture of art and technology in contemporary Australia. In *Synthetics: Aspects of Art and Technology in Australia, 1956-1975*[7] he highlights the socially productive role of feedback between practitioners across discipline in the development of new media technological art.

The work *Willy-willy*, 2013, part of this research project, Figure 2.2, is an idiosyncratic assemblage of audio-visual equipment configured to play an animated vector graphic figure in continuous loop. Each piece of equipment has been selected for a particular functionality, each is a discrete part in the audio-visual playback system implemented here. The vector graphic data circulates around and between a looping audio sampler/sequencer, a laboratory oscilloscope designed for the visualisation of electronic signals as waveforms, and an amplifier that sonifies those same signals. The work is a study into the underlying structure of a vector graphic display, some of which is mathematical, some of which presents as physical patch cords, wiring and electronic hardware, some presenting as phosphor lines glowing on a cathode ray tube, and because the signal encoding the graphics is at audio frequency some structure is available to be heard. Discrete elements are separated and seen to be interconnected and the animation runs through them all, and loops.

In another manner *Willy-willy* contains personal narrative. The work was produced in response to a call out by Julie Doye who curated the group exhibition *Retro-Specs* at M2 Gallery in July 2013. The curator asked artists to locate artworks from childhood and produce new works

[3] From the Ancient Greek 'to make', and the root of the word poetry, poiesis is emergent creative work reconciling experiences and understandings of the living world in ways that affect and cultivate the continuation of the world.

[4] Roy Ascott, "Preface" in *Consciousness Reframed: Abstracts*, (Newport, Wales: CAiiA, University of Wales College, 1997), p 1.

[5] Stephen Jones, "Towards a Philosophy of Virtual Reality: Issues Implicit in 'Consciousness Reframed' ", *Leonardo*, Volume 33, Number 2 (2000), p 125.

[6] Jones, "Towards a Philosophy of Virtual Reality", p 131.

[7] Stephen Jones, *Synthetics: Aspects of Art and Technology in Australia, 1956-1975*, (Cambridge, Massachusetts: MIT Press, 2011).

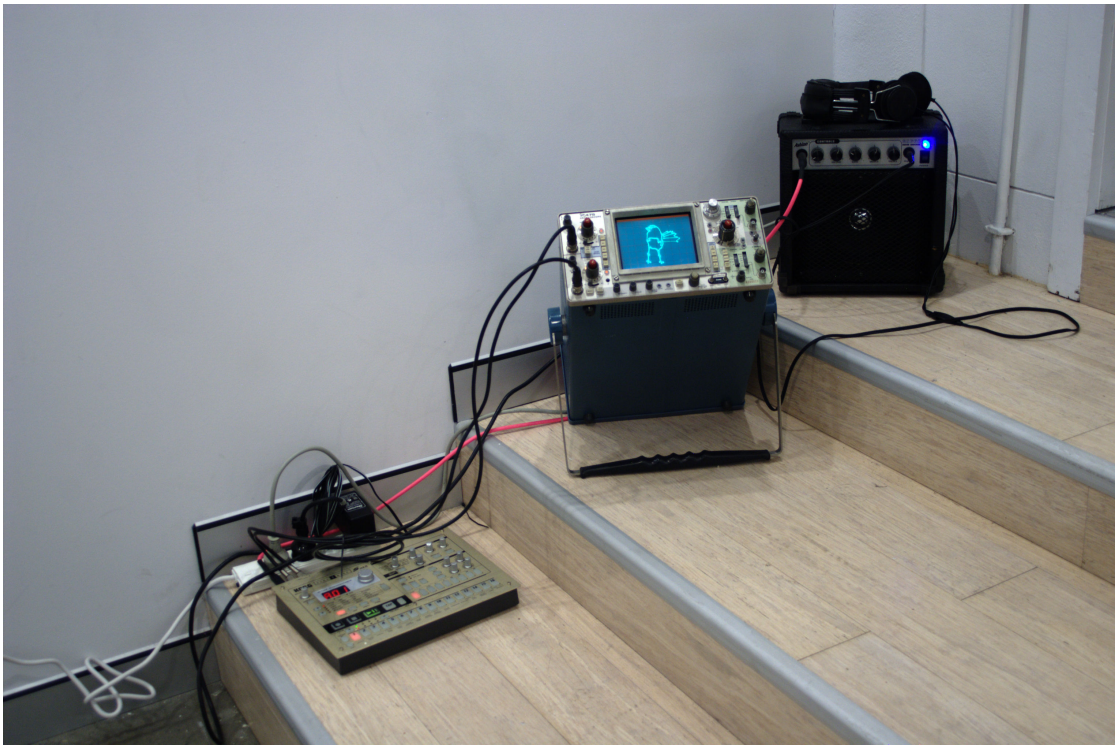

Figure 2.2: *Willy-willy* installation, Michael Petchkovsky, at M2 Gallery, Surry Hills, July 2013.

responding to those from the perspective of our contemporary practice.

It was satisfying (and a little unsettling in its coming to consciousness) to find a thread of continuity where at age four I had been studying and speculating on the component parts that would go together to make a clockwork animated model bird (Figure 2.3). To realise that I had done so by presenting line elements alongside a coloured view of the imagined, assembled whole, with side depictions of the bird in action eating a worm, and of the clockwork mechanism in skeleton view. And to compare that with my current research into the parts that make a vector graphic and a mechanism for animated display. To honour the early impulse, the childhood dream that I would build this toy when I grew up, I went with the motif of a small bird, a Willie Wagtail, to be material for the vector drawing.

Aware as I am of the Freudian implications of such symbols I note that a psyche is a sum of parts[8] and a thing more nuanced than the Victorian mindset gave it credit.[9] A psyche,

[8] Freud's description of the Id, Ego and Superego model of a constructed and compartmentalised psyche is considered revolutionary in Western thinking and underpins much of modern understanding of psychological and interrelational matters.

[9] Of course there has been a great deal of valuable analysis, critique, expansion, deconstruction and progress beyond Freud's theories in the century since they were put forward. The reader may refer to a title such as the Australian post-Jungian collection *Depth Psychology, Disorder and Climate Change / Robert Bosnak et al.*, edited by Jonathan Paul Marshall, (Sydney: Jung Downunder Books, 2009) for a sample of contemporary psychological discourse.

Figure 2.3: *Clockwork bird diagram*, texta drawing, Michael Petchkovsky, 1973.

one's developed consciousness and identity, can be considered an active process that is shaped by nature and nurture, and that engages interactively with the entities and environments it encounters in looping, feedback-like manner. So *Willy-willy* references that as it explores a retrospective response to an artwork I produced as a child.

There are a number of available readings of the small bird symbol. There is the more adult sparrow of Catullus and Sappho in poetry. Catullus' "O sparrow that are my sweetheart's pet, with whom she likes to play"[10] may be detected in the eponymous Willy, a playful figment here rendered to perch at the sill, the threshold of the inner machinic and virtual world, separated by a screen from the viewer, as a familiar, an animated entity in representational space. In this regard the work makes a cursory joke about conscious and unconscious phallo-centricity as exhibited by the male artist.

To Sappho though sparrows bore the chariot of Aphrodite "fair fleet sparrows drew thee, flapping fast their wings around the dark earth"[11] and this moves towards another reading of the bird symbol. "A little birdie told me something" my grandmother used to say. The messenger, the bird understood as a carrier of the passions and of information, a conduit, a secret teller,

[10] The opening of Roman poet Gaius Valerius Catullus' second recorded poem "Catullus 2", circa 54BC in the G P Goold translation (London: Duckworth, 1983).

[11] From Greek lyric poet Sappho's sixth century BC "Hymn to Aphrodite" translated by H. T. Wharton in *Sappho. Memoir, text, selected renderings, and a literal translation*, (London: Stott, 1885).

a spy, a tele-communicator navigating boundless territory and bearing the weight of heavenly bodies in signal exchange and flap of wing.

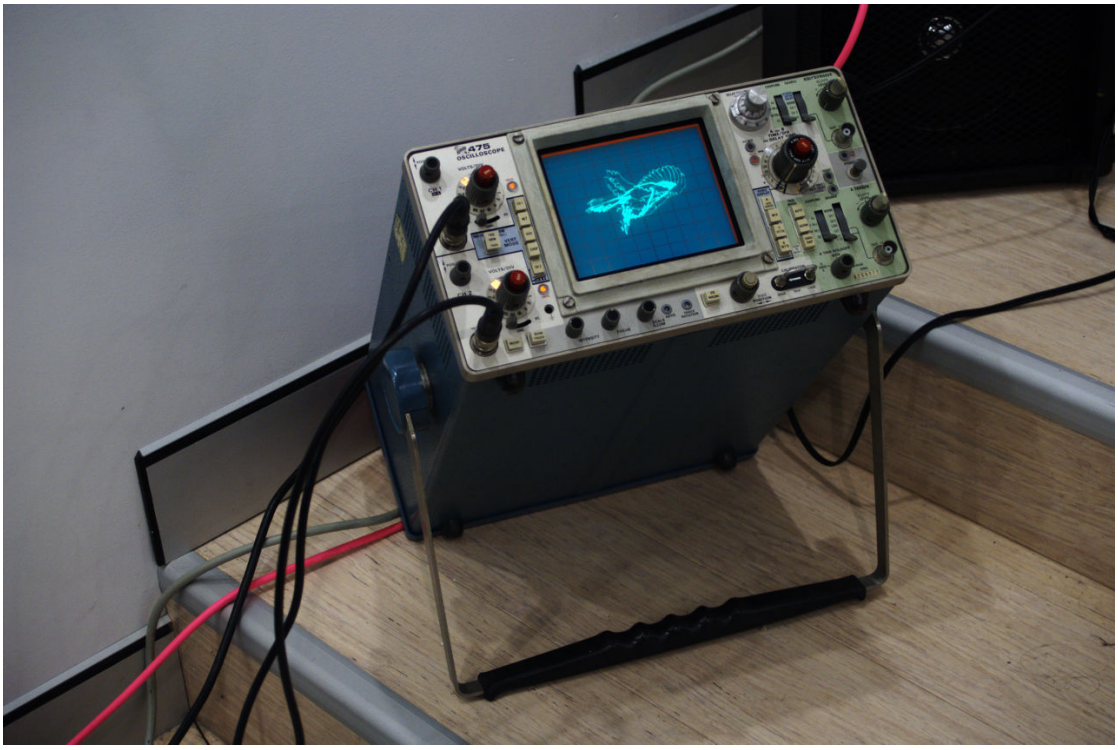

Figure 2.4: In the midst of the *Willy-willy* installation an oscilloscope screen shows the bird, tail-wagging and taking flight.

I personally associate Willie Wagtail with a story recounted to me in private conversation with a friend when the little bird was spotted perching nearby to us, eyes and ears attentive, tail wagging as he sang out the occasional chirp. The birds in the bushes flew from camp to camp. They imparted information from one camp to another. This led to conditions of war, the upheaval of a mountain, great sorrow and revolution in the social order. This telling of Willie Wagtail was in a cautionary context, and the story teller relayed it as pertinent to our discussion and waved the bird away before continuing to speak. Watch out, someone is listening to what we are saying. Words travel. Information is revealed to another party. Trouble may ensue. Information is gold, it must be handled with attention and delicacy and with regard to context. The flicking tail of the little bird serves to grab our attention and remind us of the power of words, symbols, information, and the importance of details and context in information exchange. A telltale can be a blinking light on a console, accessible at a glance and indicating the operation of a piece of equipment. A great deal of information can be encoded in the attention grabbing flicker, the LEDs on a network router indicate an active process of data exchange and

there is a security exploit[12] inherent in early router designs where the flashing of the LED is driven by the binary content of the datastream, the data leaks from the network and is available for interpretation and re-interpretation by the casual observer.

In the midst of the expanded set of equipment for vector graphic display, (Figure 2.4), expanded so as to reveal something of its components and its process and function, is a representation of the messenger. Willie Wagtail alternately wags his tail on screen and flaps and flies away in an animation loop. The bird is at once encaged by the reticular grid on the oscilloscope screen, a piece of lab equipment for the visualisation of electrical waveforms, comes and goes as a virtual image transmitted along cabling, and is (over)heard as the waveforms comprising the vector drawing come through headphones and amplifier as a series of repeating tones. Bridging between worlds, poetically and conceptually, as much an entity as Jaromil's virii.

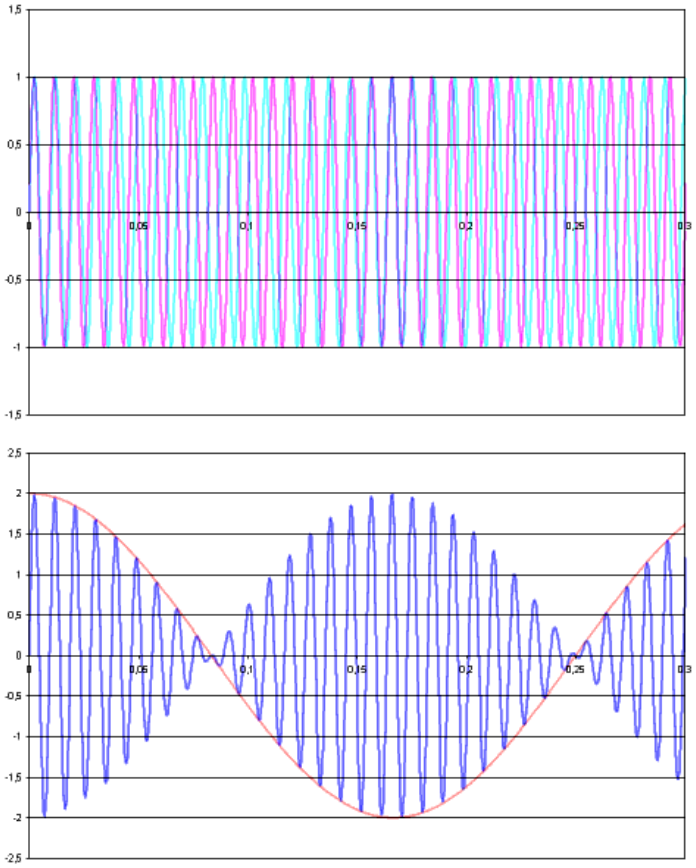

Figure 2.5: Beat frequency superposition of sine waves. http://commons.wikimedia.org/wiki/File:Beat.png

Having made one lap around the work I will now turn to the titling and then return finally again to the idea of feedback. Willy-willy is an Australian English term for a whirlwind or dust devil. These transient phenomena exhibit a visual presence, roughly person sized, that is at once stable and in constant flux. The vortex of wind supports a column of dust and debris spinning in rapid motion. The whirlwind results as the confluence of a set of environmental factors, can be understood in terms of physics and meteorology as air currents generated by temperature differentials, following circular paths defined by the forces of angular momentum, given a transient macro structure as a self sustaining vortex, made visible by the take up of loose material on the ground surface, audible as the material laden air whips and whirrs about an axis. The point of contact with the ground and the axis extending upward move in an ambulatory manner across typically flat

[12] This is a form of TEMPEST as described in Joe Loughry and David A. Umphress, "Information Leakage from Optical Emanations", *ACM Transactions on Information and System Security*, Vol. 5, No. 3, (August 2002), pp 262-289. Van Eck phreaking is a related activity where the contents of display devices are remotely read by monitoring electromagnetic leakage from the device flickering in a distantly observable room. Wim Van Eck, "Electromagnetic Radiation from Video Display Units: An Eavesdropping Risk?", *Computers & Security*, Vol. 4, No. 4, (1985), pp 269-286.

terrain, seeming to seek for something or then standing still to signify a place before moving on again. Structure is clearly apparent in the streams of dust composing the vortex, in their motion and in the repeat of a larger particle, a leaf or a scrap of paper, going around and around and around. There is an undulation along the vertical column that bears a relationship to the circular frequencies and ambulatory motions, stretched along the upward axis and illustrating time in the way it lags and makes dancing beat patterns, sums of waves, on a longer scale. A type of

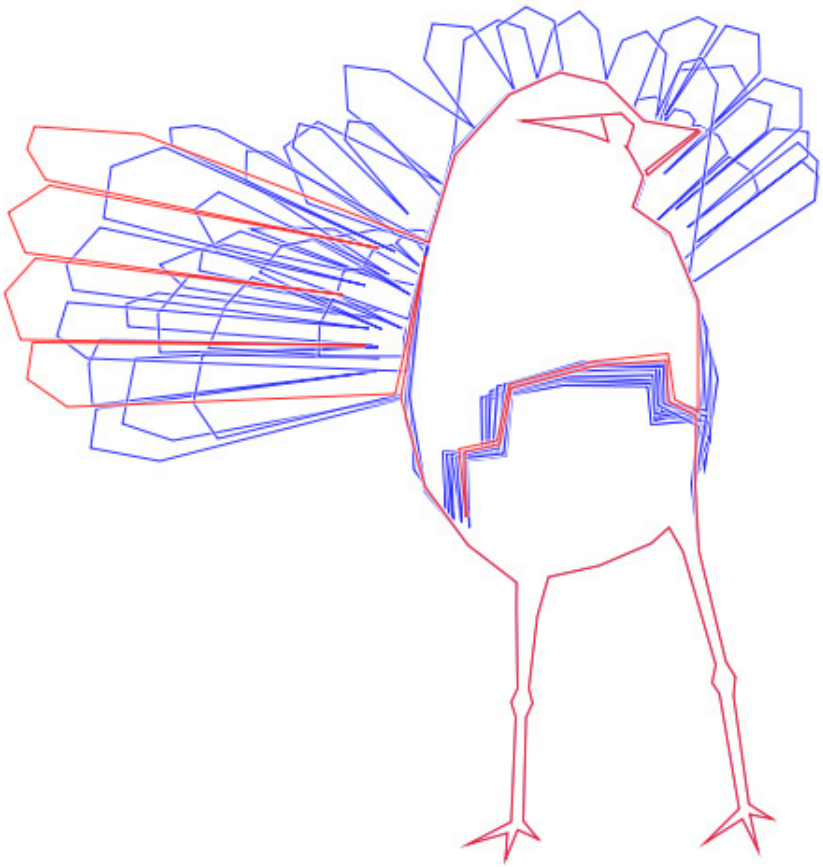

Figure 2.6: Concatenated frames of vector outlines used in the composition of *Willy-willy* signal data, Michael Petchkovsky, 2013.

summing of two waves is the technique I implement to draw the *Willy-willy* vector graphic on the oscilloscope screen. Figure 2.5 shows superpositions of two sine waves making complex two

dimensional patterns.

Figure 2.6 is a composition of a set of frames of vector outlines that was hand drawn with vector graphics editing software. A vector description of a figurative image consists of a list of coordinate points $(x0, y0), (x1, y1), (x2, y2)$[13]... and instructions for filling the lines and shapes formed by these coordinates with (r, g, b, α)[14] colour. These lists of colour and position data values can be encoded in streams of numbers that bear a resemblance to multi-channel digital audio sample data.[15] In fact a free software application exists for the purpose of converting vector graphics to audio frequency data, *LaserBoy*,[16] Figure 2.7. This is useful in the field of laser projected graphics. Animated graphical figures can be projected by a laser beam that is rapidly diverted in (x) and (y) directions by mirrors, such that the beam sweeps out lines and shapes in the visual field, and a stereo audio signal can be used to drive the mirrors' movement.

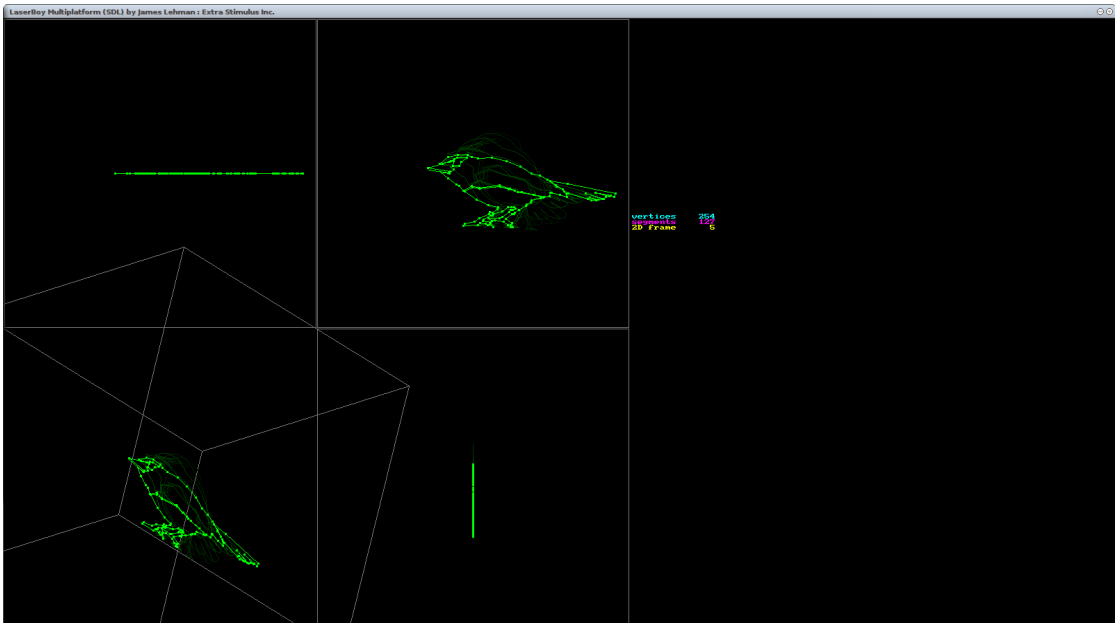

Figure 2.7: Using *LaserBoy* software to convert vector frames to audio in the composition of *Willy-willy*, signal data, Michael Petchkovsky, 2013.

I realised that the stereo audio waveforms produced by software like *LaserBoy* would show up on an oscilloscope that was configured to position its electron beam horizontally and vertically by

[13] In the Cartesian coordinate system these pairs of $(x\text{n}, y\text{n})$'s represent points in two dimensional space.

[14] (r, g, b, α) values encode red, green, blue, and transparency colour descriptions.

[15] Digital audio sample data consists of strings of integer numbers that mathematically represent the shape of an audio waveform for recording and playback purposes. Stereo sample data will have two synchronised strings of such waveform descriptive numbers for left and right speaker playback, and each pair of numbers from these two streams can be treated as $(x\text{n}, y\text{n})$ coordinate points for drawing vector forms in a similar manner as to that in which a single channel audio waveform can be reconstructed and visualised as a sine wave like graphical representation of sound. Further colour visual data can be encoded as number streams in multi-channel sample data alongside the two streams of positional data.

[16] James Lehman, *LaserBoy*, (distributed under the terms of the GNU General Public License, 2003), http://laserboy.org/.

two separate signals. This is the method used by television studio technicians to generate sci-fi ambiance by pushing summing waveforms (like those of Figure 2.5) to the horizontal and vertical deflectors of cathode ray tubes to generate Lissajous figures. The Lissajous figure is a graphical form commonly known for example in the 20th-century Australian Broadcasting Corporation logo, or seen on the flight decks of 1960s - 1980s science fiction film and television productions.

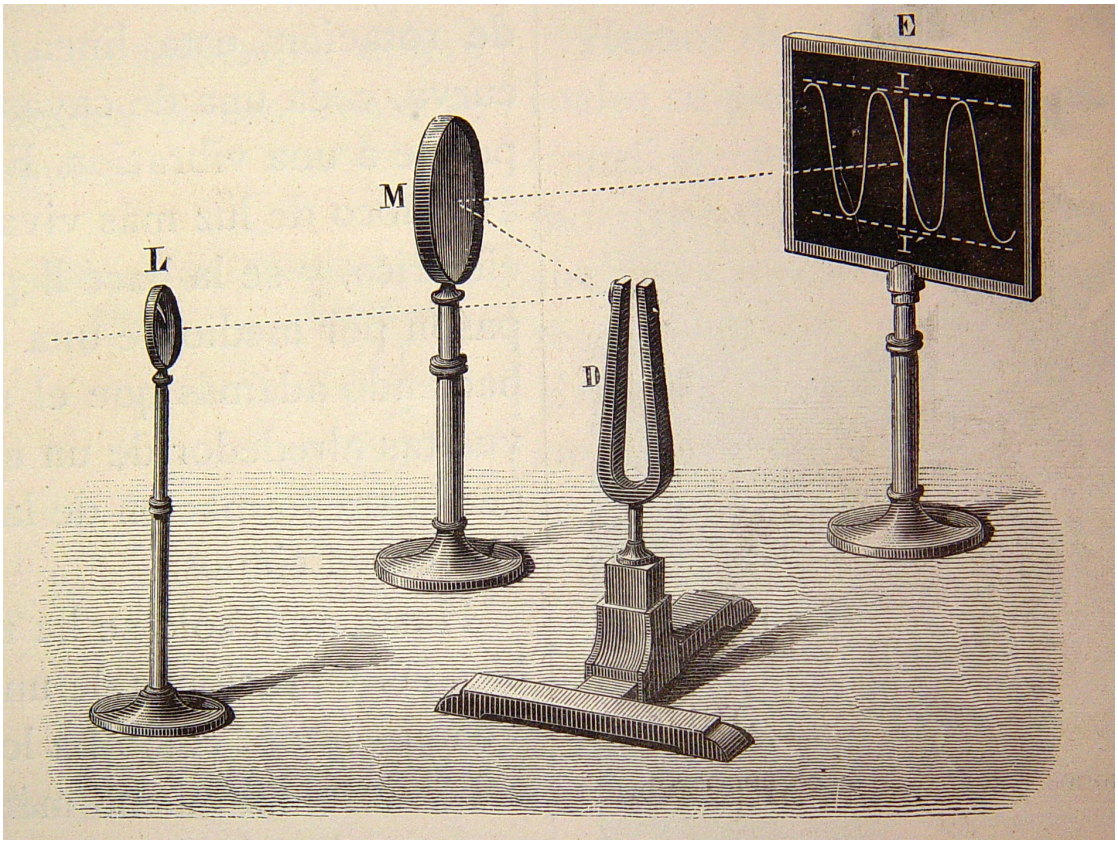

Figure 2.8: *Optical method of M. Lissajous: projection of sound vibrations*, file licensed under the Creative Commons Attribution 2.0 Generic, accessed December 14, 2015, https://commons.wikimedia.org/wiki/File:M%C3%A9todo_%C3%B3ptico_de_M._Lissajous_-_proyecci%C3%B3n_de_las_vibraciones_sonoras_%281882%29.jpg.

Jules Antoine Lissajous developed apparatus for the observation of vibratory processes as waveforms, see Figure 2.8. Lissajous attached mirrors to the ends of tuning forks such that "a sheaf of light thrown from the lamp on to ... mirror[s]... could produce a ring of light on the ceiling and various other figures".[17] Lissajous' vibrating mirrors set at right angles sum the waves of their vibration frequencies to produce figures by the movement of a light beam in two dimensions. As an instrument of measurement the Lissajous apparatus is showing the phasic relationship of one frequency to another by the patterns of their super-positions, with an

[17] C A Taylor, *The Art and Science of Lecture Demonstration*, (CRC Press, 1988), p 50 - quoting John Tyndall's contemporary account of Lissajous' 1857 lecture/demonstration to the Royal Institution.

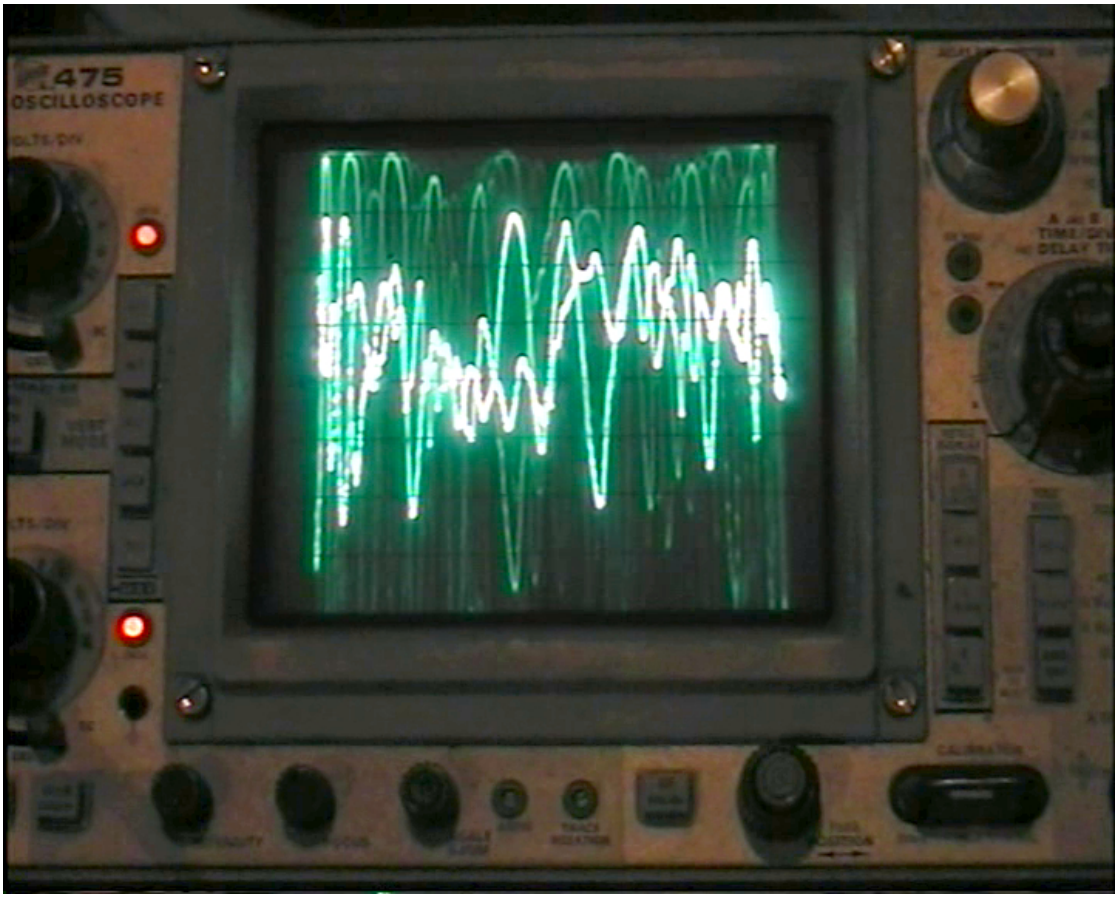

Figure 2.9: Video still, VLF natural radio recording at Hazelbrook, NSW, Australia, 28 June, 2013, displayed as Lissajous figure on oscilloscope screen. Study for *Willy-willy*, Michael Petchkovsky. See the section Links to Online Material to access the full video file.

exquisite degree of sensitivity. I have made use of Lissajous' method of studying graphical figures arising from phasic differences in summed waveforms in the research and implementation of the work *Willy-willy*, for example by displaying audio recordings summed together with analogue synthesised sine waves of variable frequency as seen in Figure 2.9. Post-Revolution the French government established a committee in 1858, of which Lissajous was a member, to set a standard for pitch[18] and this was part of a larger movement in the definition of a set of standard units of measurement that has led to our modern Le Système International d'Unités (the SI metric system) which was envisioned as a common and uniting metrology "for all people, for all time".[19]

[18] Whipple Museum of the History of Science University of Cambridge, "Lissajous tuning forks:the standardization of musical sound," accessed November 30, 2014, http://www.hps.cam.ac.uk/whipple/explore/acoustics/lissajoustuningforks/.

[19] Quote attributed to the French philosopher, mathematician and political scientist Marquis de Condorcet in Ken Alder, *The Measure of all Things - The Seven-Year-Odyssey that Transformed the World*, (London: Abacus, 2002), p 1.

In the 1950s and 60s the electronic synthesis of waveforms and their display on cathode ray tubes was the state of the art of electronically rendered graphics.[20] As visual phenomena in and of themselves Lissajous figures are appreciated for their beauty and complexity, their representation of physical and mathematical principles.

I have been talking about the structuring of the work *Willy-willy*, structured signals encapsulated in the work. Regarding these structures as devices, literary and mechanical, technoetic. And about energetic wave form functions. Bundles of energy that conform and cohere to, that co-exist as parts of the work's propagation. The whirlwind is known to be an energetic phenomenon in the electromagnetic spectrum as well as, or in concert with, the structured energy play of air temperature and physical material. The dust particles become electrically charged

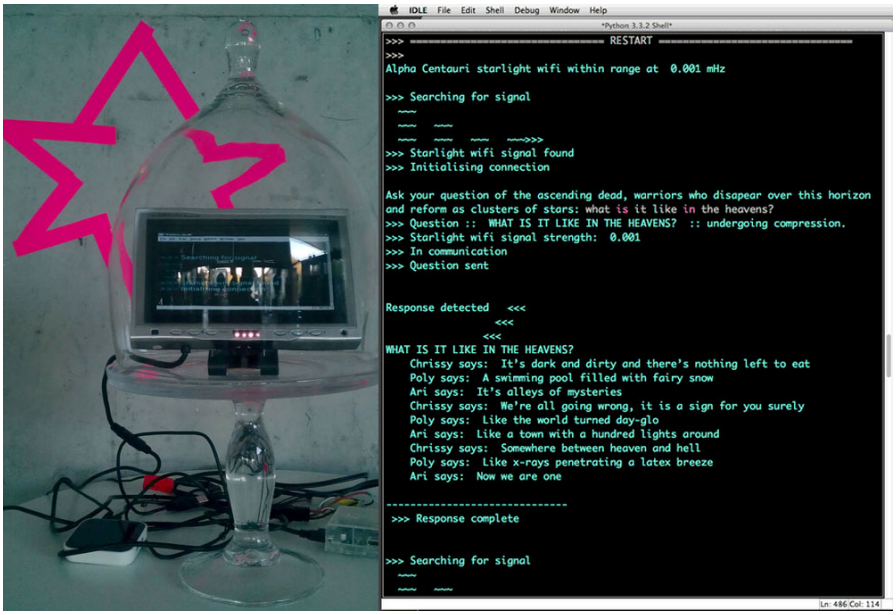

Figure 2.10: Linda Dement and Nancy Mauro-Flude, *Awry Signals, A Eulogy for the Stellar Girls*, 2013, image retrieved from the website of the artist, accessed December 16, 2015, http://www.lindadement.com/awry-signals-images.htm.

as they are lifted and subject to friction. Static electricity, triboelectrics[21] means that electrons transfer between materials in the conditions present within a whirlwind. Charges develop and are moving as current[22] along a spiral path, just as occurs in a coil of wire, making radio noise and magnetic force and helping to pick up further material by electrostatic attraction.[23]

To mention another contemporary artist who poetically and technoetically repurposes electronic devices, and hacks their signalling like they are lyric elements, Linda Dement has made

[20] Jones, *Synthetics: Aspects of Art and Technology in Australia, 1956-1975*, pp 42-43.
[21] The triboelectric effect describes the phenomenon of electric charge developing when materials are brought into and out of contact with one another.
[22] This is the definition of electrical current, a moving charge.
[23] Jasper F. Kok and Nilton O. Renno, "Enhancement of the emission of mineral dust aerosols by electric forces", *Geophysical Research Letters*, Volume 33, Issue 19, (2006).

a seance with the stars in *Awry Signals, A Eulogy for the Stellar Girls*, Figure 2.10, at Bundanon Niteworks in 2013.[24] This collaborative work of hers with Nancy Mauro-Flude makes use of a Raspberry Pi,[25] which is an open source, open hardware micro-computing platform, to broadcast bespoke wifi network signals to the æther. A Python[26] scripted text user interface that is accessed seance-like with questions and answers sets up a ficto-critical discourse with the departed souls of Chrissy Amphlett, Poly Styrene and Ari Up, a quintessential rock star radio interface to the fifth element air waves. The script programmed by the artists is performed live with audience participation. *Awry Signals, A Eulogy for the Stellar Girls* makes ingenious use of language and technology to question the contemporary communications media and by analogy to ask metaphysical questions as well. There is a valourisation of feminist voices in discourse through pop-cultural channels with this work. Also the Romantic, occultic practice of conducting and participating in a seance is valourised and brought into realisation in a science-fictional manner with contemporary equipment and theory.

There is something of the whirlwind in *Willy-willy* going back to look at Figure 2.2. There is an axis of gyration as signals travel the cabling and the animation loops. The equipments, which are nodes on the cable loom, could have been whipped into configuration by the dynamic processes of convection and vortex. An apparent jumble with incontrovertible systems of order embedded and animating the scene - each piece of equipment, like the leaf and the loose paper, and each winding cable for that matter, has come out of the junk box, the op-shop, the hock-shop and off the street-side pile of domestic hard rubbish. The installation is elongated, and even inclined to vertically rise a set of gallery steps. The elongation, a stretching, serves to illustrate orders of detail available at differential scales and how they coalesce as nodes on a standing wave, like the undulating whirlwind column frozen in its sway and speaking of time and data spinning out from tight centripetal circles along a wandering traverse. Telltales blinking, leaking data and leaving trails. Feedback as elements leave the system like the flailing sensing of a whirlwind, and re-enter imprinted with the impressions of their collisions, for another go around.

[24] Linda Dement and Nancy Mauro-Flude, "Awry Signals, A Eulogy for the Stellar Girls", 2013, accessed May 26, 2015, https://bundanon.com.au/research-and-projects/siteworksXXX/artworks2013/.

[25] The Raspberry Pi project has its homepage at https://www.raspberrypi.org/.

[26] Python is an open source computer programming language, cf. https://www.python.org/.

Chapter 3

On Just Doing It

"[Our] function is to explore, discover, invent, solve problems, crack jokes, make music - all with love. In other words, create a magic world."
Valerie Solanas, SCUM Manifesto, 1967.[1]

Spot on and funny, with a turn of phrase that is charmingly direct. Descriptive, derisive and directive to action. Valerie Solanas, in her classic SCUM Manifesto, uses the literary device of allegory[2] - proposing the formation of a Society for Cutting Up Men, a science-fictional organisation of revolutionaries who in the order of a number of weeks or months[3] would bring about a liberation from patriarchy and the implementation of a leisure society and a better, free and open world. The suggestion is clear science fiction in so far as it rests upon the implementation of reproductive technologies to selectively breed an all female population. And allegorical in that by making such suggestion, and further proposing the elimination of living males, towards egalitarian and liberatory goals - the author highlights the patriarchy as a primary superstructure that contributes to social malaise, a power hegemon that hinders egalitarianism and suppresses liberation. Solanas uses descriptions of the characteristics and actions of the protagonists - "mindless, insecure, pandering male[s] ... [and] ... secure, free-wheeling, independent, groovy female[s]"[4] who go about variously enacting patriarchal control structures or subverting, bypassing or di-

[1] Valerie Solanas, *SCUM Manifesto*, (Oakland, CA: AK Press, 2013), ebook version, section "Suppression of Individuality, Animalism (domesticity and motherhood), and Functionalism".

[2] The etymology of the word allegory is from the ancient Greek allos *other* and agoreuo *I speak*, and is the device of saying one thing to mean or suggest another, often with a moral or political message. A figurative speaking. Solanas herself is quoted in an interview with Howard Smith for the *Village Voice* of July 25, 1977 as saying "It's hypothetical. No hypothetical is the wrong word. It's just a literary device. There's no organisation called SCUM...", cf Freddie Baer, *About Valerie Solanas*, http://www.womynkind.org/valbio.htm.

[3] Solanas, *SCUM Manifesto*, in the closing section the author declares "A small handful of SCUM can take over the country within a year by systematically fucking up the system".

[4] Solanas, *SCUM Manifesto*, section "Prevention of Friendship (Love)".

rectly confronting them - to deeply question social norms, and to reiterate that by our agency our social worlds are constructed.

The allegory, the literary device is a way of encoding a message, a way of delivering a critique, a way of expressing a desire for change. And the science-fictional telling of an imaginary other world, of another scenario, demonstrates the possibility, the probability, the curious nature of worlds and worlding. Where in the first chapter I have discussed relationships between the physical and the setting in which physical interactions take place, and in the second chapter looked at ways in which artistic devices can expand to tell their stories technoetically by innovative re-programming and re-purposing of technological media - in this chapter I will discuss artwork I have produced during this research project, utilizing the medium of an open source computer game engine. An iterative series of computer code performances, the *Fractures* series forms work that programmatically re-presents scenery and geometry from real and virtual worlds by the implementation of algorithms acting on data sets. This medium of the game engine is examined for its procedural and rhetorical action as a human|machine interface.

In Donna Haraway's most well known publication, A Cyborg Manifesto, "an argument for *pleasure* in the confusion of boundaries and for *responsibility* in their construction"[5] is put forward. Throughout the chapters of this document I hope I am illustrating something of pleasure that hovers in the play over those interstices between one thing and another, particularly in the contemporary context of technoetic art making. And that that pleasurable play of poiesis (which is cultural production) is accompanied by thoughtful, conscious, socially and emotionally constructive noesis - ways of knowing and being - descriptions and enactions of interstitial action extending, even if confusedly, across boundaries in excitedly uncertain and unexpected manner. It is interesting that Haraway describes using the device of "the cyborg as a fiction mapping our social and bodily reality and as an imaginative resource suggesting some very fruitful couplings"[6] in the *Cyborg Manifesto*. She uses the meme of our very intimate coupling with technology - the cyborg being a physical amalgam of organism and machine - as a springboard for critical discourse.

In this chapter *On Just Doing It* I wish to draw attention to the relational use of language devices in technoetic process, from the perspectives of formal computer programming language and in a literary sense as well. The artwork *Forest, Fracture*, 2015, presented for exhibition with this project, derives from a series of performances and recordings of computer graphics produced with live coded game engine software for HD projection. Figure 3.1 is a screenshot of an active live coding session within *Forest, Fracture*. Ian Bogost, a theorist and arts practitioner in new media, argues that the virtual worlds of game engines, which are procedurally generated interfaces between 'player' and simulation, are rhetorical zones. Rhetoric as Bogost describes it encompasses the kind of literary devices mentioned above. Rhetoric being "the field

[5] Donna Haraway, "A Cyborg Manifesto: Science, Technology and Socialist-Feminism in the Late Twentieth Century", in *Simians, Cyborgs and Women: The Reinvention of Nature*, (New York: Routledge, 1991), p 150, italics are original.

[6] Ibid., p 150.

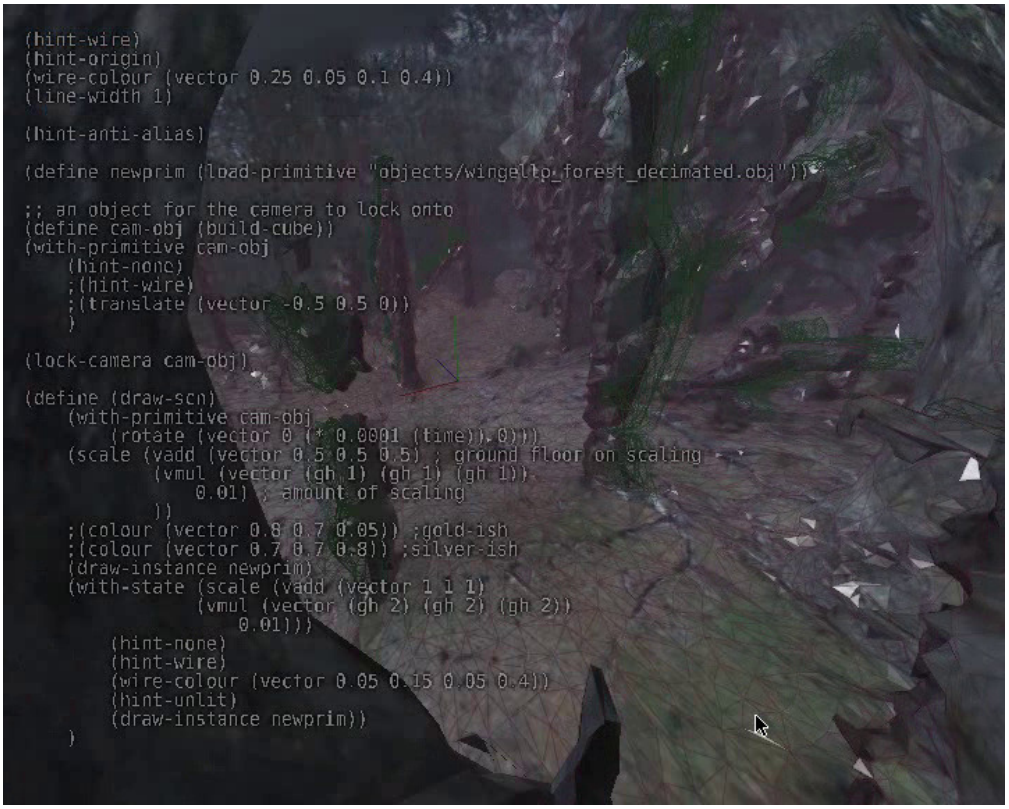

Figure 3.1: Still screenshot from *Forest, Fracture*, 2015, live computer graphics *fluxus* game engine session, Michael Petchkovsky. See the section Links to Online Material to access to further *Forest, Fracture* documentation.

of communication that deals with persuasive speech",[7] Bogost cites Kenneth Burke as expanding the concept of rhetoric beyond the oratory to look at how it operates in visual media, there as visual rhetoric.[8] Furthermore Bogost identifies a 'procedural rhetoric'[9] at play in this particular medium, the computer game interface. Process in Bogost's description of the computer game, the procedures around the gaming experience, includes the programmatic source code that models the rules of the virtual space and defines and negotiates the actions and interactions that will play out in there. More broadly Bogost uses the term procedure to describe structured behaviour,[10] sets of rules or constraints, descriptions of actions and things and their interactions. The procedural has a rhetoric in so far as these descriptions, these space and boundary interfaces may act persuasively, suggesting a particular course or outcome, or training and teaching the player, the audience. These intentionally constructed procedures, sets of rules, are conceptually

[7] Ian Bogost, "The Rhetoric of Video Games", in *The Ecology of Games: Connecting Youth, Games, and Learning*, editor Katie Salen, The John D. and Catherine T. MacArthur Foundation Series on Digital Media and Learning, (Cambridge, Massachusetts: MIT Press, 2008), p 123.

[8] Kenneth Burke, *A Rhetoric of Motives*, (Berkeley and Los Angeles, CA: University of California Press, 1969).

[9] Bogost, *The Rhetoric of Video Games*, p 125.

[10] Bogost, *The Rhetoric of Video Games*, p 122.

comparable to Haraway's responsibly constructed boundaries - and the game engine is indeed a human|computer interface, a medium of communication ripe for pleasurable, playful, boundary excursive instances of discourse.

Game engines are unified collections of software routines for the modelling of interactive virtual environments. Game engines provide structured sets of procedures for the drawing of three dimensional graphics, sound generation, responsive to user input with physics rules for the implementation of artificial gravity and so forth. The creative producer uses a game engine by providing it with geometry and graphics data, and by programming blocks of interaction and action within the available toolset of the virtual environment. A unique feature of the *fluxus*[11] game engine I have used for implementing the *Fractures* series, is that it is a live coding, live rendering software environment. *Fluxus* makes the display of lines and stanzas of computer language directly visible, the program blocks as they are typed, scrolling and actively modified by the user/performer, are overlaid on the visual display of the computer graphics that result from the code's execution, as seen in Figure 3.1. This overlay of text reveals the active source code that generates the game engine experience, which in Bogost's terms comprises an element of procedural rhetoric. The visibility of the software code also serves to foreground associations around free and open source software, the classification and presentation of types of intellectual property. Live coding virtual spaces, objects and interactions in the *fluxus* game engine is a direct implementation of technoesis with rhetorical impact.

Live coding is a performance practice that has arisen from computer hacking conferences and gatherings and real-time live computer audio and video performance settings.[12] It is a manner of sharing and appreciating programming technique and may be performed before large audiences, or as interactive art installation. Other well known live programming environments in the performance and installation art context are the packages ChucK, Impromptu, SuperCollider and Max/MSP.[13] Still images, code listings and recordings of live coding sessions are forms of documentary record, and can also be fed back in as source material to make further iterations of the existing work. In an earlier iteration of *Forest, Fracture* I have made a live coding performance of *Civil-Fracture*, Figure 3.2, in collaboration with Derek Carter and Alex Gereg, bringing street art and analogue synthesiser input into the game engine environment to explore themes of civil disobedience with a live audience. The software tool *fluxus* has been written and produced by artists working in the live coding field with the aim of facilitating and expanding this practice. The software is released as free open source as a distribution methodology, making it widely available to live coding practitioners, encouraging the development of a community around the use and performance of the tool. Open source refers to the free sharing (under one of several established licensing frameworks) of the actual computer source code that constitutes the program. Under typical commercial licensing frameworks the source code of a distributed program is regarded as proprietary intellectual property and is hidden from the end user in what

[11] *fluxus*, ©2007 Dave Griffiths, http://www.pawfal.org/fluxus/, released under the GPL licence.
[12] Nick Collins, "Live Coding of Consequence", *Leonardo*, Volume 44, Number 3, (2011), pp 207.
[13] Ibid., p 208.

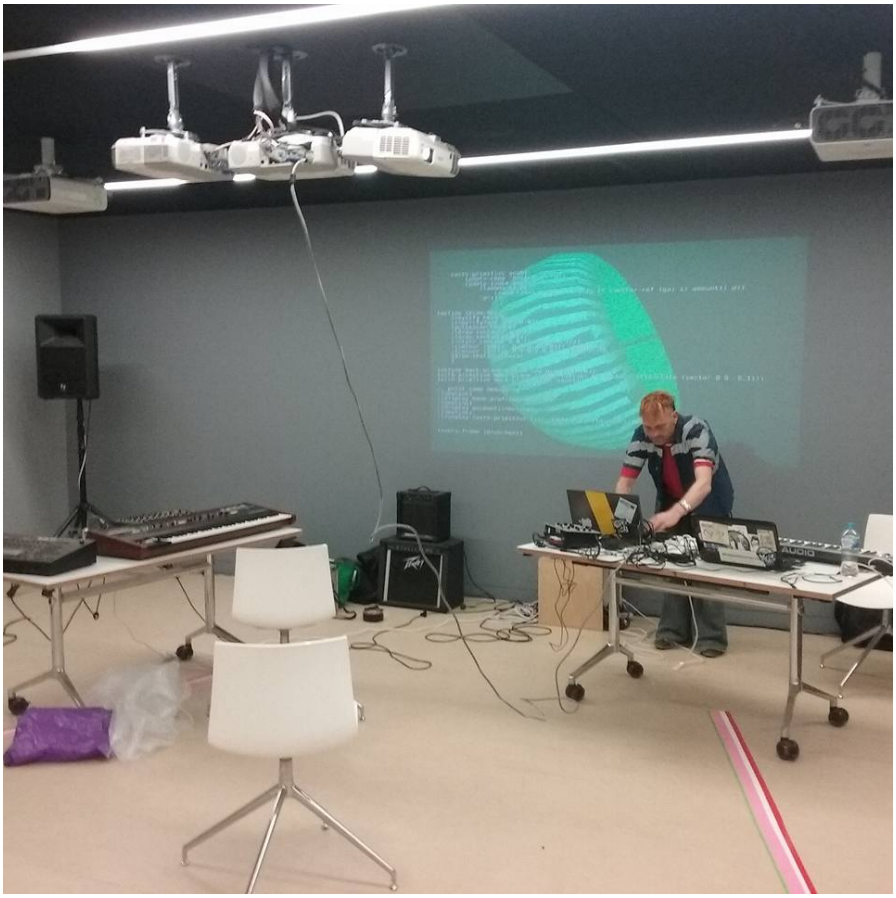

Figure 3.2: Michael Petchkovsky, *Civil-Fracture* live coding performance at MCA Artbar in collaboration with Alex ZAP Gereg and Derek Carter aka Doer as ZAPGALAXY+Doer+Petchkovsky, curated by Haines & Hinterding, August 28, 2015. http://www.mca.com.au/events/artbar-28-august-2015/. Documentary photograph of the installation courtesy of Derek Carter.

are referred to as compiled binary packages. With an application such as *fluxus* it is extremely beneficial to the end user community that the source code is available for study and modification, computer programmers learning much from looking at existing coding techniques and able to contribute novel source code to the project's continuation and evolution.

The software *fluxus* is described in its manual as named for "the idea of constant change (flux)"[14] as the live coder rapidly and interactively generates, executes and modifies mutable lines of instruction and description. It is notable that the *Fluxus* art movement espoused an emphasis on the creative process in action alongside anti-commercial, anti-art and do-it-yourself sensibilities although the software *fluxus* in its naming does not lay claim to identification with the *Fluxus* art movement there is undoubtedly something of the *Fluxus* œuvre to *fluxus*.

[14] From the *fluxus* manual file *fluxus-documentation-en.pdf* distributed with the software, http://www.pawfal.org/fluxus/packages/, p 2.

In a paper authored by Dave Griffith (the originating author of the fluxus software here described) et al,the suggestion is made that "[c]omputation is a metaphorical movement"[15] in the structured and iterative way computational processes transform data sets which are abstract representations. It is also noted that humans perform computation[16] in our embodied and organic, interactive, communicative, collaborative way. In fact we do it all the time, to pour water, to measure feelings, to make allegories, to oxygenate and decarboxylate our blood by altering breathing rhythm, to navigate dancefloors, to produce safe spaces, and so on. The

Figure 3.3: *Daisy Chain*, live coding system in *fluxus* environment by Dave Griffiths, September 25, 2007, image released under the Creative Commons Attribution - Share and Share Alike 2.0 Generic license, https://www.flickr.com/photos/dave-griffiths/143 6996641/in/album-72157606702470971/.

paper *Visualisation of Live Code* describes a livecoding presentation as a kind of concrete poetry performance, where "our eyes saccade across code, the shapes on screen are categorised into these symbols, and we perceive them as the tokens (words) and statements (sentences) making up our program"[17] whilst simultaneously we see the code algorithms function to draw complex, representational figures. The 'metaphorical movement' is live presented in action.

Griffiths has made use of *fluxus* to produce, share and perform further programs that are

[15] Dave Griffiths, Alex McLean, Nick Collins, Geraint Wiggins, "Visualisation of Live Code", in *Proceedings of Electronic Visualisation and the Arts London, 2010*, edited by Alan Seal, Jonathan Bowen, Kia Ng, (London: BCS, 2010). http://www.bcs.org/upload/pdf/ewic_ev10_s2paper1.pdf, p 28.
[16] Griffiths et al, "Visualisation of Live Code", p 27.
[17] Ibid., p 26.

visually metaphoric of computational process. His *Daisy Chain*,[18] Figure 3.3, represents blocks of functional sound producing code as visual tokens, animated flowers that move both in user directed and in self directed manner. The program blocks actively modify their own structure and the structure of the visual/sonic environment they inhabit as they run live, and the live coding performer has full access to make syntactic, procedural modifications to the code as it runs. Another *fluxus* based work of Griffiths' *Al-Jazari* populates a virtual 3D world with robots whose 'thought bubbles' the interacting user can modify and reprogram "with the aim to increase the accessibility of live coding to the point where anyone can become a live coder".[19]

The open source project, which is the genesis and distribution method of software tools such as *fluxus* is a mass collaborative sharing of the process of computer program writing, where many authors contribute to the actual source code of the software tools they use, and share those contributions freely as useful, functional intellectual property. The GNU Manifesto[20] in fine sci-fi-critical style says "In the long run, making programs free is a step toward the postscarcity world, where nobody will have to work very hard just to make a living. People will be free to devote themselves to activities that are fun, such as programming, after spending the necessary ten hours a week on required tasks such as legislation, family counseling, robot repair and asteroid prospecting. There will be no need to be able to make a living from programming."

Early in the course of undertaking this MFA research project it was necessary to establish a platform of software tools, anticipating a set of digital production needs, *fluxus* being a core tool amongst those. Wherever possible I make use of open source software, this is a philosophical and political stance that I have adhered to for many years in my own practice. I rely on my experience working with open source, my own familiarity with existing software packages and access to the research community of developers who maintain and expand the base of available free software tools - particularly in the field of computer graphics. I find involvement with open source to be productive, engaging, discursive and fertile terrain for the practice of contemporary cultural production in the electronic medium.

A computer program is a fluid and malleable thing as a technoetic language device, and able to self-replicate. My use of the open source GPL licensed program *fluxus* is in accord with the rights afforded by the GNU Manifesto, the GNU Manifesto is implicitly included in the source of all GPL licensed programs as a condition of their use and distribution, a procedural block that makes the GPL license possible to implement by describing a rationale and a methodology of software production and copying. It is therefore possible to look at the GNU Manifesto as a language program block, part of the software that is produced, copied and distributed. The GNU Manifesto has fed and gone into the artwork *Forest, Fracture*, as an idealistic, perhaps allegorical, rhetorical, reproductive computer virus.

Figure 3.4 shows a still frame from the first recording I made of live generated, audio respon-

[18] Which is described in Griffiths et al, "Visualisation of Live Code", p 29.
[19] Griffiths et al, "Visualisation of Live Code", p 30.
[20] The GNU Manifesto was written in 1985 by Richard Stallman, http://www.gnu.org/gnu/manifesto.html, accessed 26 September, 2015.

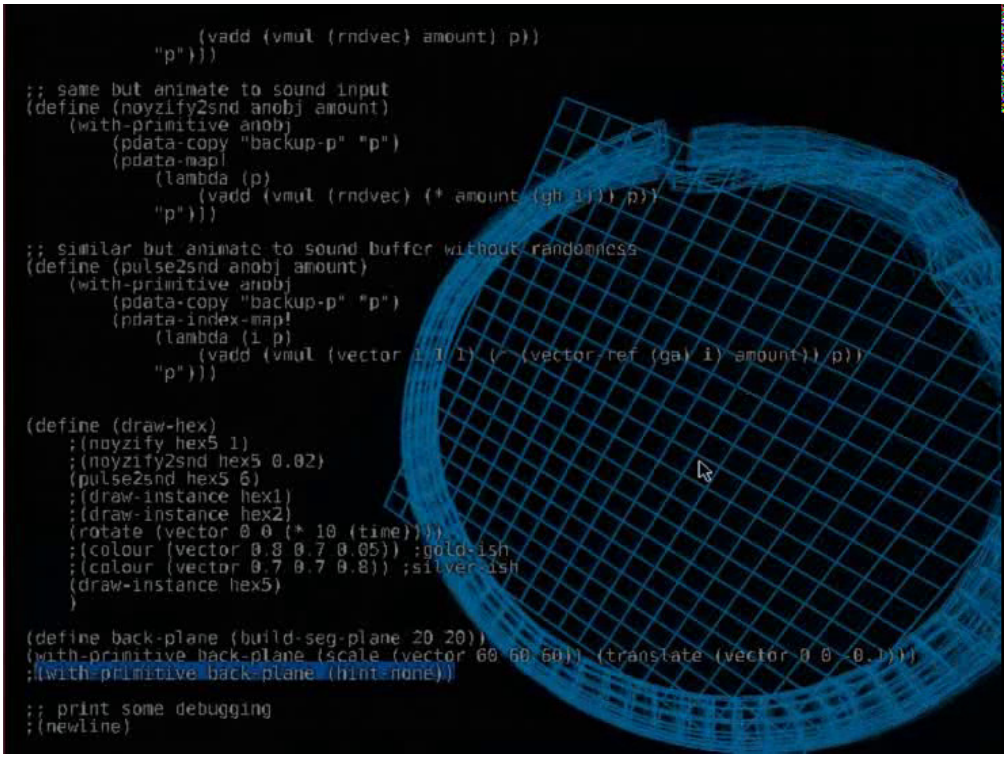

Figure 3.4: Still screenshot from the recording *circle_geometries-Fracture_01-MKP-2013.avi*, a *fluxus* game engine session produced as a study for *Forest, Fracture*, Michael Petchkovsky, 2013. See the section Links to Online Material to access the full video file.

sive computer graphic geometry produced with the set of software tools described above. The five minute animation *circle_geometries-Fracture_01-MKP-2013.avi* is a recorded example of live coding. Mouse and text insertion cursors are visible on screen as I scroll and type and move the viewpoint of the virtual camera. Changes made to the code structure are visualised as the syntax describing the forms on screen simultaneously updates the appearance of basic geometric forms, their shape, colour, texture, and scale, and the environment of their rendering simulated light effects, background appearance, fogging, blurring and so on. The scene is further animated as I move through the code and change variables such as the number of sectors composing the torus. I make use of commenting (the placement of semi-colons at the start of a line) both to add information to the text in human-readable form, and as a shortcut where I can switch a line in and out of the execution loop by inserting or deleting the commenting semi-colon. The role of language is foreground in this medium, like concrete poetry the shapes of the flowing text structures enunciate their function and meaning. The syntax of each function and statement directly shapes the graphic forms that are rendered on screen. There is meta information contained in commenting and the naming of functions and variables. Code and its computation is perceived and seen to be malleable.

Further iterations of the initial *circle_geometries-Fracture_01-MKP-2013.avi* code I tested for drawing and manipulating virtual geometries have developed into the code of *Forest, Fracture*, seen back at Figure 3.1, where several layers of data manipulation are applied. Most obviously there is a rendition of the surface data in wireframe depiction, outlining the vertex and vector nature of the displayed data. It may be noted that multiple copies of the data sets are present, and they are treated differently. A green reminiscent of early monochrome computer display (or perhaps reminiscent of organic growth, or of toxicity) is applied to one wireframe which conforms tightly to another wireframe in grey, then the green wireframe jumps out of sync as its scale and position is modified by code block alteration. A third copy of the data is presented with colour texture derived from the original photographs. Lighting effects pick out the faceted quality of this algorithmically smoothed and artificially shiny surface representation data. Analogue electronic synthesised sound mixed with live microphone monitoring, pervades and further animates the scene. The sound and visual interaction is erratically punctuated by signal level peaks and vibrates with the synthesised strain of sine waves affecting the geometric meshes. With text code overlaid the animated image speaks of imagined space and cultures and of a dissatisfaction with present day unsustainable ecological practice and dystopic outcomes therefrom. In their raw electronic quality and interactive immediacy the sound elements act to highlight the constructed nature of the visual scene by another mode again.

Implementing this 'procedural rhetoric' - through live coding as in the artwork *Forest, Fracture*, through interstitial play that opens fractures, through structuring lyric poetic stanzas as does Jaromil, or setting out imaginative and allegorical science-fictional scenarios like Solanas - relational dynamics are apparent between consciousness and linguistic and non-verbal processes, and the previously mentioned noesis, poiesis and agencies at play. In terms of 'just doing it' the game engine is operating as a direct programmatic implementation of virtual world construction. Understood as procedural rhetoric it is not only the program code, but its metaphorical action in producing visual rhetoric that simulates lived experience in affective interface with an audience that is the mode of doing things in this contemporary medium. The models that Barbara Maria Stafford references,[21] of mirror neurons running processes that are computed on the hardware of our minds, can be seen in this context as part of what we do autonomically as well as consciously, as we are doing it, synchronizing information and sensory data, matching congruences, making associations that are recursive and feedback enriched, as cultural producers, as subjects, objects and communicators, as human beings. Interestingly this is an implementation of contemporary scientific realist models of the physical organic structure of our conscious processes, the synapses of the mirror neurons described. Stafford's comparison of the contemporary model with a parallel train of thought in Enlightenment Associationist ideas of a "culture of sensibility"[22] where "thought and learning become kinetic and very physical"[23] serves both to embed knowledge pro-

[21] Barbara Maria Stafford, "Hedonics", in *Sensorium: Embodied experience, technology, and contemporary art*, editor Caroline A. Jones (Cambridge, Massachusetts: MIT Press, 2006), p 152.
[22] Ibid., p 153.
[23] Ibid., pp 151-152.

duction processes in the bodily, and to critique contemporary knowledge claims by presenting an alternate paradigm that enunciates the process of noesis in a more romantic language than that of Scientific Realism. As much cyborg as the idea of our brains being computers running on the matrix of our experience and interaction with the world is - 19th Century British Associationists[24] understood "a powerfully hedonic alternative to propositional or analytical thought"[25] to be the basis of our physical, organically embodied sensory interaction with the world.

Yet another phrasing of this methodology of the language device in contemporary electronic media is given by Virginia Barratt who describes the VNS Matrix, an Australian art collective of

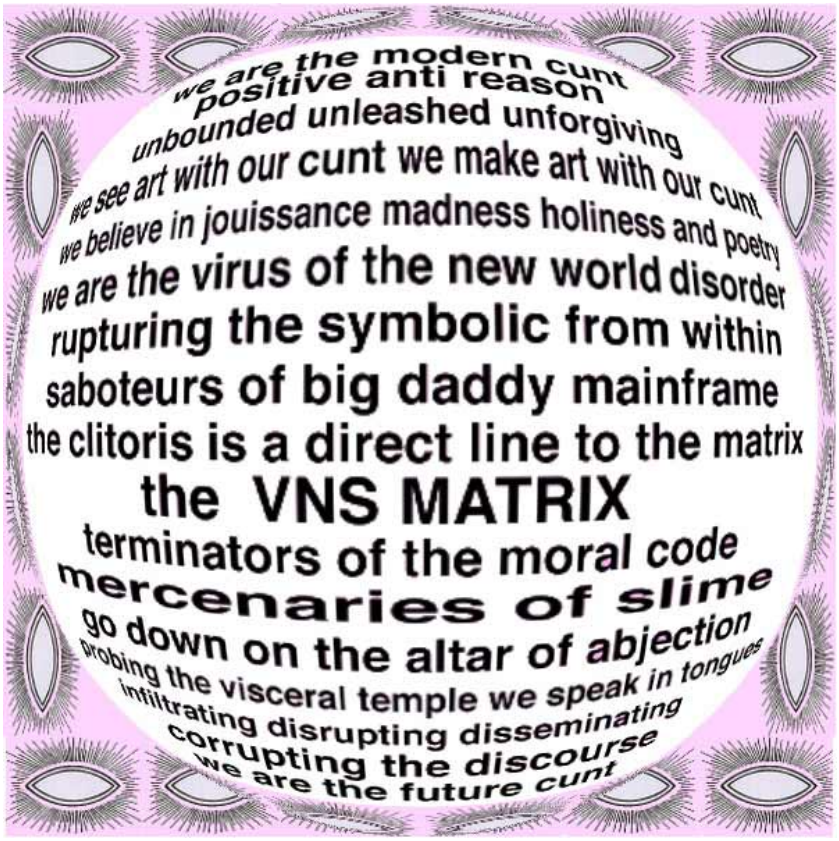

Figure 3.5: VNS Matrix, *Cyberfeminist Manifesto For the 21st Century*, 1991, Josephine Starrs, Francesca da Rimini, Julianne Pierce and Virginia Barratt, accessed September 30, 2013, http://www.sysx.org/gashgirl/VNS/TEXT/PINKMANI.HTM.

which she is a founding member, as producing "a linguistic weapon of mass instruction"[26] with their 1991 artwork *Cyberfeminist Manifesto for the 21st Century.* The *Cyberfeminist Manifesto for the 21st Century* announces its program in text, see Figure 3.5, "we are the virus of the

[24] Ibid., p 150.
[25] Ibid., p 152.
[26] Virginia Barratt, *VNS Matrix: Selected Curriculum vitae*, (2015), http://virginiabarratt.net/VNS_cv.pdf, p 1.

new world disorder", describes procedures such as "rupturing the symbolic from within" acting allegorically as "saboteurs of big daddy mainframe... terminators of the moral code... disrupting the discourse... we are the future cunt".

Conclusion

"The time has come, the Walrus said. Perhaps things will get worse and then get better. Perhaps there's a small god up in heaven readying herself for us. Another world is not only possible, she's on her way. Maybe many of us won't be here to greet her, but on a quiet day, if I listen very carefully, I can hear her breathing."
Arundhati Roy, "come september", in The Ordinary Person's Guide To Empire, 2004.[1]

In describing her own writing practice Arundhati Roy says "[f]iction and non-fiction are only different techniques of storytelling".[2] She speaks about the plurality of voices that describe ways of seeing, and in doing so, in sharing points of view, they analyse power dynamics, they engage as they recount stories.[3] Stories come to us and we can but re-tell them, re-present. "They insist on being told... wrenched out by the aching, broken world I wake up to every morning."[4] The essay *come september* is a wrenching out of the threat of the return of fascism,[5] of America as documented by Noam Chomsky.[6] And in the same collection, in *the loneliness of noam chomsky*,[7] Roy gives credit to Chomsky's "mass of evidence... formidable. Terrifying, actually"[8] that has been collated and published on the subject of misuse of power by the military industrial complex, contemporary imperialism. These are rhetoricians, Roy and Chomsky, social commentators of a particular political bent. They are both expert users of language and here in Roy's instructive *Ordinary Person's Guide* an allegorical world declared by a story telling Walrus, is breathing and on her way, and a lonely function of recording and describing the power dynamics, the

[1] Arundhati Roy, "come september", in *The Ordinary Person's Guide To Empire*, (London: Flamingo, 2004), p 40.
[2] Roy, "come september", p 13.
[3] Ibid., p 14.
[4] Ibid., p 13.
[5] Ibid., p 14.
[6] Ibid., p 17.
[7] Arundhati Roy, "the loneliness of noam chomsky", in *The Ordinary Person's Guide To Empire*, (London: Flamingo, 2004), pp 41-66.
[8] Roy, "the loneliness...", p 48.

social relations, the procedures of empire is "only *one* of the ways in which Noam Chomsky has radically altered our understanding of the society in which we live".[9] Roy elaborates this story of media analysis in a way that resonates with Bogost's descriptions of procedural rhetoric, structured and instructional speaking, when she self-corrects her turn of phrase regarding what it is Chomsky's work helps us to understand - the society in which we live being better referred to as "the elaborate rules of the lunatic asylum in which we are all voluntary inmates".[10] This could be subject matter for a computer game, a programmatic, hacked, hallucinatory, rhetorical story line. This bunch of words.

We have drifted from quantum physics to here as surely as the noble protagonist of Margaret Cavendish's *Description of a New World* was blown by the winds and guided by the gods in a boat adrift towards the icy pole of her world and beyond on to the pole of another *Blazing World*,[11] waves propagating in an imaginary æther, a medium analysis. Donna Haraway when talking about the quantum says "the boundary between physical and non-physical is very imprecise for us..."[12] and this is in complete concurrence with scientific realist descriptions of the universe that quantify a limit to precision of measurement somewhere on the order of the Planck constant, h.[13] Being a region of boundary breakdown makes the quantum realm a place where radical contemporary, and activist, "political-fictional (political-scientific) analysis [is] possible".[14] This research project describes such analytical manoeuvres as noetic ways of being and understanding in the world, and technoetic in so far as they utilize concepts and materials of technical and scientifically derived mediums such as the contemporary electronic media.

The work *The Regard of a Motive Force* takes measurings and has its measure taken, making measurements in regions of the unknown. Research into interactive modes of measurement is continuing as I develop e-field sensor equipment, Figure 4, and related technologies for entity detection and interaction in space. This kind of sensory system is responsive to the presence and proximity of spectators in space. Using radio wave frequencies distributed by shaped antennæ these circuits allow an audience interactive human|machine interface. Other implementations of this kind of sensory system are seen in three dimensional room scanning devices using structured light and offset photographic techniques to generate spatial awareness. It is quite

[9] Ibid., p 47.

[10] Ibid., p 47.

[11] Margaret Cavendish, *The Description of a New World, Called the Blazing World* (London: A. Maxwell, 1668), the opening paragraph.

[12] Donna Haraway, "A Cyborg Manifesto: Science, Technology and Socialist-Feminism in the Late Twentieth Century", in *Simians, Cyborgs and Women: The Reinvention of Nature*, (New York: Routledge, 1991), p 153.

[13] The Planck constant, h, is the smallest unit of action, a measure of energy across time in units of joule seconds, $J{\cdot}s$. The photon was identified as a discrete particle within the light wave when it was conceptualised that a Planck constant's worth of $energy \times time$ at the wave's frequency was equivalent to a description of an uncharged particle, by Einstein in the formula $E = hf$. So the Planck constant, h is a resolution of wave|particle duality, energy E also being equivalent with physical mass multiplied by the speed of light squared, $E = mc^2$. And h is also a limit to measurement, the smallest quantum of energy over time, it is a boundary between physical and non-physical. Measurement in a quantum physical universe can never be precise because the Planck constant intervenes to prevent measurements beyond the scale of h. This is the *uncertainty principle* of quantum physics, $\sigma_x \sigma_p \geq \frac{\hbar}{2}$. A relationship between position and momentum that is mutually exclusive of measurement below the reduced Planck constant, $\hbar$, that is $\frac{h}{2\pi}$, divided by two.

[14] Haraway, "A Cyborg Manifesto", p 151.

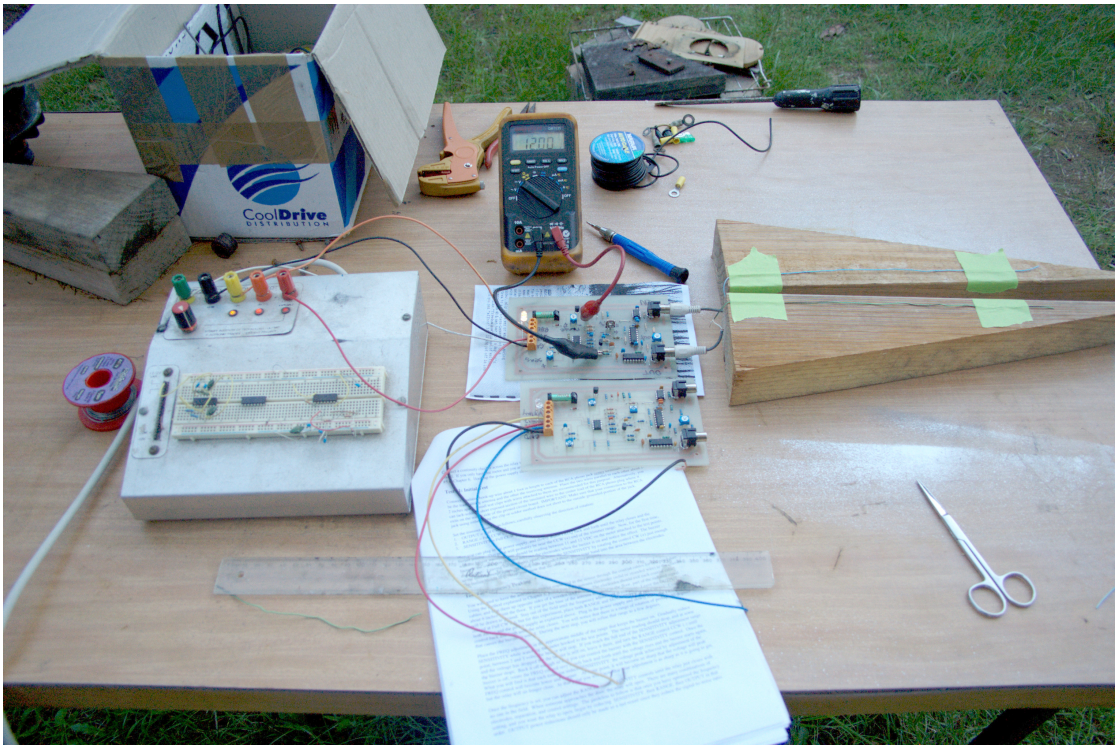

Figure 4: Etched and assembled circuit boards for electric field sensor equipment under test conditions, Michael Petchkovsky, 2014. The custom built electronic circuits pictured here are built according to Russel Bik's "People Detector" plans, which are made freely available for non-commercial use by Russel Bik Design, *Electric Field Proximity Sensor*, accessed November 30, 2014, http://www.bik.com, which Bik developed in cooperation with the MIT Media Lab.

conceivable that radio wave frequencies distributed by shaped antennæ could find application beyond the bounds of earth as well and areas for further study include the Very Low Frequency natural radio spectrum[15] and amateur radio astronomy and optical SETI.[16] These measuring, sensing, responding devices are under research here for their potential in expanding and facilitating space for interactive, cross-boundary discourse. Speaking on poietic systems at Aarhus University's 2014 *Anthropocene: Arts of Living on a Damaged Planet* conference[17] Donna Har-

[15] The VLF radio spectrum contains audio frequency natural radio signals known as sferics, tweaks and whistlers that are the results of atmospheric electrical activity and that propagate around the globe by electromagnetic wave refraction between the earth and the ionosphere, cf. the Inspire Project, "Types of VLF Radio Signals," accessed November 30, 2014, http://theinspireproject.org/default.asp?contentID=17.

[16] Amateur built radiotelescope antenna arrangements can be aligned to extraterrestrial radio sources such as electrical storms on Jupiter, cf. Mal Wilkinson and John Kennewell, "Detecting Jupiter's Radio Emissions", *Southern Sky*, (July/August, 1994), http://www.spaceacademy.net.au/spacelab/projects/jovrad/jovrad.htm. Equipment for the detection and sending of interstellar nanosecond laser pulses is under study in the field of Search for Extra-Terrestrial Intelligence in the visible light spectrum, cf. Ragbir Bhathal, "Microwave and Optical SETI Searches", *Australian Institute of Physics, 18th National Congress*, (Adelaide: November-December, 2008), http://www.aip.org.au/info/sites/default/files/Congress2008/AIPC2008/PDF/AUTHOR/AP081049.PDF.

[17] Donna Haraway, "Anthropocene, Capitalocene, Chthulucene: Staying with the Trouble", talk presented at the *Anthropocene: Arts of Living on a Damaged Planet* conference, (Denmark: Aarhus University, May 9, 2014), http://anthropocene.au.dk/arts-of-living-on-a-damaged-planet/.

away draws an important distinction between world modelling paradigms that are conceptually closed and homeostatic, and those that are symbiotic and interdependent. She cites the natural sciences as revealing complex cross species interdependencies that are generative examples of sympoietic life, for example the symbiotic relationship between Hawaiian bobtail squid and light emitting bacteria that live in specialised structures within the squids' skins and appear "like a starry sky from below so that [the squid] can swim along and get its prey".[18] Relational dynamics spanning from the sea floor to the realms of the distant constellations. With a sense of

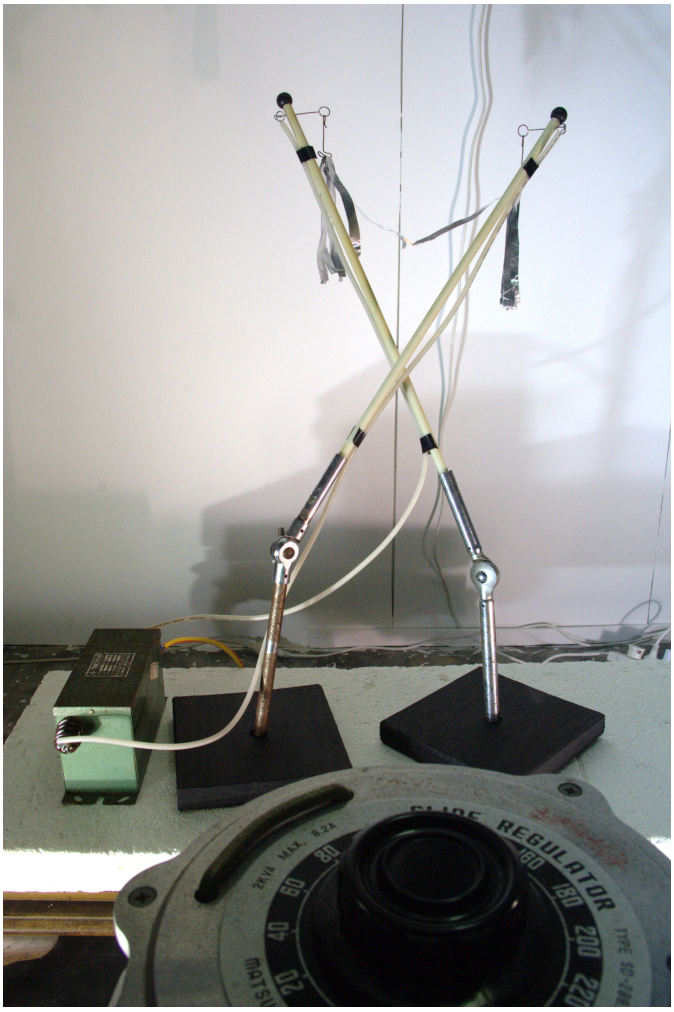

Figure 5: *The Regard of a Motive Force* documentary photograph, Michael Petchkovsky, 2015.

realism informed by Karen Barad's kind of agential sensibilities, I am inspired by science fiction

[18] A text transcript of Haraway's talk, "Anthropocene, Capitalocene, Chthulucene: Staying with the Trouble", is available at http://opentranscripts.org/transcript/anthropocene-capitalocene-chthulucene/, from which the above quote is sourced.

author Ursula Le Guin's *ansible*[19] in the setting up and operation of *The Regard of a Motive Force*, Figure 5. The *ansible* is a fictive device of interstellar communication. In Le Guin's *The Left Hand of Darkness* a cultural envoy must be able to communicate with far distant colleagues whilst in the field. Because radio communication would not be practicable at light speed between the stars a quantum entangled communications channel is devised for instantaneous, faster than light, metaphysical telepresence. The *ansible* is a plausible device by the standards of scientific realism, a shimmering semaphore mediated by quantum strangeness that communicates by forces propagating through another, ætheric, quantum, literary space.

Willy-willy has been seen to function as a literary whirlwind, its détourned parts brought together blurring boundaries between the wavelike signal and the physical media of signal playback, and spinning back out to reveal expanded structural detail of its form and function. Flitting between virtual and real, iterating feedback loops, I have considered the scaling and placement

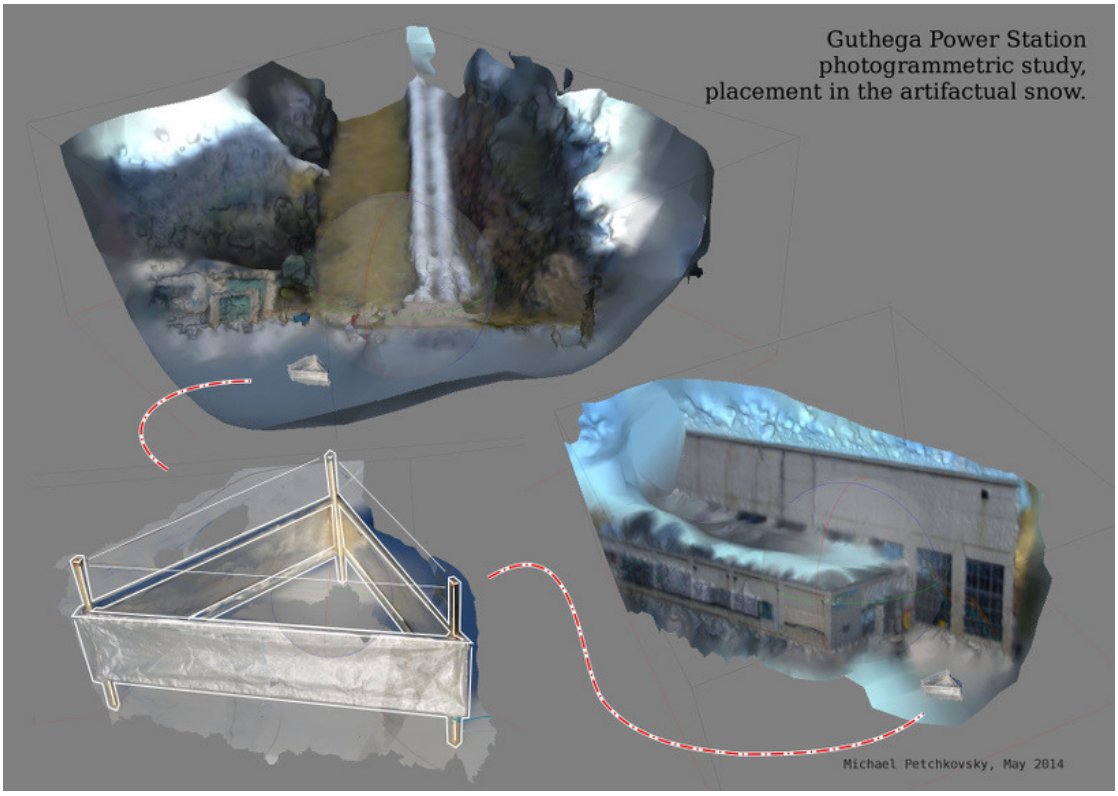

Figure 6: Study for placement of *lifter* devices in virtual environments, Michael Petchkovsky, 2014.

in environment of further technoetic devices, for example the construction of high voltage electrogravitics[20] energy devices such as *lifters*[21] as seen in Figure 6. *Lifters* use electrostatic forces,

[19] Ursula Le Guin, *The Left Hand of Darkness*, (London: Futura (Orbit), 1981), (first published 1969).
[20] Rho Sigma, *Ether-Technology: A Rational Approach to Gravity-Control*, (Published by Rho Sigma, 1977).
[21] cf. the website of J L Naudin, http://jnaudin.free.fr/lifters/main.htm, for more information regarding *lifter* design and construction.

generating electrostatic wind to fly when their aluminium foil and balsawood frames are energised at the kilovolt levels obtainable from neon sign transformers and similar devices, bridging the physics of electricity with outsider science research into spacecraft propulsion technologies, evoking science-fictional associations with ufology and modes of travel between the worlds.

Forest, Fracture establishes a visual, procedural rhetoric as a technoetic language device, programmed and structured and transparently referencing its own source code overlaid as it functions to represent a stretching of a gap between represented forms of boundary delineation and the ways they move in the game engine interface - the work uses procedural rhetoric in its manifestation. What all these rhetorics are signalling is open to interpretation. Donna Haraway says about the signal "Our best machines are... nothing but signals, electromagnetic waves, a section of the spectrum"[22] speaking both literally to describe contemporary communications technologies, and allegorically where her cyborg device, the machine that is the exemplar of the eponymous *Cyborg Manifesto*, is "ether, quintessence"[23] that is an agency that works across and beneath boundaries, that is a substrate for discourse and action, a special fifth state, a figure of speech. Words.

Barbara Maria Stafford refers to the terrain as the "problem of the relationship between abstract mental structures and the real world of specific events ... shared by biological research and aesthetic practices".[24] In this case she is linking contemporary scientific realist models, the biology of consciousness studies, mirror neurons in organic interface with otherness in the world, and historical cultural practices like poetry writing as understood by thinkers of the Enlightenment period. Donna Haraway goes to the organic, biological matter, beyond the technical innovation of the cyborg, and suggests that the works of feminist science fiction authors like Ursula Le Guin are sowing worlds with their stories.[25] This is a fecund form of hybridising, sympoietic propagation that is to be encouraged, that is vital and *pleasurable*.

In closing I would like to draw a link between conscious implementation of technoetic procedural rhetoric, and the means of production as understood by Antonio Gramsci. The techné being the means in technoetic poietic work. The open source computer software that is transparently referenced in *Forest, Fracture* and its production and distribution methods and general utility form a good example of a real world ownership of means of production by a model that is framed against the prevailing cultural hegemony of corporate intellectual property rights standards, in that the software is produced and owned in toto by those who use and share it. Copyright is copylefted. As Gramsci enunciated[26] there are enormous power dynamics at play that function precisely through the implementation and practice of cultural hegemony. Valerie Solanas

[22] Haraway, "A Cyborg Manifesto", p 153.
[23] Ibid., p 153.
[24] Barbara Maria Stafford, "Hedonics", in *Sensorium: Embodied experience, technology, and contemporary art*, editor Caroline A. Jones (Cambridge, Massachusetts: MIT Press, 2006), p 150.
[25] Donna Haraway, "Sowing Worlds: A Seed Bag for Terraforming with Earth Others", in *Beyond The Cyborg: Adventures with Donna Haraway* by Margret Grebowicz and Helen Merrick, (New York: Columbia University Press, 2013).
[26] Antonio Gramsci, *Selections from the Prison Notebooks*, translated by Geoffrey N. Smith and Quintin Hoare, (New York: International Publishers, 1971).

recognised and subverted this in her *SCUM Manifesto*, suggesting radical hypothetical imaginative hegemonic restructure. The means employed by artists such as Denis Jaromil Roio and Linda Dement, Dave Griffiths and Ian Bogost, Stephen Jones and The VNS Matrix, Margaret Cavendish, Mary Shelley and Ursula Le Guin are actively owned by the practitioners as they deeply understand and make use of them in their cultural production efforts. To use contemporary slang one could say that these artists are pwning[27] the means of production. And in terms of the power dynamics of cultural hegemony this is progressive work, this seeding, this generativity, this playful expression of hope.

[27] The misspelling of the word own as pwn is taken to indicate a full spectrum, appropriationist taking of possession, an ownership accentuated by deep knowledge of the systems under investigation and an almost casual, at least error tolerant facility as a computer game player. See for example http://www.urbandictionary.com/define.php?term=pwn. The term is said to originate from a typographic error in the map design of a level of a multiplayer online computer game, where the letters P and O are side by side on the QWERTY keyboard, ironic and purposeful use of the misspelling being widely adopted as a figure of speech among online communities.

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List of Figures

Appendix, List of Exhibitions

31 July - 13 August, 2013. *Willy-willy*, Michael Petchkovsky. Exhibited at *Retro-Specs*, curated by Julie Doye, M2 Gallery, Shop 4/450 Elizabeth Street, Surry Hills, Sydney. http://m2gallery.com.au/Exhibitions/tabid/87/listid/35/Default.aspx.

22 June, 2014. *The Regard of a Motive Force*, Michael Petchkovsky. Exhibited at *BLACK-MODULAR (First Edition)*, curated by David Haines, MAP Blue Mountains, Modern Art Projects. http://www.modernartprojects.org/blackmodular-first-edition/.

28 August, 2015. *ZAPGALAXY+Doer+Petchkovsky*, collaborative and immersive live coding performance with fluxus game engine, *Civil-Fracture* code, Michael Petchkovsky, and audio and visual components by Alex ZAP Gereg and Derek Carter aka Doer. At *MCA Artbar*, curated by Haines & Hinterding, Museum of Contemporary Art, 140 George Street, The Rocks, Sydney. http://www.mca.com.au/events/artbar-28-august-2015/.

23 - 27 February, 2016. *The Regard of a Motive Force*, and *Willy-willy*, and *Forest, Fracture*, Michael Petchkovsky. Postgraduate Degree Show, SCA Galleries, Building 29, Sydney College of the Arts, University of Sydney, Balmain Road, Rozelle.

Catalogue of Work Presented for Examination

23 - 27 February, 2016. Postgraduate Degree Show. SCA Galleries, Building 29, Sydney College of the Arts, University of Sydney, Balmain Road, Rozelle.

Willy-willy, 2013, Michael Petchkovsky. A real time sound and image sculpture. A free standing sculptural arrangement of three pieces of electronics equipment: oscilloscope, sampler/sequencer and amplifier/speaker or headphones on a low plinth. Dimensions variable.

The Regard of a Motive Force, 2014, Michael Petchkovsky. A high energy kinetic and video sculpture. A free standing interactive high voltage installation for performance and documentation. Dimensions variable.

Forest, Fracture, 2015, Michael Petchkovsky. An audio responsive computer graphics live coding HD projection installation. Dimensions variable.

Links to Online Material

Relevant material, digital content produced during this research project is made available on the author's website:

http://www.michaelpetchkovsky.org/MFA/WaveForm_WaveFunction/resources/

Video files mentioned in this paper are downloadable at the following URLs:

Video footage, *Electroscope Arrangement*, study for *The Regard of a Motive Force*, Michael Petchkovsky, 2014. http://www.michaelpetchkovsky.org/MFA/WaveForm_WaveFunction/resources/ElectroscopeArrangement/

Video footage, VLF natural radio recording at Hazelbrook, NSW, Australia, 28 June, 2013, displayed as Lissajous figure on oscilloscope screen. Study for *Willy-willy*, Michael Petchkovsky. http://www.michaelpetchkovsky.org/MFA/WaveForm_WaveFunction/resources/VLFrecording/

Forest, Fracture recordings of live coding performances. http://www.michaelpetchkovsky.org/MFA/WaveForm_WaveFunction/resources/ForestFracture/

Recording *circle_geometries-Fracture_01-MKP-2013.avi*, a *fluxus* game engine session produced as a study for *Forest, Fracture*, Michael Petchkovsky, 2013. http://www.michaelpetchkovsky.org/MFA/WaveForm_WaveFunction/resources/CircleFracture/