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“All Systems Go!” Flux + Cybernetics = Art Machines

Su Ballard

Imagine admiring a caged bird and it suddenly squawking, “All systems go! All systems go!” It would be quite a moment. In 1971 artist Hans Haacke named a caged mynah bird after the founder of cybernetics Norbert Wiener. ‘Norbert’ the bird was trained to speak the catch phrase of the late 1960s: “All systems go!” But all did not go to plan; Haacke’s exhibition at the Guggenheim was cancelled and the bird remained mute in the studio. Despite its failure to be realised the work lives on as an evocative example of art’s engagement with real-life and real-time systems. At the same time that Haacke was creating numerous works exploring the broad contexts of systems, including polling systems and critical environmental systems, Jack Burnham (a curator and good friend of Haacke’s) was connecting systems thinking directly with art practice. Artists including Haacke, La Monte Young, John Cage and Nam June Paik were looking for ways to open up the properties of the art object to relationships of time, control, biology and communication. In thinking about their work Burnham wrote:

> While the system is a fundamental concept of cybernetics, its value as an artistic idea lies in its power to cope with kinetic situations, and particularly the connecting structures of evolving events.[1]

Burnham realised that Norbert Wiener’s description of cybernetic systems as evolving relational events tempered by feedback, offered a challenging concept by which art could inhabit new environments, new machines and new materials.

In his 1998 commemorative lecture for the Kyoto Prize ‘Norbert Wiener and Marshall McLuhan: Communication Revolution’ Nam June

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Jack Burnham, ***Beyond Modern Sculpture: The Effects of Science and Technology on the Sculpture of This Century***, New York and London: G. Braziller, Allen Lane, The Penguin Press, 1968. p.318.

Paik wrote that Wiener "construct[ed] the technical interior of the electronic age."[2] In 1950 Wiener had famously defined cybernetics as the science of communication and control between humans and machines, and/or machines and machines. The relationships he described were more than ones of simple stimulus and response; they were circular and occurred in a variety of environments through an assemblage of systems. Wiener identified systems as organic and artificial, human and non-human. Occupying the systems were machines. These machines used "sensory members" to respond to and monitor feedback.[3] The slippage here is crucial to the way that artists in the 1960s and 1970s developed concepts from cybernetics. If feedback was regulated through sensory members, this could potentially mean that machines had 'senses' or equally, that humans were machines. The flux suggested between a human as a machine and a machine as a human presented fertile ground for imaginative couplings.[4] There was not a straightforward one to one relation between art and science, human and non-human, feedback and response. As systems themselves, art and cybernetics were infracted in each other. For example, in Paik's <TV Buddha>1974 a seemingly closed and meditative cybernetic system is interlaced by a viewer captured in the process of observation. In this and other works Paik extended possibilities within which the relationship between human and machine became more than one of feedback; it became systemic and aesthetic.

Cybernetics +

Cybernetics as a discipline grew out of a need to understand and map complexity and organisation, both social and biological. In his discussions in 『Beyond Modern Sculpture』 Burnham relied, in particular, on Austrian biologist Ludwig von Bertalanffy's biological definition of systems, writing: "systems, in essence, were the multileveled organisational structures of living forms, and very diverse systems could have very strong similarities according to the way they were organised."[5] Evelyn Fox Keller explains that these concepts of organisation and self-organisation were

2
Nam June Paik, "Norbert Wiener and Marshall McLuhan: Communication Revolution," 1998, http://www.inamori-f.or.jp/laureates/k14_c_paik/img/lct_e.pdf and http://www.inamori-f.or.jp/laureates/k14_c_paik/ctn_e.html.

3
Norbert Wiener, ***The Human Use of Human Beings***, 2nd ed., Boston, MA: Houghton Milfflin, 1954[1950], pp.24-25.

4
Pamela M. Lee, ***Chronophobia: On Time in the Art of the 1960s***, Cambridge, MA & London: MIT Press, 2004, p.62.

5
Jack Burnham, ***Beyond Modern Sculpture***, p.317. See also Luke Skrebowski, "All Systems Go: Recovering Jack Burnham's 'Systems Aesthetics,'" Tate Modern, 2006, http://www.tate.org.uk/research/tateresearch/tatepapers/06spring/skrebowski.htm.

necessary to counter the prevalent mechanistic and design-based accounts of life.[6] The discourse of cybernetics had moved quickly from Wiener's notion of the steersman to Humberto Maturana and Francisco Varela's models of the autopoietic living system; able to self-organise and couple and uncouple with its environment. Wiener had argued that machines and humans use sensory members to control noise and error. The explicitly biological model of second-order cybernetics understood that machines could be connected, and inside new relationships components could be differentiated and transformed. Although the systems that Wiener described were never static (growth or emergence occurred through self-regulation, a kind of self-observation from within the system)[7] in second-order cybernetics, the observer was no longer separated by boundaries of materials or technologies, but was another system engaging across and with that which he or she observed.[8] Self-organisation was not simply an internal mechanism of fluctuation and control but informed by environmental features often outside of the system's control.

Machines are always in action, inter-relations form and un-form, monitoring (observation) and further action mean that very quickly internal error, noise and external forces can also become integrated within the system. This definition of a machine formed from its relations influenced Gilles Deleuze and Félix Guattari's notion of a 'machinic assemblage.'[9] The machinic assemblage is not only formed from relationships of control and communication; Deleuze and Guattari open up the potential set of relations to include actions and energies that transform the bodies and machines involved. Guattari comments that Varela "characterise[s] a machine by 'the set of inter-relations of its components independent of the components themselves.'"[10] If the artwork is also understood as a machinic assemblage formed through transforming sets of inter-related components (both human and machine), then we can see how ideas from cybernetics continue to offer art a place within which boundaries of feedback and noise can be exploited and chance celebrated.[11] For the remainder of this essay I will call this cybernated machinic assemblage of art, the 'art machine.'

6
Evelyn Fox Keller, "Marrying the Premodern to the Postmodern: Computers and Organisms after WWII," in Darren Tofts, Annemarie Jonson and AlessioCavallaro, eds., ***Prefiguring Cyberculture: An Intellectual History***, Sydney and Cambridge, MA: Power Institute and MIT, 2002, p.60.

7
For von Foerster "systems achieved their apparent self-organisation by virtue of their interactions with other systems, with an environment." Fox Keller, "Marrying the Premodern to the Postmodern," p.60.

8
There is not time or space here to go into the important distinctions between first and second order cybernetics. See N. Katherine Hayles, ***How We Became Posthuman: Virtual Bodies in Cybernetics, Literature and Informatics***, Chicago and London: The University of Chicago Press, 1999. pp.73-75, 132-4.

9
For an excellent discussion of the machinic assemblage in these contexts see: John Johnston, "Machinic Vision," ***Critical Inquiry***, No. 26, Autumn 1999, pp.27-48.

10
Félix Guattari, ***Chaosmosis: An Ethico-Aesthetic Paradigm***, trans., Paul Bains and Julian Pefanis, Bloomington & Indianapolis: Indiana University Press, 1995, p.39.

11
Paik described the impact of cybernetics as "the exploration of boundary regions between and across various existing sciences." Paik quoted in Carolyn Kane, "The Cybernetic Pioneer of Video Art: Nam June Paik," ***Rhizome***, Wed May 6th, 2009,. http://rhizome.org/editorial/2009/may/6/the-cybernetic-pioneer-of-video-art-nam-june-paik/.

+ Flux

Steering between different systems and the shifting attentions of scientific discourse were numerous artists including Haacke and Paik, as well as George Brecht, Yoko Ono, Alison Knowles and Mieko (Chieko) Shiomi amongst others. This does not mean that these artists illustrated the ideas of science or cybernetics; as Pamela Lee comments, there was a current of systems thought occurring across social, cultural and scientific spheres and artists were part of the discussions.[12] George Maciunas named the artistic current, Fluxus and coordinated a series of festivals and events that represented a variously embodied attitude that explored moments when media, events, time, communication and artists intersected.[13] As Maciunas articulated it, flux focuses on the flow of materials in different environments. Influenced by John Cage's studies in chance and indeterminacy flux artists like Paik, Young and Dick Higgins, were making attempts to disengage feedback from regulation and the artwork from the object it embodied in. Rather than simply remodel objects, cybernetics as read by these artists became a tool to explore the possibilities and forces of the assemblage. Their practices were irreverent and experimental.

In 1968 and 1970 two exhibitions across two major centres of art production further tested the boundary regions between the science of cybernetics and the practices of art. Jasia Reichardt's <<Cybernetic Serendipity>> at the ICA in London and Burnham's <<Software, Information Technology: Its New Meaning for Art>> at the Jewish Museum in New York, were propositional, asking, in what ways could aesthetics and technology be considered together. Reichardt writes in the catalogue:

> the idea behind this venture […] is to show the links between the random systems employed by artists, composers and poets, and those involved with the making and the use of cybernetic devices.[14]

Relationships of communication and control pointed towards a shared place for humans, objects, and machines. Although they had quite different agendas, together these early exhibitions suggested a future for

12 Pamela M. Lee, ***Chronophobia: On Time in the Art of the 1960s***, Cambridge, MA & London: MIT Press, 2004, p.62.

13 Astrit Schmidt-Burkhardt, ***Maciunas' Learning Machines: From Art History to a Chronology of Fluxus***, second revised and enlarged edition, New York: Springer Wien, 2011. Janet Jenkins, Elizabeth Armstrong and Joan Rothfuss, eds., ***In the Spirit of Fluxus***, Minneapolis, Minnesota: Walker Art Centre, 1993.

14 Jasia Reichardt(curator and editor), ***Cybernetic Serendipity: The Computer and the Art, A Studio International Special Issue***, New York: Frederick A. Praeger, 1969. p.5.

relationships between art and cybernetics, and prefigured an art world that would become concerned with ethical and ecological relations between human and non-human entities. Humans, objects and machines were seen to enter into new kinds of relationships.[15]

The works included by Burnham in <<Software>> and Reichardt in <<Cybernetic Serendipity>> tended toward negative feedback rather than the autopoietic (first-order rather than second-order cybernetics). Viewers were invited to observe both artistic and scientific systems at work; where the precarious maintenance of stability was tempered by experimental practices that were technically unstable and aesthetically challenging.[16] Jasia Reichardt recognised that in exploring systems, these kinds of assemblages that scientists were making looked no different to those made by artists. One of Reichardt's leading premises for <<Cybernetic Serendipity>> was that in an exhibition of immense scale, a visitor would not be able to tell whether they are,

> looking at something made by an artist, engineer, mathematician, or architect. Nor is it particularly important […] it will not alter their impact, although it might make us see them differently.[17]

For her the exhibition was not an exhibition but a demonstration of contemporary thought, and in this there was no reason why works of art could not be based on "misunderstandings and partially digested information."[18]

Burnham had another focus. He was keen to stretch systems thought into aesthetic thought. Thinking about art beyond the art object, Burnham considered that "machines and their components naturally fit together into larger and more efficient systems."[19] In informatic discourse, systems theory had shifted the focus away from the objects themselves, and onto relationships between objects. When Burnham talked of the movements from object to systems thinking he qualified this as an adjustment:

> from the direct shaping of matter to a concern for organizing

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Echoing the discourses of first-order cybernetics Burnham writes: "the computer is part of a continual system and, as such, it processes information metabolically… [the computer] is a means by which information is directed incrementally toward the maintenance of a constant level of stability, a function similar to that of the human nervous system." Jack Burnham, "The Aesthetics of Intelligent Systems," in ***On the Future of Art***, 95-122, New York: Viking, 1970, p.97.

16
Jack Burnham, ***Software, Information Technology: Its New Meaning for Art*** (New York: Jewish Museum, 1970). Participating artists included: Vito Acconci, David Antin, Architecture Group Machine M.I.T., John Baldessari, Robert Barry, Linda Berris, Donald Burgy, Paul Conly, Agnes Denes, Robert Duncan Enzmann, Carl Fernbach-Flarsheim, John Godyear, Hans Haacke, Douglas Huebler, Joseph Kosuth, Nam June Paik, Alex Razdow, Sonia Sheridan, Evander D. Schley, Theodosius Victoria, Laurence Wiener.

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Reichardt, ***Cybernetic Serendipity***, p.5.

18
Quoted in Maria Fernandex, "Detached from History: Jasia Reichardt and Cybernetic Serendipity," ***Art Journal***, Vol.67, No.3, 2008, p.6.

19
Burnham, ***Beyond Modern Sculpture***, p.319.

> quantities of energy and information. […] These new systems prompt us not to look at the **skin** of objects, but at those meaningful relationships within and beyond their visible boundaries.[20]

In the lead up to the <<Software>> exhibition Burnham took this technical interior and identified it with new kinds of aesthetic practices, that he named 'systems aesthetics.'

= Paik (flux + cybernetics)

Works by Nam June Paik were included in both Burnham's and Reichardt's exhibitions. Paik's art practices had already repeatedly engaged and questioned ideas of communication and control in the machine.[21] His works in <<Cybernetic Serendipity>> and <<Software>> bought together a commitment to indeterminism, a deep knowledge of information systems, and a playful attention to the materials of communication. To <<Cybernetic Serendipity>> Paik contributed two works: a series of manipulated television sets and the <Robot K-456>. Physicist Norman Bauman writes in the catalogue "Mr. Paik has reworked the television sets to give the viewer a bit of control."[22] Bauman describes the experience of holding a magnet to a television, the thrill of seeing magnetic fields in motion. "When you learn to play a Paik TV, you are forced to see these patterns of technology in terms that are different from those you learned in physics."[23]

Viewing patterns of technology, and questioning the boundaries of the closed system of first-order cybernetics is central to Paik's <Zen TV> 1963~75. The first manifestation of <Zen TV> was part of the installation <<Exposition of Music – Electronic Television>> in 1963. In that exhibition, <Zen TV> was one of thirteen television experiments where Paik says he sought to "study the circuit, to try various feedbacks, to cut some places and feed the different waves there, to change the phase of waves, etc."[24] Each television work was a different manipulation of the same received image broadcast from German television, and the back of each was open so that the audience could see what had actually been transformed inside.

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Ibid., p.369.

21
Paik describes his works for <<Cybernetic Serendipity>>: "I wanted to make an electronically controlled robot and work with a color television set. I made a set with three cameras, feeding colors onto the same screen. I also made a spiral generator with Shuya Abe, the Japanese engineer, where you see a spiral on the screen. Since 1963, Mr. Abe has been my major collaborator in TV art. I cannot thank him enough." Douglas Davis interview with Nam June Paik, ***Art and the Future***, n.d., http://cyberneticzoo.com/?p=3437.

22
Reichardt, ***Cybernetic Serendipity***, p.42.

23
Ibid., p.43.

24
Nam June Paik, ***Afterlude to the Exposition of Experimental Television***, Wuppertal: Galerie Parnass, 1963, http://www.medienkunstnetz.de/source-text/31/.

For <<Cybernetic Serendipity>> Paik put together a different selection of manipulations including versions of <Zen TV> and <Participation TV>. In the original <Zen TV> a received television broadcast image is compressed into one narrow line, appearing horizontally but viewed vertically (the TV is on its side). The line holds movement and light on one strip of the surface of the monitor. The television has been removed from any entertainment or information mandate and instead suggests "a way of viewing a medium within a new set of references" that is, "both as an object and as a medium, in terms of what it is we normally see on television, and how we relate to it."[25] By developing a new set of references for television Paik suggests that a medium is not fixed but refers back to previous material incarnations and forward towards the manner in which that material might be approached by a viewer. The signal compression separates the received information from an informative matrix, becoming instead part of a system of visual experiences. Paik says his approach to electronic television involved two steps.[26] The first step is expansion, moving the material away from a pre-defined or determined tendency. Secondly, Paik undertakes an engagement with the physical properties of the television finding within them indeterminacy and process (waves). In <Zen TV>, without any specific medium to aid in making sense or fixing the image, the viewer must undertake an exploration through the materials of noise and light. By a reduction of the purity of the televisual medium, and a subsequent increase in the noise of the image, the viewer becomes a cybernetic part of the art machine.

In <Zen TV> Paik undid presumptions about how systems behave from the inside out. Television was compressed back into its surfaces becoming a single line of unintelligible data. The ability for technology to present noise as a kind of second-order systems mapping is taken up by New Zealand artist Stella Brennan's tribute and digital update (a bit like a new upgrade package for a perfectly working programme) <Zen DV>2002. In Brennan's <Zen DV> two video monitors sit on plinths side by side at the end of a wall. Joined by umbilicals of leads and headphone cabling, they each play test signals: one is of the default blue screen, a reference colour telling us that no signal is coming into the system. The blue screen

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John Hanhardt and Jon Ippolito, eds., ***The Worlds of Nam June Paik***, New York: Solomon R. Guggenheim Museum and Harry N. Abrams, 2000, p. 95.

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"One can say that electronic television is not the mere application and expansion of electronic music in the field of optics but represents a contrast to electronic music (at least in its starting phase), which shows a pre-defined, determined tendency both in its serial compositional method and in its ontological form (tape recordings destined for repetition). [...] I have not only expanded from 20 kHz to 4 MHz the material being treated, but have more pronouncedly used the physical property of the electron (indeterminacy, the dual character of corpuscles (particles) and waves (status)." Nam June Paik, ***Exposition of Music - Electronic Television***, Wuppertal: Galerie Parnass, 1963, Leaflet printed for the show, http://www.medienkunstnetz.de/works/exposition-of-music/images/1/?desc=full.

is specked with dust and glitches and accompanied by a sound reminiscent of a diamond stylus scratching on the end of a vinyl recording. The other monitor shows the colour bars (white, yellow, cyan, green, magenta, red, blue) and tone (usually for digital media this is 1kHz) used to calibrate screens. Every screen, monitor and projector represents its colour differently so colour bars allow a precise mapping of the intended colour of a work with the actual colour of a work. The tone allows us to listen for any variation in the speed of projection. An oscillation in the tone means the speed of playback is not exact. Brennan has applied scratch and filters from audio and visual programmes to these signals; dust commands have been set into operation. What Brennan introduces to Paik's series is the relationship of digital to analogue and, like Paik, she makes us acutely aware of the specificities of the art machine through the particular noise contained within it or that is generated through its signals.

Brennan says that "<Zen for TV> is in retrospect, a parable of compression – all the flickering data of the televisual image flattened into a narrow band of light."[27] <Zen DV> suggests the reverse of this for digital media. Data is opened out. Brennan's remaking of the cybernetic contexts of Paik's works highlights the indeterminism of systems thinking, and demonstrates how the relationships formed between science and art are often analogical.

In <<Software>> Burnham defined software as the artwork's conceptual structuring. On top of software he located the hardware that allows the artwork a matrix of possible activities. The implication of his approach is that the artwork materialises through and across all layers of the art machine, including the interactive or observant viewer.[28] Brennan demonstrated that materials also impact on the system and its processes. Although the focus is one of environment over object, art objects are not completely replaced.[29]

Paik's teledynamic environment called <Participation TV> was first shown in Kynaston McShine's <<Television as a Creative Medium>> at the Howard Wise Gallery in New York City; a sound activated piece it was then modified into <Participation TV No. 2> for the travelling version of <<Cybernetic Serendipity>> in Washington, D.C. Now visual, the three

27
Stella Brennan, ed., ***Dirty Pixels***, Auckland: Artspace, 2002. p.11.

28
Burnham, ***Software, Information Technology***.

29
For Burnham, systems aesthetics highlighted how "art does not reside in material entities, but in relations between people, and between people and the components of their environment. [...] The change that I perceive, however, encourages the recognition of man as an integral of his environment. The biological sciences are already beginning to realise the mistake of separating organisms from their habitat or subjects from their systems." Jack Burnham, "The Aesthetics of Intelligent Systems," in ***On the Future of Art***, New York: Viking, 1970, p.96.

television cameras of <Participation TV No. 2> observe a room and its inhabitants. The information they gather is displayed as signals on one television screen by the red, green, and blue cathode guns respectively; the screen shows three different images in three different colours at once. Amplitudes from three tape recorders at reverse phase control colour brightness. Thus the viewer sees themselves three times in three colours on the same screen, often appearing to float in the air or become multiple as multi-coloured feedback echoes shatter into infinity. In <<Cybernetic Serendipity>> this effect of the distributed body was repeated on three different TV sets arranged around the environment.

In <Participation TV> Paik plays with the rules of cybernetic systems, conflating repetition with distribution and forcing a system back into itself. The closed, yet open, feedback loops of <Participation TV> demonstrate how limited our processes for viewing have become. Paik reminds us that two-way television came long before one-way television. This ultimate in autopoietic systems was an inspiration for New Zealand artist Sean Kerr's interactive participatory live online sound performance <M4RI: ping pong pop> 2010.

Kerr claims that he seeks to generate "ill-mannered scenarios and misbehaving machines."[30] Commissioned by the Aotearoa Digital Arts Network for the <<Electrosmog Festival of Sustainable Immobility>>, <Music For Remote Individuals: Ping Pong Pop> was an irreverent online multi-user sound performance. For fifteen minutes early on a Sunday morning four New Zealand artists played with sine waves sending them across the Internet via a network hub in Amsterdam. Although the participation and interaction was in real-time the samples were already there, uploaded in the days before the performance. This prepared network has echoes of Paik and Cage's prepared pianos. However, rather than being embodied in a single object, and like the multiplying bodies in the room for <Participation TV>, the prepared samples were split between the four users and then rendered back into the same sonic space. For the performers, participation involved sending instructions to the samples that were already there. An activity that would seem meaningless, except that the fascination with systems and their sources meant that performers and

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http://www.seankerr.auckland.ac.nz/.

listeners became the observers of a perfectly malfunctioning autopoietic system. Pips, blips and whistles produced an indeterminate and distributed sonic environment. Control was given to the sine waves themselves, and the 'art machine,' like that of <Participation TV>, became a more-than-human combination of sensory members stretching across a country and out into the Internet.

Originally built in 1964, <Robot K-456> was a collaboration between Paik and Shuya Abe and named after Mozart's relatively unknown piano concertos, the Köchel versions. Like any Frankenstein-ian creature the robot stripped bare had many manifestations. For <<Cybernetic Serendipity>>, <K-456> inhabited the interior of the gallery, alongside other similar creations by engineers and scientists. Although the other roboticists in <<Cybernetic Serendipity>> seemed to strive for verisimilitude, Paik was more interested in <K-456>'s uncanny ability to stop traffic. Having already walked the streets of New York in 1964, now in London <K-456> was given a starring role on the poster, and roamed the gallery spouting political rhetoric and dropping beans. After a later outing by the robot (when it found itself embroiled in a staged car crash) Paik said that <K-456> represents "the catastrophe of technology in the twenty-first century. And we are learning how to cope with it."[31]

Rather than embrace the catastrophic, New Zealand artist Simon Ingram has taught a robot machine to imitate the human artist. (As far as I know, <K-456> never picked up a paint brush). Not free to stroll the gallery, the robot in <Looking for the Waterhole>^{2012} is chained to the wall as it makes paintings drawn from inaudible and invisible frequencies along the 'hydrogen line'(1420MHz).[32] The behaviour of the machine robot is both within and outside the network. It is as if Ingram has combined <K-456> with <Participation TV> to generate an art machine that creates, records, and outputs artworks within a single closed system. In Ingram's <Radio Painting> series of which this is a part we sense the presence of a new kind of art machine: the networked self-painting machine that is connected to the universe. This art machine is a networked being that receives signals from the ionosphere, via an inflatable parabolic dish, transforms and translates these signals by software and code and turns them into paint.

31
In 'The First Catastrophe of the Twenty-First Century'(1982), <K-456> was removed from its pedestal at the Whitney and guided by the artist down Madison Avenue where it walked out into the street and was 'accidentally' hit by a car.

32
The machine's antenna collects those in the range of 18 to 25 kHz best. A number of other artists are currently working with VLF: New Zealanders r a d i o q u a l i a (a collaboration between Adam Hyde and Honor Harger) work with radio telescopes as radio receivers, which listen to radio signals being transmitted from planets and stars. Their project <Radio Astronomy> could be seen to be a rehabilitation of the poetic resonance behind Renaissance astronomer Johannes Kepler's 'music of the spheres.' See http://www.radio-astronomy.net/. In 1996, Australian Joyce Hinterding installed <Aeriology> an enormous copper VLF receiver inside Artspace in Auckland, Artspace in Sydney, and V2 in Rotterdam. Hinterding's ongoing collaborations with David Haines to capture "radio from the sun" include <Earth Star> exhibited at The Gallery of Modern Art, Queensland and Ok Centrum Contemporary Art Austria, which won the Ars Electronica Award of Distinction in 2009. See http://www.sunvalleyresearch.net/?p=340.

By the time the received energy of the machine has become a mark on a stretched surface, it has been filtered through a series of cybernetic relationships. An antenna has scanned for and grasped at a frequency, software has interpreted and visualised that frequency, and the artist has manipulated the frequency converting it from energy to sound to image. Shifting parameters have generated a set of behaviours that appeal aesthetically, that are deemed worthy of putting brush to canvas. And then finally the machine – strapped into two-dimensional space before the canvas, unable to inhabit more than the constraints of an x and y axis – has begun to paint. As a cybernetic system the self-painting machine is more than these materials. It is also an interface. As it collects remnants of matter occupying the time spaces of the radio telescope, the machine enacts the social and aesthetic relationships that support these technologies. Picking its way through frequencies the self-painting machine listens to transmissions that only it can hear, transmissions that span great distances by bouncing between the earth and its atmosphere. Ingram's robot painting machine occupies entire networks plus the electromagnetic environments that bought it into being.

In an age where it is essential to temper aesthetics with ethics, and when visual data are quickly distributed via multitudes of networks artists like Brennan, Kerr and Ingram are questioning the systems and behaviours of the materials we work with. As Paik said: "the real issue implied in Art and Technology is not to make another scientific toy, but how to humanize the technology and the electronic medium."[33] Ingram's radio paintings, like Paik's <K-456> are art machines that are the result of an equation between flux and cybernetics. Both simultaneously corrupt and celebrate the connectivity of the network where technology is an enabling rather than determining factor.

Cybernetics + Flux = art machine

Cybernetics continues to offer a key position from which to approach art machines that highlight the contribution and role of both the

33
Paik cited in Gene Youngblood, ***Expanded Cinema***, New York: E.P. Dutton, 1970, p.306.

environment and viewer to the emergent processes of systems. As Burnham said in 1970 "it has been the very nature of the machine that it could always be connected with other machines to perform a complex array of work motions."[34] Constructed from human and non-human parts, these human-machine systems also suggest that systems, technology and the human mediate each other. They connect. Not only with one another in the same exhibition spaces, but with viewers across time. In describing <Robot K-456> Burnham writes that Paik showed us:

> if the names of Rauschenberg, Wiener, John Cage and Marshall McLuhan are repeated with enough fervency and juxtaposed with random mathematical symbols then the age of the electronic humanoid plugged in for instant global communication will be upon us.[35]

In his writings Paik identified the way that Wiener's "sensory members" contributed to art machines that inhabited the forces of entropy and the realm of the more-than human. Formed from a combination of aesthetic flux and cybernetics the more-than human art machine, suggests productive affinities that continue to be developed by artists questioning straightforward aesthetic relationships with objects.

Letting the bird out of the cage and making all systems go! will humanise us by making us more-than human; it will also make us think outside of the divisions betwseen systems and aesthetics and materials and information. The information systems that Weiner developed lead to the increased power of the American military industrial complex and simultaneously influenced global developments in biology, sociology and art. It was Paik and the other artists included in <<Software>> and <<Cybernetic Serendipity>> who explicitly addressed this bifurcation. Without a direct engagement between art and technology the violence of the cold war and its antecedents goes unaddressed. In the artworks by Paik and others there is a careful critical embrace of the technologies of systems aesthetics, that anticipates again and again the more-than human 'art machines' of the 21st century formed from the equation of cybernetics and flux. #3

34 Burnham, ***Beyond Modern Sculpture***, p.317.

35 ***Ibid.***, p.351.

Susan(Su) Ballard

Ballard is an art historian and curator from Aotearoa New Zealand. Her research focuses on the encounter between art history and new media in the art gallery with an emphasis on systems, aesthetics, utopia, noise, machines, nature, accidents and errors in contemporary art. She received her Ph.D. titled Out of Order: Encounters with Digital Materiality from UNSW, Sydney, Australia in 2008. Recent book chapters include a discussion of New Zealand artists' collective 'et al.' in 『Error: Glitch, Noise and Jam in New Media Cultures』 (2010), and a reflection on contemporary understandings of frequency and the sublime in 『Far Field: Digital Culture, Climate Change, and the Poles』(2011). In June 2012 Ballard edited a special issue of 『The Fibreculture Journal』 on "Networked Utopias and Speculative Futures." She is a director of the Aotearoa Digital Arts Network, and co-edited 『The Aotearoa Digital Arts Reader』 in 2008. (http://www.ada.net. nz) She is a senior lecturer in Art History at the University of Wollongong, Australia. (http://www.suballard.net.nz)