

**EMERGENT SOUNDSCAPE COMPOSITION:
REFLECTIONS ON VIRTUALITY**

by

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ABSTRACT

As a synthesis of art and techno-scientific practice this thesis explores human-virtual interaction not as acoustic interface, but as resonant environment. The pervasive computer-mediated environment is argued to form a site for the creative expansion of the limits of human awareness through the creation of cognitive and cultural hypotheses. This thesis defines the concept of an *emergent soundscape composition*, through which virtuality is explored in two studies entitled *Lost* and *Found*. The results of this art research are presented as intersections in the disciplines of acoustic ecology, audible display and algorithmic composition in a discussion that frames the context, terminology and concepts engaged in such emergent soundscape composition. Design criteria for the evaluation of emergent soundscape composition in the computer-mediated environment are presented with reference to this frame and used to evaluate *Lost*. In a case study of *Found* the development of a subversive aesthetic substantiates a re-evaluation of the concept of the human-computer interface as resonant environment that engenders a diffuse awareness of the imaginal world.

DEDICATION

In December 1999, I was sitting in my aunt's kitchen, in Graff-Reinet (South Africa) drinking morning coffee and discussing with Alan (my life long friend) our plan to spend the night between the millennia in The Valley of Desolation. We were all relaxed, and spoke slowly as one does on holiday in the Southern African summer upon reaching one's destination. My aunt remarked tangentially "there a lot of flies about today, it'll rain later this afternoon". Four o'clock came and the rain fell.

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GLOSSARY

Acousmatic Music: Music with no visible sound source, that is intended for performance over loudspeakers.

Musique Concrete: (French: concrete music) A development introduced in Paris in 1948 by Pierre Schaeffer at the studio of the French Radio (O.R.T.F.). Its aim was to replace traditional musical material with recorded sounds which were then manipulated by filtering, tape reversal, speed changes, tape cutting, or other electronic means. The source of all sounds, however, was environmental. The experimental side of this study developed the concept of l'objet sonore (see Sound Object). (Truax 1978, p.78)

Sonification: The use of non-speech audio to convey information.

Soundscape: An environment of sound with emphasis on the way it is perceived and understood by the individual, or by a society (Truax 1978, p.126).

Sound Event: A sound or sound sequence in its spatial and temporal context as part of a soundscape, it acquires its meaning through its social and environmental context, as well as from its own acoustic characteristics (Truax 1978, p.116).

Sound Object: A phenomenological sound formation, independent of its referential qualities (Truax 1978, p.119).

Masking: The effect one sound has on another by making it harder or impossible to hear (Truax 1978, p.73).

Earcon: A sound that is used to symbolically represent a specific event or object.

INTRODUCTION

Motivation

In the future, you won't buy artists' works; you'll buy software that makes original pieces of "their" works, or that recreates their way of looking at things.

— Brian Eno in an interview with Kevin Kelly (1995)

The computer-mediated environment is an increasingly dominant aspect of our everyday experience. This a point of view is brought about through the steady march of technical “achievement” - in what Heidegger (1977) describes as the constant challenging of nature to be brought under our will as *bestand*. Science fiction author Bruce Sterling observes the following historical strata in our relationship with technology:

- Artifacts are made and used by hunter-gatherers and subsistence farmers.
- Machines are made and used by customers in an industrial society.
- Products are made and used by consumers, in a military-industrial complex.
- While Gizmos are made and used by end-users, in whatever today is - a “New World Disorder”, a “Terrorism-Entertainment Complex”, our own brief interregnum.

— Sterling (2004)

Replacing gizmos he postulates a *spime* as a physical device whose ownership is primarily a membership in a user group and secondarily possession of the physical device. Membership in the user group engages the user in a set of virtually mediated alliances with the other members. Interacting members of the user group alter their spimes adding value to the physical device and change its meaning. These alterations are replicated to other members of the user groups through virtual connections. Sterling sees a future in which we spend our time wrangling with the problems and opportunities of material culture.

Contemporary material culture is not purely concrete; it's enmeshed by the virtual. The fantasy of immersive virtual reality replacing our material world has been buckled inside out, back and forth, overlaid and revealed to us in the actuality of a real but plastic environments. Disneyland is our (virtual) reality. The distinctions between physical and virtual are increasing blurred — a blurring *spimes* are poised to further. But whatever the future holds, our present is a world in which the virtual and actual are both real to us. Virtuality stands as a cultural preconception that the material world is permeated with information (Hayles 1999, p.68). This thesis is an exploration of that preconception through the nature of human-virtual interaction.

Research Questions

In order to reflect on this virtually permeated world, I propose two main research questions:

1. How can a sonic artwork be made which represents virtual events or process so that the significance or emergent meaning of everyday human-virtual interactions is revealed?
2. Furthermore, how can such an artwork be situated so that a techno-centric practice is placed in a broader critical framework? In other words; how can technology be addressed without assuming the dominant technological point of view but rather reveal unrepresented implications which afford new cultural forces to grow?

Simply restated, this project is an exploration of virtuality, from a critical but engaged point of view. These questions are part of a broader research agenda - exploring the critical potential of technology. Capital investment in technology has been exploring the potential of technology as a machine of function (competition, industry & management). The poetic-critical potential, i.e. the art of technology, is vastly unexplored in comparison. This is a place for that exploration.

This questioning in turn may be seen as part of the redefinition of our relationship with technology, or in Heideggerian terms, gaining a “free relationship” (Heidegger 1977) to it. So this thesis is part of larger project that asks: what is our relationship to technology, and by implication what could it be?

Terminology Redefined

The answer to these questions is a shift in perception, a new subjectivity revealed in the main title of this work *Emergent Soundscape Composition*. The art-research presented here has produced a redefinition of technology for me, which is summarized in this title.

Emergent

The works *SOVS-1:Lost* and *SOVS-2:Found*¹ are emergent tracings. This mode of emergence is in contrast to the broader generative digital aesthetic, which values the creation of works of infinite complexity from simple discrete mathematical or computational models. Fractals, automata and generative grammars are abstract models exhibiting this aesthetic². The key difference here is that these abstract models bloom in the virtual space — producing virtual fauna and flora. We know that abstract worlds that can be made concrete. In the emergent works presented here, the emphasis is on making a thin augmentation that is added to an existing or

¹ Hereafter just called *Lost* or *Found*. SOVS is an acronym for Sonification of Virtual Space.

² See the *Computational Beauty of Nature: Computer Exploration of Fractals, Chaos, Complex Systems, and Adaptation* (Flake 1998) for a complete introduction.

found virtual phenomenon so that its presence can be perceived. The complexity in the found phenomenon's stochastic processes emerges as a rich soundscape via simple mapping and tracing techniques rather than being generated by iterative rendering. While the virtual phenomenon, a computer network, explored here is less abstract than pure mathematical or computational models; the network does have an everyday relevance that motivates its emergence. The phenomenon's meaning is opened up for contemplation by an expanded pool of witnesses and interactors. Such emergence posits an understanding that the boundary between the physical and virtual realms is intrinsically weak.

Soundscape

The *Lost* and *Found* projects are not *musical* compositions. *Lost* gives voice to a virtual environment that was mute. The distinction between soundscape and music is easy to make with reference to popular music, in which rhythm and harmonic relations play a central role. This distinction is more difficult to make in reference to western art music, in which John Cage's project, as critiqued by Kahn (1999, ch. 6, p. 4), encompasses all sounds and all possible sounds as music. In response, *Lost* reclaims the role of signification in sound, i.e. the sound object represents more than just the sound itself, but a sound event. It is my intent to include meanings beyond those heard or listened for in musical listening, hence soundscape is a more accurate term; especially for my first work *Lost*.

In slight contrast, *Found* does not fit perfectly the vernacular definitions of music or even soundscape. Perhaps it is organized sound art, which dilutes the place-based notion implicit in *soundscape*, and intersects with a more general definition of soundscape as a sonic environment in which a communicative balance can be formed amongst sounds, sound makers and listeners. In *Found* a kind of resonance or correspondence between sounds becomes a model for communicational relationships between players. This correspondence hints at something similar to the relationship witnessed in an unspoken dialog — perhaps a sonic version of body language — rather than the sonic soundscape communication describing one's place in a space or the emotional and conceptual expressions found in acousmatic music. This resonance gives way to a sense of harmony as evidence of understanding that is formed in the embodied “dialog” of sound making.

Composition

The view of composition held here is not that of composing in linear time, i.e. the production of a score, which is rendered or performed into sound. In *Lost* the composition is a set of rules, which describe sonic responses to events, similar to that of Cage's process pieces such as

the *Williams Mix* (Cage 2000). These rules are encoded in software and are played out in a variety of ways so that the soundscape produced never repeats and is potentially infinite in duration.

This type of interactive composition with encoded software rules is generally termed algorithmic composition (Cope 2000, p.2). Specifically in *Lost* the rules are mappings from virtual to sonic events.

In *Found* the algorithmic composition system itself becomes an instrument, and the compositional process widens its scope to include:

- Collaboration with other players, and
- Iteration between performance using the instrument and modification of the instrument's rules after reflection on the performance.

This enlarged view is not interactive composition but *composing interaction* both with other players and the instrument.

Why Sound? Why only Sound?

This thesis specifically limits itself to exploring the ways in which sound can be incorporated to answer the research questions. Sound was chosen because it provides a mediating relationship between listeners and their environment (Truax 2001, p.12) and the virtual realm is easily conceived as a space — cyberspace. What is the soundscape of cyberspace?

Before exploring this mediating role in detail we can list the following fruitful characteristics of sound:

- Communication of Events – positioned in time and space relative to the listener.
- Setting an Ambience – a symbolic/emotional realm reflecting a mood
- Contextual Sensitivity – sound resonates in acoustic space, reflecting the context in which a sound is made.
- Amenable to Concurrency – multiple sounds can be both perceived and propagated simultaneously.

This thesis is thus an application of soundscape studies and an extension of these studies toward virtual and poetic communicational potentials. Lastly similarity of the intangible (virtual) with the ephemeral (sound) initially spurred my research agenda to focus on primarily audible works. However in principle all sense modalities could be explored in further work which is beyond the scope defined here.

Epistemology

“There are two modes of knowing, those of argument and experience.” (Roger Bacon)
Commentary: “They are complementary to one another; neither is reducible to the other; and their simultaneous working may be incomparable. One mode is verbal and rational, sequential in operation, orderly; the other is intuitive, tacit, diffuse in operation, less logical and neat, a mode we often devalue culturally, personally, and even physiologically.” (Robert Ornstein: *The Psychology of Consciousness*)

— Pauline Oliveros (1984 p. 101)

Before we start I would like to frame my assumptions about knowledge and how it can be obtained by providing the underlying epistemology of this research. Here we are concerned with the interplay between two types of knowledge, enactive procedural knowledge embodied in a professional practice (Schön 1983); and structured symbolic declarative knowledge denoted as theory. Furthermore we recognise a valuable spectrum of human attention, from focused analysis associated with the production of theory, to wide-ranging imaginal awareness (McCullough 1998 p. 111) associated with inspiration and practice. In this thesis we will not privilege either one of these modes of knowing.

So then, **making** is seen as way of research, which installs both of these types of knowledge through technique. Technique is developed in the practice of making and doing when one exercises awareness in a discovery of difference. Iterative **reflection** on the qualities of these differences and the procedures (techniques) that brought about these differences generates theory. Making is distinct from doing as it allows for the occasioning of an artefact which stands as an object of reflection. The truth-value of both these types of knowledge is constituted in a *social reality* as it is produced and reproduced by people. My research epistemology is therefore Critical Research.

Critical Research holds that people can consciously act to change their social circumstances; however it recognizes that their ability to do so is constrained by various forms of social, cultural and political domination. In this study I explicitly name the domination of *Technological Determinism* but simultaneously recognize the potential of technology in encoding alternative cultural practices.

Method

Since I am concerned with an understanding of processes and procedures in their social and cultural contexts from the point of view of participants, this research is performed in the qualitative tradition.

The structure of this research is reflected by the above epistemology, and proceeds by an iterative narrowing of focus or triangulation. In each phase I engage in art practice and reflect on

the light it sheds on my research question, with a view to revealing gaps in current theoretical constructions, as a means to expand on our knowledge of our social reality.

Phase 1 - *Lost*: Encoded Practice

Lost, the first work presented, is an example of an encoded practice — in which the composition's dynamic processes are explicitly encoded as a software program. This was performed to develop an initial awareness of the virtual phenomenon. The resulting research data is the program itself and the analysis is a reflection on theoretical assumptions encoded into the software artefact. This reflection prompted an adaptation of the design criteria of soundscape communication theory to the computer-mediated environment and the evaluation of *Lost* in terms of these criteria.

Phase 2 - *Lost*: Questionnaire

Faced with an artefact based on soundscape communication theory and only my own experience of it, I attempted to broaden the scope of my framing of the nature of virtuality by (a) testing this theory in a 3rd person investigation of the semantics of *Lost*, and (b) extending my conceptual backdrop to explore the broader roles of the virtual as found in Deleuze's philosophy of the virtual.

The resulting research data is a set of questionnaire answers. The analysis of this data using concept mapping, reveals the communicated cognitive models and broader meaning of *Lost*. In this context a reflection on Deleuze's virtual philosophy exposes the linkages between ontological and informational conceptions of virtuality.

Phase 3 - *Found*: Case Study

Finally, in an attempt to develop an alternative cultural hypothesis of human-virtual interactions, I engaged in a case study of a collaborative sound making/composition project with an artist not engaged directly with technology. The analysis of the case study is a reflection on gaps found in the theory of human-virtual interactions.

The research was formulated as a case study as it strives to reveal a participant's point of view of the compositional process, while the researcher is in the "field" i.e. actively collaborating and researching. The other participant, Igor Santizo, was aware of my dual role.

Thesis Structure

Following this introduction is a literature review chapter that weaves together relevant conceptual frameworks, intersecting disciplines (acoustic ecology, auditory display and the philosophy of technology) and related art works into a conceptual backdrop.

Next, the thesis projects, *Lost* and *Found*, are documented and analyzed in their own chapters. Hence significant observations are largely presented as they emerge in the discussion of each project and are not deferred until a separate discussion and analysis chapter.

A final chapter concludes the thesis with a summary directly answering the research questions and highlighting novel features of the works. Further questions opened up by this work are noted last.

CONCEPTUAL BACKDROP

Paradigm: Technology as Cultural Material

Technology is a set of tools and techniques in which the cultural practices of our society are encoded. For example the in Western African context the world is divided into 3 realms: the living, the dead and the unborn. Through the ritual of the mask, we have access to the knowledge of all three realms

— Attributed to Henry Daniel paraphrased from the author's memory, New Forms Festival Conference, 2004, Vancouver Art Gallery.

In his book *Information Arts*, Stephen Wilson (2001), catalogues the work of more than 200 artists who have created works in 82 scientific research areas. He argues that technological and scientific research now influences every corner of everyday life. His argument is that science and technology have cultural effects, which can benefit from the critical perspective and traditions held by the arts.

The volatility and myopic vision of the so-called high technology industry spurs questions of how useful it has been to rely on speculative financial capitalistic markets and governmental-military agendas to guide technological innovation. Wilson (2001 p.6) goes further to note that the effects of scientific and technological acts have changed our view of both the world and our humanity and have had profound philosophical effects.

Specifically, communications technologies have challenged our ideas on time and space. It is thus no wonder that artists, who are often in the forefront of social and philosophical change, are engaging with science and technology as a medium itself. Science has been less reciprocal in acknowledging this state of affairs, but now faces the challenges laid out by Wilson and others (Thackara 2001, Newby et al 2002); in acknowledging the poetic nature of scientific/technological works.

The zenith of this disciplinal disjuncture, which began in the renaissance, was highlighted by C.P. Snow as a split in *views of progress*. He remarked that the “two cultures” (Snow, 1998) of the arts and sciences could scarcely communicate with each other after developing in two divergent directions. The vision of multidisciplinary, interdisciplinary and transdisciplinary approaches are to respectively renew contact between these cultures, explore the interstitial spaces between these cultures, and to go beyond the confines disciplinarity imposes.

What is the theoretical scope for an interdisciplinary inquiry such as this thesis which claims to be an intersection of scientific and artistic practice? To answer this question the following sections explore the points of intersection between art and science with particular reference to technology.

Questionable Truth Claims

1. System of Symbols and Narratives

The construction of theory in both the arts and sciences represents an attempt to paint a picture of an underling “reality” — a mechanism or perspective with predictive or explanatory power. This common quest, found in philosophy, art and science of building massive theoretical structures more accurately represents the thought of the participants than an underling reality (Slager et al, 2003). However, a key difference between art theory and science is that that scientists largely believe in the reality of this structure, although both base their theoretical structures on observation.

The Leonardo series of journals is one of many forums dedicated to this vision. Paul Feyerabend (1996), writes that art often looks like science and science often looks like art. Both are involved in the construction of “manifest worlds”. He goes on to blur the distinction entirely by saying that scientific “researchers are artists who, working on a largely unknown material, Being, build a variety of manifest worlds that they often mistakenly, identify with Being itself.”

The shape of theoretical structures is constantly under revision. Argument among a theory’s proponents and the theorist’s peers determines its acceptability. The rationality of this argumentation is highly esteemed especially in the scientific community. However, even when scientific theory is presented, *aesthetic* considerations play a role in the argumentation in support of theory. Scientists who are not formally trained in aesthetic consideration nevertheless develop an aesthetic intuition and set of values. Elegance and beauty are determining factors often cited in the acceptance of scientific theory.

For example, physicists view the exceptional symmetry of the Maxwell equations as beautiful, while Einstein's “resistance against the indeterminism of quantum theory was an expression of aesthetic dislike, not an expression of doubt for the theory's ability to come up with good predictions” (Slager et al 2003). This aesthetic dislike entails a preclusion against a theoretical construct simply because is not elegant.

The scientist’s aesthetics are linked with the renaissance idea of unity of the virtues where anything that is true must also be beautiful. Extensive case studies of this phenomenon in science can be found in James McAllister’s (1996) *Beauty and Revolution in Science*.

How far can this aesthetic dimension support a link between the arts and sciences? The set of aesthetic values upheld by scientists is less complex than that of art critics and art theorists. Further, artists often develop their own individual aesthetic while the sciences seem to adopt a more naïve but general sense. The point is that scientists are not only pursuing truth, but aesthetic value too.

2. Generation of Knowledge founded on Observation

Both the sciences and the arts cultivate bodies of knowledge. For the arts this knowledge is often specific while for the sciences generality is highly valued. The preconception of a science that discovers and an art that applies this knowledge, as means for production, is false. Artists and artisans have discovered and used “subtle properties of matter” (Smith 1980) *before* these were noticed by scientists.

Central to my argument for the art-science linkage is the fundamental role of the senses. The empiricism of scientific quantitative measurement is extended by life science and social science to include qualitative observations. These observations can be further extended to the reflective study of artists and their environment. The senses are thus a unifying origin for both art and science. Can the senses be held accountable as the basis for the pursuit of knowledge? The father of western philosophical thought, Plato, was deeply sceptical of the senses, to the point that he criticized people who wanted to discover with their ears what the harmonic intervals were (Böhme 2000). This would have led to a theory of music divorced from listening. Plato argued that our subjective sense apparatus which we relied on to observe the world is open to illusion and when confronted with a paradox can only be “corrected” by rational reflection (Cornford 1973, p. 333 & p.238-240). This fundamental distrust of the senses led Plato to place the imaginings of the mind at the bottom of his hierarchy of thought, where these imaginings (based on the senses) have the least truth-value, and would produce false knowledge of the world. The imaginings of the mind or “conjectures”, as Plato also referred to them, are highly prevalent in the imaginal world of art. Plato gave the following examples: shadows, after-images, shiny surfaces, optical illusions, dream-images and fantasies (Lavine 1984 p. 33). Plato’s emphasis on logic and reason as the high arts of the mind can be held highly accountable for the development of the western scientific and philosophic traditions, and their associated elevated social status. This can be heard when we talk of *high* technology. Twenty-four centuries later, contemporary philosophic thought questions the wisdom of its founding father’s hierarchy of knowledge. Asking; what truth value the “low” world of images holds for us now?

Philosophical Interlude: Virtuality Confronted

Knowledge of the virtual image-world does indeed seem vitally important to us now — in our image-mediated environment. While the scientific quest has certainly built an impressive theoretical cathedral and its ubiquitous technological artefacts, can we continue to discount an awareness of the illusory senses? Plato's primacy of ideas is upended by Gilles Deleuze's *transcendental empiricism*, in which "any idea that we use to explain experience is itself an event within experience" (Colebrook p.86). I read this as saying that: Thought is sensed too — it thus cannot explain the senses because it is itself sensed. The implication then is that there is no pre-existing rational subject that can be appealed to in order to explain the sensing of the world. The truth of rational thought is therefore just as illusionary as the other senses, and like them takes part³ in structuring the self. For Deleuze the distinction between the actual-world and image-world⁴ falls ontologically flat. For him they are both images:

There are images, things are themselves images, because images aren't in our brain. The brain's just one image among others. Images are constantly acting and reacting on each other, producing and consuming. There's no difference at all between *images*, *things* and motion.

— Deleuze (1995, p.42, original emphasis)

This challenging proposition is simultaneously daunting and emancipatory. Daunting because it leaves us foundering in a world of images — an ontological house of mirrors. But in return for giving up absolute points of view, we shed the primacy of any one subjectivity, and become participants in a broader ecology of being — not centred around ourselves or even humankind in general, but still maintaining an empirical link to sense-experience.

Before considering the relevance of Deleuze's radical empiricism to this thesis, I must answer another question: Can we really claim, as I am implying above, that the virtual image world Deleuze refers too is at all related to the virtual information world of the computer mediated environment? For computer scientists *virtual* is used in terms such as: virtual memory, virtual machine and virtual reality. These terms refer to devices which simulate the functionality of the actual entity. This understanding is given in the 2nd part of the following definition.

From WordNet (r) 2.0 :

virtual

adj 1: being actually such in almost every respect; "a practical failure"; "the once elegant temple lay in virtual ruin" [syn: virtual(a), practical(a)]
2: being such in essence or effect though not in actual fact; "a virtual dependence on charity"; "a virtual revolution"; "virtual reality" [syn: virtual(a)]

³ The senses are not wholly responsible, as Deleuze did not side with either the phenomenologists or the structuralists.

⁴ I propose that this image world is a virtual world, as it is defined in contrast to the actual world.

The computer science virtual is typically a software (information) implementation of a hardware (physical) object, which simulates the function of the hardware. The jargon file⁵, a respected dictionary of computer science terminology, claims this usage probably stemmed from the term *virtual image* used in optics to refer to an imaginary source of an image “behind” a mirror. A link between the virtual as image and the virtual as information is in evidence from the computer science point of view. Jean Baudrillard’s *simulacrum* broadens this virtual information-image from the above computer science formulation, to a detached post-modern sensibility of an image-based existence. Baudrillard’s hyperreal world is a world composed entirely of simulacra — a Disneyland spread over the whole earth.

From Deleuze’s point of view the virtual includes Baudrillard’s hyperreal image world, but is also more. He speaks of an immanent virtual power of becoming which is always present in the actual, and is “the power to become in unforeseen ways, not limited by the present forms” (Colebrook 2002 p. 100). This additional significance is reflected in the vernacular of the computer-mediated environment today when we speak of the condition of *virtuality*. We speak then not of a functional similarity between two implementations but of a virtual state of being. What is it for something to be virtual? Virtuality in this context is a cultural preconception that the material world is impregnated with information so it is more than its actual material (Hayles 1999 p. 69). Deleuze’s notion of virtual power is seen then in this paradoxical cultural conception. We imagine a virtual power as an information augmentation substantiating our physical world. We see more than is there. Our imagination has been invaded by information. Still, Deleuze’s notion is broader than the computer science usage or the cultural preconception, because for him:

- there is nothing technological about the virtual, rather it is ontological, and
- there is nothing unreal about the virtual, it is no less real than the actual.

What then is the relevance of Deleuze’s claims to this thesis? Firstly Deleuze’s rejection of a virtual- actual- distinction provides a radical point of view that, like Baudrillard’s, fits the computer-mediated environment. Our everyday experience is brimming with advertising, mediated images and copies of icons. This disjunction has set up a tension between the image (virtual) and actual (real), characterised by Baudrillard’s simulacra. Virtual reality, the computer simulation of a world, is the epitome of this unreality. Deleuze’s purposeful and productive ignorance of this distinction resolves the tension: We proceed by grounding our emerging selves in the interaction of images experienced, making no distinction of which is more real — the experience of a computer generated phenomenon or an actual sunset.

The projects described in this thesis are sonifications of virtual phenomena. They become tests for Deleuze’s philosophy as a site for virtual-human interactions. If Deleuze is right these

⁵ <http://www.catb.org/~esr/jargon/>

works should not promote feelings of alienation consistent with the vertigo of navigating the hyperreal, because we are already natives of the image world.

Secondly Deleuze's thought as a commitment to immanence implies an alternative to objective Truth finding, while at the same time supporting a reinvestment in local truth searching and retaining an empirical basis that provides theoretical compatibility with (a fractured) science of poetic facts. So, not only is the virtual- actual- distinction removed, but also new kinds of imaginary sciences are called for. Hints of such a science-poetry may be found in Christian Bök's 'pataphysical *Crystallography* (Bök 1994).

Art-Science Disjunctions

Having cast a fluid account of the linkage between art and science with an accumulating focus towards virtual-human interactions as a research subject, we now turn to their disjunctions. Critical theory and cultural studies have become the accepted discourse in the analysis of the techno-scientific dominated world. These studies are critical of the underlying narrative of progress, and challenge both sciences' claim to universal truth and art's claim as leader of the avant-garde. Three central themes of this discourse have emerged:

- Firstly the rejection of the modernist idea of one dominant cultural stream,
- secondly, an investigation into the impact of mediated images/representation,
- and lastly an emphasis on deconstruction.

We will examine features of this response through art making in "Response 2: Deconstruction as Art Practice" on page 16, but first let us complete a review of the origins of this disjunction between art and science.

The techno-scientific pursuit is characterised by;

- an association with a "natural order" of highest authority,
- a high degree of practical and/or commercial value,
- universality,
- methodological self-assurance, and
- an optimistic tone and a view that technology transforms culture in positive ways.

In contrast Critical Theorists see an insidious nature of pervasive information technology that promotes mechanistic thought and life. They point out the fragility of each new techno-scientific paradigm that offers up a series of failed utopias. Even within paradigms cracks emerge in the integration of real world technological systems based on rigid abstractions. These criticisms and their underlying tensions are played out in Philip K. Dick's paranoid writings and illustrated in dystopic cinema adaptations such as *Bladerunner*. Critical Theorists may see technologists as being

oblivious to the underlying meta-narratives they are enacting with slavish techno-fetishism. To such theorists, the devotional excesses of high techno-culture may indeed appear as primitive delusion, carried forth by high priests who are unaware of the cultural ramification of their technical programs and artefacts.

Technologists are self-delusional with respect to the autonomy of their research. Feyerabend (1996) points out that physicists' "elementary particles are manufactured not found". The technology itself, e.g. a particle accelerator, is a machine that is directly involved in the production of theory. Driving the research equipment involves skills that inculcate the research findings in a manner that is more telling than the theoretical knowledge the researchers process. Technologists are learning what the equipment can know, because they feel what their equipment can do. Even within science paradoxes, the thought experiments devised by John Archibald Wheeler, have revealed (Feyerabend 1996 & Rhodes) how a researcher's choice of measuring apparatus can alter the behaviour of a phenomenon under study.

The art-technology disjunction is further intensified by the fact that artists find themselves the *subjects* of technology which is designed for and by technologists. Such technologies contain the technologist's own cultural perceptions inextricably buried as simplistic aesthetic and complex functional affordances. These alienate an intuitive sensitivity and presume specialized analytical knowledge. Meanwhile these same technologies, which are the object the scientists'/technologists' actions, have functional power and elevated social status. Artists find themselves in an inverse power relation as the objects of a technology which is felt as a force of domination.

Art Research as Response

We have opened the ground charting the intersections and disjunctions of art and techno-scientific disciplines. In doing so we have found a motivation for exploring the poetic significance of the virtual — in that our culture is impregnated by a post industrial information economy — a hyper reality in which people work and live in an abstracted image plane — a plane of mediated abstractions, codes and signifiers.

In this context the computer is conceptualised not as simply a tool but as a representation transformation machine, and is thus directly implicated as an agent of the hyperreal milieu. How can this virtual world-weaving machine be subverted so that it comments on its own underrepresented implications and promotes the development of new cultural perspectives? Art practices are adept in the integration of the material and representation worlds, which historically are fused into artefacts exhibiting an "aura" of originality (Benjamin 1968). Working in the virtual image-world, we are challenged to find such an aura. The following section explores modes

in which we can envision cultural workers proceeding in disciplinary agnosticism. Wilson (2000) provides the following three responses that I elaborate on.

Response 1: Modernist Practice of Art making with Modification for the Contemporary Era

Many artists take a view of information technology as a medium no different from traditional mediums such as paint or clay. These artists view the technology of, for example, virtual reality as a novel means to work in established modes such as realism, expressionism, abstraction, surrealism and conceptual work. They work to develop a personal sensitivity, creativity and vision, with the goal of acceptance into galleries, museums, collections and critical acknowledgement (Wilson 1993). In a sense this work does not acknowledge McLuhan's famous maxim "the medium is the message" (McLuhan 1964 p. 7), which is the "the change of scale or pace or pattern" that a new invention or innovation "introduces into human affairs." (McLuhan 1964 p.8, Federman). This mode of response operates without acknowledging how a technology, for example Photoshop, influences the artist's production of images. This question is addressed fully in *Abstracting Craft*, where Malcolm McCullough arrives at the view of the computer as more than a tool, but an active agent nearer to an improvisational partner.

Artists working in this mode must contend with the art world's lethargic acceptance of work produced in new mediums. Work involving new technology is seen as disconnected from established traditions. Benjamin (1968) saw this disconnection with tradition as contributing to the lack of *aura* of the original in film and photography. Certainly the ease of duplication and lack of an original art object has been an obstacle for collectors and galleries to value this work. The result has been that photography, video and cinema has experienced a 100-year lag in entering the art canon. This perception is even truer for digital works when compared to analogue reproductions due to our ability to make unlimited numbers of perfect copies, without one of them being the original. In contrast to their ease of propagation these copies are fragile — eroding in time due to their high degree of integration in the passing sedimentary strata of obsolete hardware and software. If information art can't last, how can we have timeless masterpieces of this form?

The notion of the singular genius-artist creating an original masterpiece at the peak of a tradition has eroded with the acceptance of outsider art, for example, Jean-Michel Basquiat, and collaborative or process based works of the Fluxus movement. Yet, it seems that these ideas based on the value of the original are not fully dead, even if Picasso is commonly attributed to have said "Bad artists copy. Good artists steal". Could this hesitant acceptance of the copy in the art world be more a resonance of our cultural shift into the hyper-real than the effect of the introduction of a non-traditional medium?

Superficially, the functional use of the same technologies involved in this mode of art making and in consumer product production and advertising, pop culture engines and education cast a similar style over this work reinforcing a perception of it as “low” art. In a deeper sense since the work is not critically aware of its own technological medium, it appears derivative of that medium because of the unacknowledged but strong implications that technologies have which overshadow the work.

Response 2: Deconstruction as Art Practice

Consistent with such a critical awareness is a mode of art production in which self-deconstruction is a main agenda. Such deconstructive works attempt to examine and reveal the subtexts, meta-narratives and representations that underscore contemporary life. This is therefore a form of reflexivity that examines the processes of representation itself within art.

If the work is engaged with technology this reflexivity can be turned toward science, technology and the culture of science and technology for analysis, in order to reveal or address the implications that technologies have. Why does technology have such a strong effect on the reading of a work? Could it be precisely its cultural biases that are highlighted, when they are transformed from a functional role and then implicated in a cultural work?

As discussed earlier, such culturally specific biases stem from a view of science and technology as;

- theoretical structures representing the thought and practice of their practitioners more than any underlying reality,
- forces of power & domination, and
- reliance on naively received notions of progress, objectivity, representation and nature.

This means that one cannot simply use scientific or technological process without dragging in a load of semantic baggage. Could this be why the means of production are often hidden from the audience in new media works? We often hide our gear behind screens and fake walls. The opposite approach is to strip the hardware down to its bare bones and present it simultaneously so that the means of production is rendered visible — open to questioning. Each technology, whether obsolete, “high” or traditional, presents different connotations and thus an artist needs to choose an appropriate technology consistent with their intended expression, if they have one. In this mode of critical production, art works of intended expression or message are rare because artists making and writing are engaged in a subversive practice, whereby their work actively questions itself, including its position in the technical sphere. These artists learn how to work proficiently in the technical sphere, and are often self-taught hackers or *bricoleurs*. Typically

the work will present a legitimate technical feat at first glance but hint at or at best make obvious the limits of technical legitimacy in general.

Response 3: Invention and Elaboration of New Technologies and their Cultural Possibilities as Art Practice

Artists may enter into the techno-scientific sphere as peers, not just commentators, even while maintaining the above critical perspective. There is a view then of science as the art of our era, but this is not sufficient. While it incorporates the view of science as a culturally active subject, this view merely expands the technical sphere into the cultural. It does not incorporate a criticism of technology itself. For this additional shift one would require a metamorphosis the actors themselves — replacing specialists with polymaths — in a diverse science that includes a wider range of aesthetic considerations.

These polymaths would hopefully be freer from the market and socialization of disciplinary priorities and therefore able to explore new directions of unprofitable and previously discarded lines of inquiry. The vision here is of an exploration of integrated disciplines able to recognise technical and cultural costs, possibilities and implications.

Practical Hybridity

In reality artists combine all three of the above responses. The 1st work presented in this thesis deals with technology directly as its subject, in an attempt to bring general awareness and focused attention to the social dimensions of a virtual phenomenon without alienating listeners. The work can operate in both a gallery context and in an ambient public art context. It reflexive awareness is that its voice betrays itself: it makes a public display of an invisible secret world. It inverts the idea of a single user being immersed into a cyberspace virtual reality, by opening up the virtual into a public physical space. In this installation space the technology incriminates itself by showing how it is being employed. The result is a new technology, that does not measure and so is not a technical instrument, rather it poets and is a social instrument. The 2nd work engages a new actor into the field and gives voice to commentator whose perspective is not technological, but is enrolled as a peer. The virtual phenomenon is then made to sonically answer this new actor's questions. This inverts the traditional view of technology as dictating a view around which the social and political must conform.

The view of technology as infused with cultural identity and embodying a political voice is not generally acknowledged. The idea of technology as a universal driving force behind a linear line of progress is deeply entrenched. This myth of technological determinism has been well refuted by a movement of social constructivists (Feenberg 1999). Their argument bears fruitful examination before we continue.

Technological Determinism

When technocratic hegemonic forces are confronted with criticism of the system, a traditional rebuttal involves an appeal to the autonomous internal logic of the system. We are told, "that's just the way it works" or that this the most efficient way. This view is so ubiquitous that the discomfit of new technological developments is expected and endured without protest in an "adjustment period" during which we "pay the price of progress". These attitudes follow from a false idea that technology flows from the immutable natural laws of science or mathematics and their assumed legitimacy. Under this vision, changes in cultural values have no effect on technological development. Technological determinism drives both the technocratic agenda and the dystopian visions of an autonomous net of increasingly integrated and increasingly large systems of technology invading every sphere of life.

Sociological studies of technology and science reveal that social forces are deeply implicated in the developmental process of technologies. These studies crack the foundations of determinism in two places. Firstly, they disrupt the conception that technological development proceeds linearly, and secondly, that social institutions must change to suit technological imperatives. Social constructivists Pinch and Bijker (1989) show in a case study of bicycle development that at each point in its development a range of possible solutions to technological problems existed. It is only in retrospect that the development looks like a technologically determined linear process. The process in the bicycle's design solidifies and follows a path through a tangled network of possible bicycle concepts. Functional properties, such as speed or stability of possible bicycles form alliances with groups of possible bicycle users. Since each technical problem can be solved in a number of ways we see that the shape of a technology is underdetermined. Social groups, such as women wearing long skirts, not only select among possible bicycle designs, they introduce new problems, which introduce new designs, such as bikes which are easier to mount. The point is that social groups can not only engage in determining which solution to a technical problem wins out, they can also reframe the design problems themselves, by being a possible user of the technology.

The process in which the field of possible bicycles is narrowed to an exemplar design is term *black-boxing*. Once black-boxed a technology is more or less fixed. It is named and gains a social meaning. In this case "what a bicycle is" is a safe means of transportation, rather than a dangerous racing machine for the young. When we view a technological artefact, we are looking at a mirror of our cultural values encoded in a design. Design encodes the result of a social debate just as codes of conduct, manners or legislation reveal the values of culture. For example, cotton spinning machines that permit only small repair access spaces between the machines, announce the social norm that children should work for a living. Feenberg explains this as follows: "*Technical codes define the object in strictly technical terms in accordance with social meaning it has*

acquired" (Feenberg 1999 p. 88, original emphasis). The technical code can be broken when this meaning is questioned. What a bicycle is can be opened up for renegotiation if new, previously ignored or marginalized groups enter the debate.

Hacking the Technical Code

How can marginalized groups, or even an individual artist enter the debate, which is dominated by hegemonic forces? The power relationship is clearly unequal. Foucault introduces a useful perspective on this question; he argues that resistance to a power relation is immanent to the structure of the power relation itself. The effect of locating the dominated subjects in the margin privileges them with a point of view where they can develop knowledge of the weak points of the power relation. This lore, termed *subjugated knowledge*, is often invisible to those who hold the power because it is useless to them from their point of view. It seems possible then that the technical code can be subverted or hacked from the marginal perspective within the hegemony by developing subjugated knowledge. This is a persistent narrative in the computer technology sphere: the hacker who uses knowledge of the system to compromise the system. So subverting a technology can change its meaning. For example the MINTEL system was originally conceived as a distribution system for public information and was subverted by French hackers and re-engineered into a communication system for private messages as documented in *Alternative Modernity* (Feenberg, 1995 Chap 7). A more viral formulation is also possible. Take, for example, the GNU/Linux operating system, which is an alternative computing environment to the dominant Microsoft Windows platform. In terms of its features and capabilities GNU/Linux is comparable, even similar. What distinguishes it from Microsoft Windows is the mode under which it is developed. The open source development model provides free access to the source code that constructs the computing environment. Access to this code is granted to anyone who would use it under a recursive license, the GNU Public License (GPL). The license is encoded in the language and rules of copyright law, but grants freedom of use and creation of derivative works to anyone with a number of special restrictions. The foremost restriction is that any derivative work must be licensed under this same GNU Public License. The whole genealogical line of works thus remains free as each user is obligated by the license to make each succeeding derivative works freely available too. The perfect reflexivity of this hack is that it creates a self perpetuating viral system, encoded precisely in the fabric of that which it is critiquing — the use of copyright law to construct intellectual property and thus threatening precisely that which is most fundamentally based on intellectual property: Microsoft.

Eduardo Kac's transgenic artwork *GFP (Green Fluorescent Protein) Bunny*, is similarly reflexive. *GFP Bunny* is a genetically engineered rabbit, named Alba, who glows green under specific lighting conditions. With this transgenic work Kac opens up a forum for critique of

biotechnology. This critique opens a space ensnaring as many actors as possible into an “ongoing dialogue between professionals of several disciplines (art, science, philosophy, law, communications, literature, social sciences) and the public on cultural and ethical implications of genetic engineering” (Kac, 2000)

In this work Kac mounts a challenge to a purely technical definition of life-creation based on the supremacy of DNA. This is achieved by moving the site of life-creation of the transgenic subject, from the technological lab, into the social private/public sphere, the home and family, a forum which subverts the power of technological experts and places everyone in the role as expert. In his words:

... what is important is the completely integrated process of creating the bunny, bringing her to society at large, and providing her with a loving, caring, and nurturing environment in which she can grow safe and healthy. This integrated process is important because it places genetic engineering in a social context in which the relationship between the private and the public spheres are negotiated. In other words, biotechnology, the private realm of family life, and the social domain of public opinion are discussed in relation to one another. Transgenic art is not about the crafting of genetic object d'art, either inert or imbued with vitality.

— Kac (2000)

This subversion is made all the more clear through Alba's nature: Alba is not green all the time, she is a white albino rabbit without pigment, only under blue light will her additional florescent synthetic gene derived from a jellyfish gene glow. Since Alba's transgenic nature is not normally visible she is not seen as a green glowing monster of Kac's creation, but her other qualities are highlighted in the absence of her green glow. She can then be seen as a regular fuzzy lovable creature whose meaning and very life is created in a context of the loving, caring environment Alba needs to grow as do all animals.

As an artist Kac's values define his aesthetics in this sphere of critique:

The word "aesthetics" in the context of transgenic art must be understood to mean that creation, socialization, and domestic integration are a single process. The question is not to make the bunny meet specific requirements or whims, but to enjoy her company as an individual (all bunnies are different), appreciated for her own intrinsic virtues, in dialogical interaction.

— Kac (2000)

Kac is quick to point out that the biotechnology used in the creation of Alba is not new or dangerous but is a well-known tool in this field. The project also does not upset any social rule in that humans have been steering the evolution of rabbits for more than 1440 years using traditional breeding techniques. By working within and crossing outside of the biotechnology domain Kac is pre-emptively bridging the social and technical spheres, before the black-boxing of this technology can occur.

This formulation of a radical aesthetic⁶ is a model for the “hacking” of our hegemonic techno-fetishistic milieu. It remains for this thesis to apply this model to the specific context of the computer-mediated environment. First a brief description of this site is needed.

Context: The Computer-Mediated Environment

Science fiction author William Gibson is credited with coining the term cyberspace, to describe a parallel virtual world. In his genre, dubbed *cyberpunk*, Gibson describes an Internet with its own geometry — spaces with territories and zones. The Gibsonian cyberspace is immersive — a virtual reality. Gibson's world is a hi-tech dystopia in which technology pervades everyday experience, and so his work fits into a broader category which bears the literary moniker *Near Bad Future*. The prospect of a society in which there are hundreds of microchips for every person on the planet peering back at us, could indeed be disquieting. In his keynote speech to the 2000 Conference of Human Factors in Computing Systems (CHI2000) and opening of the *Interaction Design Institute Ivrea*, John Thackara introduced the discipline of Interaction Design to focus on this problem.

Thackara (2001) notes that computing is becoming pervasive and invisible. The ideas of ubiquitous computing developed at Xerox Palo Alto Research Center (PARC) in the early 90s are a reality today.

In 1998 some 4.8 billion microprocessors were sold; only 2.5 percent of those were for personal computers. The other nearly 4.7 billion chips went — where? They went everywhere. They're like cockroaches. Only smarter.

— Thackara (2001)

Why view them as cockroaches you may ask? Why not flowers? Cyberpunk author Bruce Sterling asks what will happen when you go into the garden and flowers look back at you. Thackara has read his cyberpunk, and quotes this same statement from Sterling. Thackara's alarm stems from the focus that technological development is taking. Humans have been treated as just a factor in computing; the focus has been toward technology and away from humans. Computing problems have been solved creating more computing problems to be solved, while few are looking at technology in the light of human needs and desires.

The *Faraway* project (Andersen et al, 2002), performed at the Interaction Design Institute Ivrea, is a counter example. In this project surrealist creative methods form the basis of a qualitative research methodology used to uncover human desire.

⁶ This example is extracted from a previous as yet unpublished paper, which also explores this argument with reference to the writings and work of John Cage and Andy Goldsworthy. (Brady 2004)

This project is inspirational in that it provides a concrete example of the potentials for art practice (surrealist games) to reframe the problem. The very statement of a problem leads to a confrontational arena, revealing the underlying narrative of battle. The situation is an instance of a game that reframes the problem-solution battle into a site of collaborative play, and allows a design to emerge from a site of networked relations — a more complex but also more grounded approach.

Before embarking on such a reframing art practice we will review two bodies of theory: acoustic ecology and audible display. Along the way we will pick up vital conceptual viewpoints for the development of a sonic encounter with the virtual.

Forum I: Sound as Mediator, Acoustic Ecology

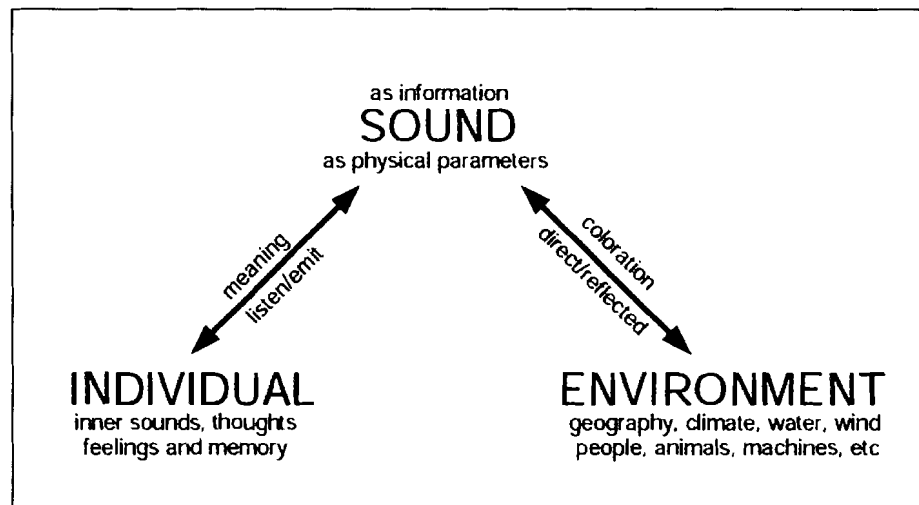


Figure 1: The Acoustic Communication model illustrating the mediating role of sound

R. Murray Schafer (1977) and Barry Truax (2001) have established the discipline of Acoustic Ecology in their classic works *The Tuning of the World* and *Acoustic Communication* respectively. These works explore the roles of sound in the environment, and have displayed and formalized how the audio spectrum is a rich resource that is shared and utilized by natural processes for communication. In particular Schafer characterized a hi-fi soundscape as an environment where masking by noise and other sounds is absent, with the result that sounds of all frequencies “can be heard distinctly” (Schafer 1977, p 43). Their Simon Fraser University (SFU) colleague, Hildegard Westerkamp, rephrased this stating there are “no anonymous sounds” (Westerkamp 1995) in the hi-fi soundscape. Beyond connecting sounds to their sources, Schafer notes that acoustic coloration caused by echoes, reverberation and absorption as sound bounces around a space, gives listeners information to navigate their environment. Kendall Wrightson writes in his excellent *Introduction to Acoustic Ecology*, “The resulting colouration offers significant information for the listener, providing cues relating to the physical nature of the environment and expressing its size in relation to the listener. This fosters a sense of place for individuals as they move around the community” (Wrightson, 2000). The Acoustic Communication model illustrating the mediating relationship between the environment and an individual through sound is pictured in figure 1.

The subtlety and range of expression found in the acoustic environment is not generally communicated within the virtual environment. Current mobile devices, virtual and augmented reality systems suffer from the same technological focus Thackara laments. They do not reflect the complexity of invisible physical interactions as sounds in the acoustic environment do. They are not aware of the acoustic ecology they are involved in and thus do not react based on their

context. The above figure leads me to wonder if perhaps sound can mediate between the virtual environment and an audience.

Forum II: Computation as Medium, Auditory Display

Formed in 1992 the multidiscipline of auditory display (AD) is involved in the rendering of information as sound. The researchers in this new field have sought to complement the visual graphical user interface with its audible counterpart. Similarly to the acoustic ecologists their starting point is the way humans use sound in the everyday environment, but their focus is more technological and less communicational. The AD texts tend to view data and information with little distinction. Their model is the generalized computational processing model: Input data is captured or generated. This data/information is processed to enhance its representational meaning — to allow humans to detect patterns in the data. Finally the data is rendered as acoustic output. The auditory display's function is to “help a user monitor and comprehend whatever it is that the sound output represents” (Kramer 1994a, p.1)

The generalized system is composed of 3 parts; information generator, communicative medium, and information receiver.

- The information generator is a database, generative computer model or, possibly real-time data-capturing component.
- The communicative medium is a digital replacement for the physical acoustic propagation medium. This heart of the AD system includes data receiving means, intermediary structures providing the mapping from data to sound, and the sound generator.
- In AD terms the listener is dubbed the information receiver.

This model is typically unidirectional: information flows left to right, input to output. Similar to the linear signal-processing model, this information-processing model does not acknowledge the active role of listener or the role of context that is fundamental to the acoustic community model.

In the signal-processing model, the signal flows from source to destination, in a series of systematic effects. There is little room for feedback, which is treated as a dangerous potential for undesirable noise. Feedback is important in the computer-mediated environment (CME), where the interactor's sense of agency is a “characteristic delight of electronic environments” (Murray 2001 p. 126).

Despite the atavistic ties in the AD model to the signal-processing model the multidisciplinary nature of the research performed in AD seems to have softened its effects. AD draws on cognitive and experimental psychology, psychoacoustics, communication, education,

computer science, mathematics, statistics, linguistics, psychomusicology, sound analysis and synthesis, physics, economics complex systems, machinery and instrumentation and sociology — truly a bewildering array. We will proceed by looking for generalizable conceptual apparatuses in AD.

Analogic/Symbolic Representation

If AD functions to ‘help a user monitor and comprehend whatever it is that the sound output represents’, we should ask in what way the display represents information?

A *symbolic* representation describes a categorically denoted representation, where the symbol replaces the information, and stands in its place. The symbol is discrete or is composed of discrete elemental quanta that do not correspond to the internal structure of the datum being represented. A doorbell is a good example, where the structure of the bell tones and the structure of the event that caused the tones have no correspondence.

An *analogic* representation reflects an immediate and intrinsic correspondence between the structure of the represented information and the representation itself. In analogic representation there is a mapping or tracing of the data, where structural features are directly represented or extracted but are not categorized. This means that relationships present in the representation are structural homomorphs of the relationships in the data being represented. A good example would be a Geiger counter, in which a change in the rate of clicks corresponds to a change in the amount of radiation present.

The distinction between analogic and symbolic representation is not binary but forms a continuum. AD systems employ combinations of analogic and symbolic representation. On one side of the continuum is sound produced by direct mechanical interactions which is the most analogic. Spoken language is placed on the other side of the continuum because in speech the symbolic sound of ‘cat’ does not have even onomatopoeic reference to a cat.

Kramer (1994a) adds another dimension to this continuum. He sketches the horizontal analogic/symbolic continuum with an added vertical dimension. This new dimension seems to indicate the degree of abstraction away from the real world soundscape present in the sonification. In this sketch the division between analogic and symbolic representation is indicated strongly at the lower levels of the real world soundscape, but weakly in more abstract sonifications. There is a sharp distinction between speech and sound produced by physical interaction. Kramer points to a greater blurring of the analogic/symbolic divide as we look at more abstract representations.

Sonification of pure data can be performed using an astoundingly arbitrary array of both symbolic and analogic mappings. Since a single sound percept can be synthesized using multiple

parameters, both symbolic and analogic mappings can be used concurrently as parameters of the same sound. Data can be grouped or sorted into discrete “pigeon holes”, which provide symbolic structure to the sonification. For example, streams of data could be associated with identifiable instrument types (horns, woodwind, etc). Then a mapping function can be used to analogically display the data’s numerical relationships over time using pitch. This would yield a hybrid display forcing us to place it in the middle of our continuum. Spatialization can be used to add an analogic quality to a symbolic sound, where the relationships between sounds can be represented as relative distances in space.

Earcons were initially conceptualized to function as symbolic icons of virtual events. But they have been analogically parameterized to reflect the dynamic properties of their event’s structure (Gaver 1994). The classic purely symbolic earcon sound is an analogue of an everyday sound. These earcons are not analogues of the information involved in the virtual event. For example when selecting a GUI desktop object a sound similar to tapping a small real object is produced. In this example there is no analogue of the computer’s actions required to select the desktop object in the earcon.

Finally the dichotomy of analogic and symbolic representation is upset during listening when the human cognitive processes pick out signatures from complex analogical representations. Over time foreground signatures are learnt as *gestalt* formations comprised of elements that were not fused together by the AD mapping. These elements come to symbolize the events with which they coincide with and a symbolic language emerges around them. For example, musicians and Morse code operators are trained to find sonic patterns which they recognize as chords and letters. In the AD literature these signatures are termed *beacons* (Kramer 1994b). Once beacons are learnt and if they are *static*, listeners can disregard the analogic representation, and work in a symbolic realm. Dynamic beacons convey a hybrid analogic/symbolic function, symbolizing a class of events with the analogical component providing details, which may not be understood, but can differentiate one instance of the event from another. If beacons are strung together they can start to function analogically again, because the relationship between symbols can be discerned as an arrangement that displays a contour formed by the sound symbols. This arrangement can be used by the AD in analogical representation.

Forum III: Musical Significance in Algorithmic Composition

The signal-processing model is broken, most profoundly, by Bargar (1994) who asserts, ‘Auditory display may be approached as a collaboration between sound designer and listener, where sounds inform a listener to extract information from them. The listener determines *how* to extract meaning based upon previous encounters with sounds carrying information’ (Bargar 1994, p. 152,

original emphasis). Here the listener is active, and the sound designer and listener are peers. In fact, the sound designer caters to the listener, by considering her previous experience with sound. Looking to the listener's receptive *action*, Bogar shows how we can start to determine what the AD needs to display for communication, as opposed to what it can display, and what communication might result. This model positions the composer as message designer predicting the potential presence of listeners capable of formulating meaning from a repertoire of auditory signals, and prompts the search for structures in music composition that can "inform auditory display designers of the descriptions of listeners and sound-production techniques" (Bargar 1994, p. 153). The structures of music composition, established through creative exploration, have become the subject of scientific research for techniques. Technology is gleaned from art making. Bargar extracts many insights into the functioning of artificial (non-speech, non-environmental) auditory communication. These are especially valuable concepts for the representation of abstract data, which also have no speech or environmental analogues, in which a musical approach to audible displays is considered.

Leitmotifs

Leitmotifs, short musical themes associated with a character or narrative event, and sound effects have been used extensively in computer games. Game players can glean a type of auditory foreshadowing by attending to these sounds.

Frames of Reference

Sounds can be used to set up a frame of reference, which do not represent the information, but form a contrast to the information. In music some sounds form a background (e.g. harmony and tonality), which changes slowly compared with the foreground features (rhythm, melody and ornamentation). Abrupt changes in the background texture can serve to illustrate a change of context.

Multimodal Frames of Reference

Audio augmentation is often subordinate to text, image or actions, and if these other modes of communication occur concurrently, observers may extract correlations between the modes. For example, the text may be viewed as ironically stated because of a sound effect present. To avoid unintended messages composers have developed techniques to accommodate or disengage these correlations, which occur between the audio and non-auditory frames of reference. For example, the stage separates listeners from performers, and allows one to disregard the significance of fellow audience members' actions.

Unintended Messages

The composer does not have perfect knowledge of the frames of reference the work will be exposed to during a performance because there are hidden frames of reference present in the listener's memory. The performance may then use a sound that triggers significant symbolic references. If this is undesirable the composer may wish to articulate the relationship between his or her sounds and the history of sounds in the local environment, in an attempt to ground the sounds in a context and avoid unintended messages.

Auditory Display Techniques

AD acknowledges following techniques, which are gleaned from observations of vocal and musical features.

- Inflection augments syntax and influences content. It is derived by analogy with vocal expression. Inflection may be synthesized by altering timbre, pitch and loudness.
- Meter and rhythm summarize local time into groups, which allow listeners to predict the onset of the next group.
- Register⁷ or tessitura allows the formation of a perceptual voice or musical stream, which improves the display of simultaneous sequences.

The above observations show how musical structure can be studied to reveal valuable concepts and techniques for auditory display. These can be used to increase the complexity of auditory display while maintaining intelligibility. Studies like Bargar's (1994) are valuable and need to be extended to incorporate a close reading of electro-acoustic and soundscape compositional methods.

A Prior Art: Babble Online - Sonification of a Virtual Landscape

Presented at the 2001 International Conference on Auditory Display, *Babble Online* is project which sonifies, in real-time, the web browsing behaviour of visitors to the www.lucent.com website (Hansen, et al. 2001). This project was designed to convey qualitative information to the website content providers, designers and visitors. It aptly demonstrates the initial ideas of reflecting virtual processes (web traffic) to give listeners a sense of activity in their virtual surroundings. Specifically the auditory display system was designed to answer the following questions:

- What is the overall level of activity of the website, is it busy or quiet?
- What proportion of the visitors browse deeply within the site, as compared to those visitors who briefly view the home page and continue elsewhere?

⁷ In music register refers to the pitch range of a human voice or a musical instrument.

- How are users distributed across the various content areas of the site?
- Which portions of the site are visited together?
- What kinds of patterns can be found in user behaviour?

Lucent's website is divided into five main content areas. A low-pitched drone effectively provides the answer to the first question. This activity drone is made up of 5 continuous pitches, each of which varies in loudness according to the aggregate number of visitors in each area of the website. As visitors browse deeper down the hierarchical branches of the web site architecture, their behaviour is categorized as mid or deep level browsing depending on their distance from the site's home page (the top). The volume of mid level accesses is sonified as a middle register rhythmic tone. The pulse loudness increases, repetition speed rises, and the timbral brightness increases with greater volumes of browsing at this level. Deep level browsing is mapped to an even higher pitched voice, with a characteristic plucked steel string timbre. Both mid and deep browsing sounds are synthesized at five discrete pitches to allow listeners to differentiate in which of five different sections the access is occurring. The sonification can be heard online (Hansen, et al. 1999).

The acoustic design is ambient and consonant. The three layers of symbolic representation (total browsing volume, mid and deep browsing) can be quite clearly picked out. Patterns can be identified such as a correspondence between web accesses in the search area followed by access in the enterprise area, which is suggested by the observation of coinciding pairs of tones. However no semantic tie is provided between the five web site areas and five pitches. To extract this relationship the listener needs to be able to identify pitch intervals and have explicit knowledge of the mapping between pitch and website sections.

Aural phenomena are exquisitely multidimensional. Tempo (repetition speed), loudness and pitch are readily mapped in this sonification, however the timbral complexity is underutilized. Brightness is redundantly used along with loudness and tempo as representation of volume in mid level browsing. While loudness and brightness do both increase when real instruments are struck harder, brightness articulates stream segregation better than frequency separation (Risset & Wessel 1982, p.43). Fixing brightness across web site areas or browsing level streams would have provided more identifiable beacons to the layers of representation, rather than varying brightness to an analogic parameter.

There is more potential for informational display using the multiple dimensions inherent in the complexities of timbre. This project seems to fall into the trap of what Douglas Kahn (1990) refers to as the "musical conceit", where mimetic sound is discarded in favour of received musical notions. The display could be trying too much to be a piece of music and in the process throws

out much potential for more sophisticated meaning making. Is this algorithmic composition encoding the programmer's/composer's traditional musical aesthetics?

In an attempt to establish grounding for this research we have looked briefly at the conceptual frameworks of acoustic ecology, auditory display and algorithmic composition. Acoustic ecology provides a description of a coherent soundscape characterized by complexity and variety in balance. Auditory display provides valuable computational strategies for information and sound processing, such as spatialization. Lastly, algorithmic composition as an art practice in a critical discourse can provide a guiding role for the use of mapping to form meaning.

EXPLORATION - *LOST*

The preceding chapter informs my sound practice. Here we will link these preceding concepts with the descriptions of the two completed works. Broadly we have now established a context, the computer-mediated environment, and then indicated a view of technology as a culturally significant medium. Now we will examine my responses in this terrain.

Beginning Notes

In the introduction I stated the aim to "represent virtual events". I would like to restate this as the notion of **mediating virtual environments through sound**. This role, of sound as mediator of environment has been thoroughly explored by acoustic ecologists. The virtual environment I am referring to is the growing invisible digital system of networked computing devices. But we might also extend this meaning from the CME to the more general meaning of virtual: that which is in effect but not directly in evidence and the cultural preconception of being inhabitants of a virtual image-world.

The approach I have taken is the construction of an audio augmented reality that represents virtuality in the everyday. Rather than intending immersion into cyberspace, I have brought the virtual out and mapped it onto physical space.

The Virtual Phenomenon: A Peer-to-Peer Network

Lost is an ambient audio-visual installation, mapping the activity of a transient community of incidental "performers" or "actors", who are participating in peer-to-peer file sharing. At this moment, music, video, images and software are being freely traded in a community of networked peers. This network is based on an open protocol called Gnutella which has been implemented by many software vendors, some of whose products are called Limewire, Bearshare and Acquisition. Anybody using these programs is able to share and find files on any other peer's computer. The network has no centre; it is a self-organizing fluid network of transient peer nodes — an ephemeral cloud. People collect files they value, and share them hoping others will do likewise. The files shared are constantly changing as people refine their collections — discarding old, uninteresting or obsolete files. The collections are expanded by a small group of initial collectors and also by people duplicating desired files they have downloaded. As some files become more popular they are easier and easier to find and replicate, because they are more widely available. In

this way the searches and the collections of files express a real-time account of contemporary desire for digital wares. The network can be viewed as a snapshot of mass longing. A selected example of the stream of searches follows:

All Kids Need
Meatloaf mp3
Little Mama
Blondie

Posing as a member of the network, the *Lost* installation, betrays its peers by submitting for public scrutiny the flow of live queries originating in the private requests found in the network. These queries form a base, often almost pornographic, but revealing essay of popular desire.

Representation, Tracing and Mapping

Confronted with the above excerpt, I was struck by its expressive potential as a multi-authored distributed found scat poetry. However the stream is rarely this eloquent.

One approach would have been to cull these phases and present them directly as live found poetry, which would be read by an interested viewer. But rather than pursuing this route, I conceived *Lost* more as an attempt to know in some general way what it's like in a widely cast glance over a virtual place — to create an everyday experience of this virtual phenomenon. Like our experience of the weather, I envisage an ambient, invisible, but fundamental experience — a groundwork on which to base possible action.

The memory of my aunt⁸ and the flies in the kitchen was still with me. I understood from this interaction that people are adept at extracting knowledge and directing their own actions from events that occur around them, so long as there is a consistency in the events. *Lost* then, in the same way as the flies, mediates between an environment and its inhabitants, and if we are inhabitants of this virtual landscape, then it seemed obvious that *Lost* should generate a soundscape.

This is unlike the mapping found in Babble Online, and many other well known sonifications which use western musical notions. For example in Charles Dodge's *Earth's Magnetic Field*, which sonified changes made by the sun's radiation on the Earth's magnetic field, the data was first mapped onto a 7 note C scale (side A) and subsequently a 12 note chromatic scale (side B). The result is thus firmly planted in the western musical tradition. Perhaps spurred on by the name of Batel's *Musical Diagrams* (my emphasis) given to the graphic method of representing the tables of magnetic data, Dodge took this "notation" as a starting point. However this notion is an extremely low-resolution representation. Each eighth-note melodic scale change represented 3

⁸ See dedication.

hours of solar flux. NASA scientists literally and figuratively digitized⁹ the complex analogue-world phenomenon into discrete musical notes. Dodge then as composer concentrated his attention on timbre and tempo of the given notation, to recreate from his imagination the radiance of what was discarded in this gross abstraction. It is a testament to his skill in constructing an expressive range of timbre and rhythm that the New York Times called it one of the “ten most significant works of the 1970s.” (Catalogue Notes)

Lost is very different from *Earth’s Magnetic Field* in that it starts with a digital world and has no musical ambitions, but rather environmental ones. It is not so much to be ‘listened to’ as to be ‘heard with’ the coming and going of everyday life. *Lost* would ideally then be installed in a lobby or other semi-public place where people come and go and may unconsciously attend to it. Over time and repeated exposure people may understand its significance as one might in overhearing the lick of wet car tires on a rainy morning and grab an umbrella on the way out.

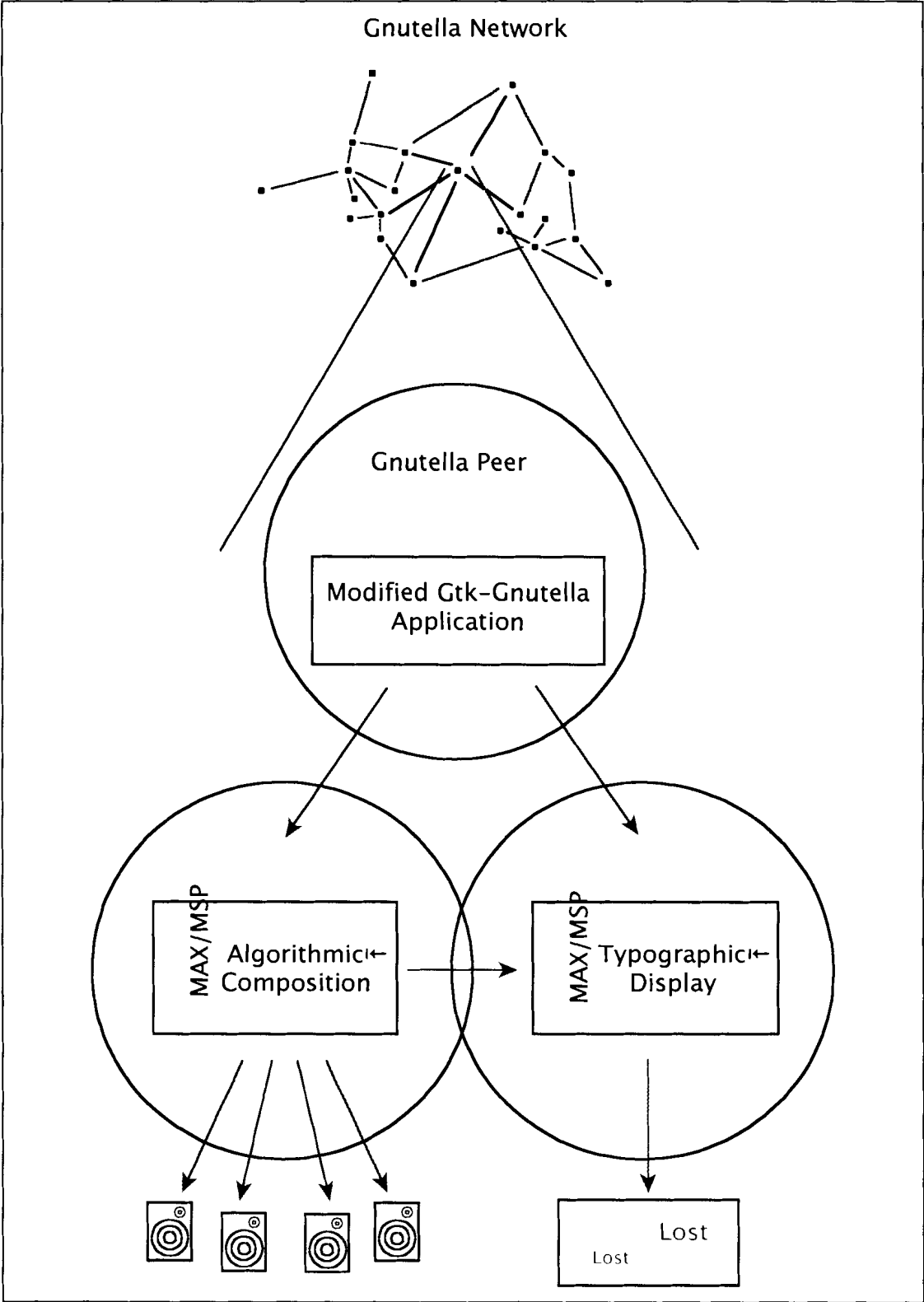
In order to hint at its subject *Lost* employs a simple visual display that shows a sampling of the torrent of queries and thus provides the audience with an introduction to the audio presentation. The audio display is a more complex multi-dimensional rendering: A spatialized storm of sharp and subdued bursts of sound surrounds the listener in a field corresponding to every arriving query. A blurred voice continually chants a query from the stream letter by letter — reflecting the stream of network bytes. Ever present is a deep hum of the network connection, which at times falters if our network node loses its connection to the other peers. When the rate of porn requests peaks the soundscape model is broken introducing a slightly more musical layer of rhythmic breath.

Technical Documentation

The work is systematically composed of three interlinked subsystems: the Gnutella peer, an algorithmic soundscape composition and the typographic display, as illustrated in Figure 2.

⁹ Digit as a finger on a hand playing piano and also as a discrete counting number.

Figure 2: Lost Systematic View



The Gnutella Peer is a customized version of an open source project called *gtk-gnutella* and runs on a Linux OS computer. It feeds the stream of intercepted queries to the remaining two components, which can run on the same or two different computers in the MAX/MSP run-time environment.

Algorithmic Soundscape Composition

The algorithmic composition is made up of four voices, which are presented in the installation space via four channels of dispersed audio. Each voice is formed by a different mapping strategy or algorithm.

Voice 1: The Connection Hum

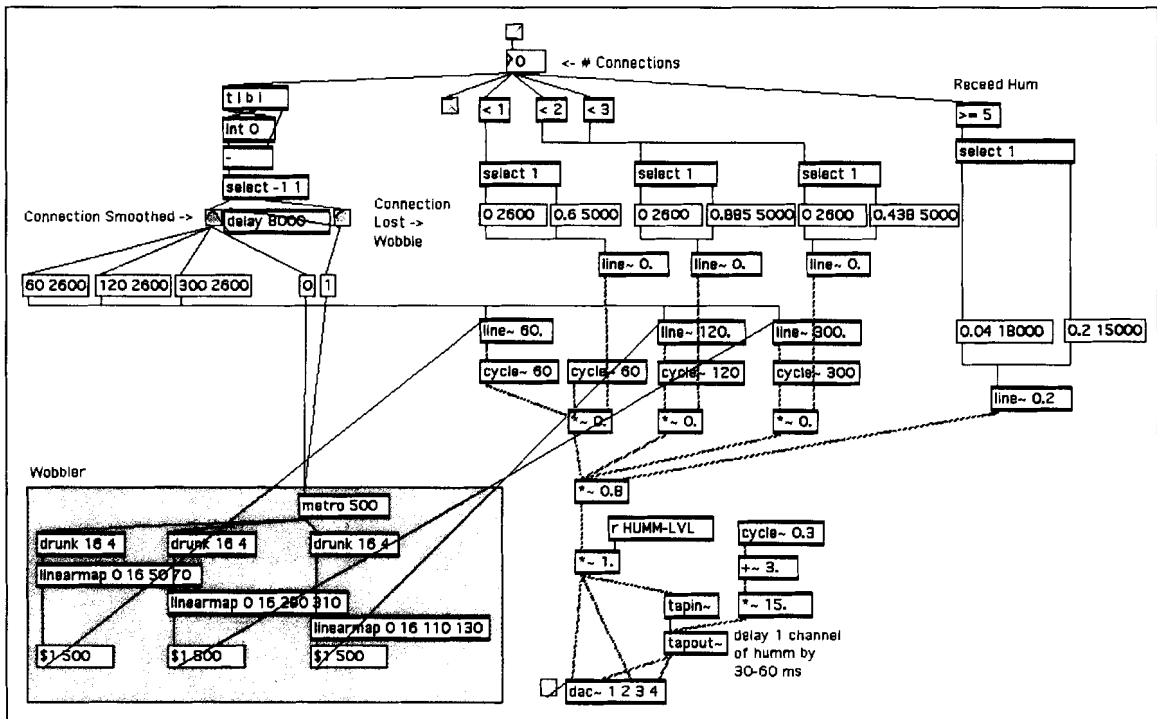
The degree to which the Gnutella Peer is connected to the network is measured by the number of active connections the peer has with other peers. While the entire Gnutella network is comprised of 800,000–1,000,000¹⁰ peers, a single peer typically maintains 3 connections to their nearest neighbours, and so is indirectly connected to one million or so peers of the entire network.

Since these connections are vital to the functioning of the peer, it can be thought of as the undercurrent of the system. To represent this connotation a 60Hz base sinusoidal tone is used to represent the first connection, with additional integer harmonics being added for the next 2 connections at 120 and 180Hz respectively. The 60Hz fundamental was chosen because in North America the AC power supply to all electrical appliances oscillates at 60Hz, this produces a characteristic tonal centre in the hum of fridges and other appliances which is almost ubiquitous in electrified settings as the background keynote of the soundscape. If more than 5 connections are obtained, the peer is in good shape and the hum's level drops and recedes further into the background. If a connection is lost the hum's harmonics will wander out of tune by up to 20Hz around the central fundamental for 8 seconds, causing a characteristic amplitude beating, which is among the most easily recognizable acoustic phenomena. This 20Hz difference plays on the border between beating and dissonance, which are among the most negatively viewed musical qualities in some cultures.

The monotony of the pure sine tone hum is alleviated by mixing it with a gently oscillating delayed version of itself sent discretely to alternate channels. The delay oscillates between 30 and 60ms, which causes phase differences and spatial effects described by listeners as a symmetrical-asymmetrical *rotation* and *undulation* of the sound field. The Max/MSP patch is illustrated in Figure 3.

¹⁰ Estimate measured from Nov 1st, 2004 to December 16th, 2004. Statistics from <http://www.limewire.com/english/content/netsize.shtml> (Accessed December 16th, 2004)

Figure 3: Connection Hum Max/MSP Patch



Voice 2: Query Drops

The connection hum is the only continuous sound presented by *Lost* and the only tonal sound. All the other sounds in the soundscape are mapped directly to events in the virtual space with a one-to-one correspondence and do not have a characteristic pitch centre. This reflects a direct temporal connection between the sound's virtual "source" event and its sound object evocation (representation). In this way *Lost* diverges from *musique concrete* and acousmatic music in that it does not attempt to view the sound object as a purely phenomenological entity devoid of source, but attempts to conjure a link between mute virtual events and synthetic sound objects. Each time a query is received from a netizen, their search query produces a synthetic drip sound. If the query is assumed to be for pornographic material using a small dictionary of words, then a harsher 'shick'¹¹ sound is made. Every query that is received by the peer is sonified as it happens. Each sound is randomly assigned to one of the four channels producing an encompassing sonic downpour. Listeners can discern the level of activity in the network neighbourhood by the relative temporal density of the downpour. If the drip versus 'shick' mapping is known, the relative distribution of pornographic to other types of searches can be also discerned.

It is of course possible to sonify more sound classes. Instead of differentiating two types of events (pornographic and other searches) it could have been music, warez¹², porn and

¹¹ This sound was also referred to as a painful zap by one listener.

¹² Software, usually illegally copied.

unclassified. I felt this would destroy the effect of being surrounded in a “rain” of queries. More importantly the distinction to add the ‘shick’ sound class came from the experience of spending time with the stream. I felt these queries jumping out at me from the streaming list of queries, and so represented them sonically as such.

Care was also taken to build in a variety of internal complexities into the sounds, so that each sound reflects a unique event not a repeated “canned sound”. This was done simply by synthesizing a variety of mixes of a short sample with pink noise bursts. A comb filter was used to alter the resulting mixed ‘drips’ to give them a more concise resonant quality, a ‘plunk’, when their frequency¹³ is low or a more blurred quality when a torrent of queries is occurring. A random enveloping function was also used to make each ‘shick’ different from the next.

Voice 3: Byte Narrator

The soundscape also contains a voice which narrates the query text. The voice reads one query at a time, letter by letter¹⁴. The voice is acoustically blurred using a comb filter, so that the text does not compete for listeners’ attention with other people talking in the installation space. The result is that the byte narrator is not a direct narration about the virtual space, but an acoustic feature of this space, as the virtual source of the voice moves around the speaker array. After listening for extended periods of time one does hear patterns of frequently repeated letters such as “X X X”, “M P 3” or “A V I”. The last two phrases are the common suffixes or extensions of filenames that are used to distinguish different file types — in this case music and video. The byte narrator gives us access to knowledge about the types of content people are interested in.

Breathy Interlude

Finally, if consistently high levels of “porn” queries are found a simple rhythmical routine runs for 4 minutes. This interlude is composed of samples of breath, played at frequencies derived from the frequency of pornographic searches. As the number these queries increases so too does the density of breath rhythm. The interlude was conceived as an alternate mode of representation, something completely different that could surprise or mystify a long-term listener, who may think they know the piece. This could be thought of as fitting into the tradition of hidden bonus tracks on compact discs, anamorphosis in painting or “easter eggs” in computer games, which are hidden bonus functionalities or cheat modes that can be discovered by expert players.

In retrospect it occurred to me that including the ‘shick’ sound during the breathy interlude, might build an association between them which would be useful as both of them are

¹³ Arrival rate, not pitch.

¹⁴ Technically speaking character by character is a more correct description.

driven by the same data — pornographic queries. This would encourage an AD reading of the composition as a measuring instrument, by defining the ‘shick’ in terms of the breathy interlude frame of reference.

What was left out

One conspicuous feature of the Gnutella network that was excluded from the representation is the actual data being shared, the files themselves. It is technically possible to repeat popular queries from the local peer and then attempt to download the files themselves. These files particularly audio could then become sound objects in the soundscape. For example the most popular song of the hour could be played on the hour. Adding such a popular song to the soundscape would be difficult as the soundscape would be masked unless small fragments of the song were used, the result would be most likely an extreme schizophrenic environment, reminiscent of radio station surfing. The NAG¹⁵ (Network Auralization for Gnutella) is an open source project which does exactly this and was completed by Jason Freeman in 2003. The result is a glitchy schizophonia and does not well fit well into the soundscape model. See Thomson (2004) for a discussion of glitch with respect to soundscape composition.

¹⁵ Website: <http://turbulence.org/Works/freeman/index.php>

Evaluation I - Acoustic Design in the Computer-Mediated Environment

The backdrop of soundscape studies of the acoustic, electro-acoustic, mass media and computer-mediated environments allows us to describe design criteria for acoustic environments that afford communication. In the following table we describe these criteria as guidelines for sound design in the computer-mediated environment, and evaluate *Lost* with respect to these guidelines.

Table 1: Acoustic Guidelines

Guideline	Description	Adherence in <i>Lost</i>
1. Reconnect Sounds with Source Events or processes	<p>In the acoustic environment sound propagates rapidly and dissipates rapidly. Thus most are perceived in sync with their source events. Even secondary reflections arriving up to 40ms late are not perceived as a secondary event under the precedence effect (Truax 1978 p.96).</p> <p>The origin of a sound is important in reconnecting sound objects with their sound sources; quite simply, the perceived origin of a sound should correspond to the location of its source event, even when the sound is synthesized. In the natural acoustic environment this is almost always the case, except for echoes and other gross reflective phenomena, in which a phantom sound source appears.</p>	<p><i>Query Drops</i> and <i>Connection Hum</i> sound objects are connected to the query arrival time, they are synchronous. <i>Query Drops</i> and the <i>Byte Narrator</i> sounds are spatialized to reflect their disparate origins.</p>

<p>2. Stimulate Diagnosis using Coloration and Timbral Complexity</p>	<p>A value of environmental sound is that it directly reflects the minutia of physical events and processes. Acoustic sound is analogic. This allows listeners to discern meaning to be found independently of their spoken language or other symbolic communication. Even speech is surrounded by paralinguistic of “um”s and “er”s, and speech sound’s inflections reveal the speaker’s emotional state.</p> <p>This is not to say that sound cannot have symbolic meaning: certain sounds gain cultural and symbolic meaning over time. The expression of sound is to be found in the combination of representation and reflection. The suggestion here is that earcons should be ideally designed to reflect and represent events and processes. The challenge is that many virtual processes are mute and abstract, making it difficult to choose meaningful iconic sounds and mapping strategies, because they have no real world counterparts.</p> <p>Sound designers can encode the details of events within the subtleties of sound’s inner composition (Truax 1992). Experienced listeners can detect aberrations in the sounds, while novices are still aware of events at a lower level of detail.</p> <p>This calls for design of classes of sounds, which vary with some parameters abstracted from the reflected event or process. There is however a danger that these parameters might alter the sound so much that it will lose its semantic tie. For example if an event’s duration is mapped to its sound duration, very short events may be reduced to the sound of a meaningless click</p>	<p><i>Query Drop</i> is modulated to reflect rate of queries and synthesized in a dynamic variety.</p>
<p>3. Avoid Masking, Limit use of Soundscape Resources</p>	<p>In order to promote the emergence of hi-fi soundscapes and thus provide a space for a range of listening levels, sound designers need to establish limits to their use of the soundscape and thus allow a functional equilibrium to develop. These limits might be in terms of loudness, spectral bandwidth use or temporal frequency and duration. For example non-critical sounds can be delayed until the ambient sound level returns to an expected norm.</p>	<p>All sounds are maintained at ambient levels. Connection Hum is restricted to lower spectral range (<180Hz). Query Drops are of short duration (<50ms).</p>
<p>4. Do Sonify Important, Anomalous and Even Routine Events</p>	<p>Careful sonification of routine events can allow sound marks and keynotes to emerge, which will provide the “natural” character of an environment to develop. Care however must be taken in ensure the sounds used have a semantic tie to the events they represent.</p>	<p>Routine events of the Gnutella network are consistently sonified. Sounds are designed to represent the synthetic nature of the digital environment without being abrasive.</p>

Table 2: Mass Media Guidelines

Guideline	Description	Adherence in <i>Lost</i>
1. Avoid Repetition of Canned Sound	Repeated undifferentiated samples will bore the listener.	Algorithmic techniques are used to generate dynamic variation of sounds.
2. Follow and Trace	Take cues from the listeners' activities and acoustic environment for indication of what tempo should be used, so that a pace can be found interactively, rather than imposed. Let content dictate structure, rather than technological or commercial interests.	Live incidental actors dictate all sound except for <i>Connection Hum</i> .
3. Identifiable Variety	Allow the listener to select the theme, character, voice or distinctive style of sounds. A cohesive style can allow listeners to group disparate sounds as belonging to an identifiable layer of audio augmentation. The act of selection of this style will increase the listeners' sense of agency, as they see their own choice is reflected in their surroundings. Provide an open architecture so that interactors and sound artist may design their own themes.	<i>Query Drop</i> sounds are identifiable as belonging to the same group of short scattered sounds. <i>Lost</i> is not open to new sounds, but will be released as an open source project. This includes the artist's sensibilities in sound design and evaluation in critical review by sound artists Barry Truax, Martin Gofrit and Kenneth Newby.

Table 3: Electro-Acoustic Guidelines

Guideline	Description	Adherence in <i>Lost</i>
1. Music and Voice	<p>Music has strong mood altering effects and does not easily mix with other music. Use it sparingly and allow listeners to easily switch it off. Similarly humans are particularly sensitive to other human voices, which may be distracting or annoying if they are poorly reproduced. Voice should be reserved for high priority, low frequency messages. Avoid excessive overlapping of multiple voices.</p> <p>Portable personal devices may travel into places where their sound is inappropriate — provide an off switch.</p>	<p>Music was not used, except for a rarely triggered <i>Breathy Interlude</i>, which is a sparse rhythmic composition. Voice is blurred.</p>
2. Provide an Off Switch	<p>Portable personal devices may travel into places where their sound is inappropriate — provide an off switch.</p>	<p>It is recommended that the installation should be located in a semi-public area in which people do not spend long continuous amounts of time. <i>Connection Hum</i> recedes — reducing its level once the connection is stable.</p>
3. Augment rather than Isolate	<p>Provide a set of sounds that act as an additional identifiable layer onto the soundscape rather than replacing or dominating the soundscape that already exists. If the communicational value of this new layer is high, but masked by noise, listeners may demand noise abatement.</p>	<p><i>Lost</i> is not immersive due to its limited visual display, limited use of voice and ambient levels.</p>

<p>4. Emulate Natural Sounds at the Internal Structural Level, Roll off High Frequencies</p>	<p>Electro-acoustically created sounds or processed sounds can be perceived as unnatural and thus more distracting. Men and especially women are more sensitive to higher frequency sounds of equal amplitude. Thus avoid simplistic synthesis methods and equal amplitudes across a variety of frequencies, rather roll off the amplitudes of high-end spectrum. For example simple and cheap buzzers create sounds of equal amplitude across their frequency spectrum, whereas sounds in the acoustic environment have reduced intensity at higher frequencies. The result is that buzzers sound unnatural to the ear.</p>	<p>Sound objects are derived from high quality recording of rich complex sounds (e.g. bells) and human voice. The amplitudes of the higher order harmonics of the <i>Connection Hum</i> are reduced. Softer pink noise used rather than white noise.</p>
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Table 4: Computer-Mediated Guidelines

Guideline	Description	Adherence in Lost
<p>1. Model the Environment</p>	<p>An internal representation of the environment in which a CME device finds itself in will be useful to help make appropriate decisions for audio augmentation.</p>	<p><i>Lost</i> is not aware of the installation space, but the artist is able to tailor <i>Lost</i> for each space by setting up the levels for each voice independently during installation.</p>
<p>2. Listen</p>	<p>As members of the acoustic community, devices should listen to the acoustic environment too. While generalized voice recognition is in its infancy, even simple ambient noise level measurement can be used to complement heuristic decisions, needed to determine the appropriateness of audio augmentation.</p>	<p><i>Lost</i> does not listen, see <i>Found</i>.</p>

Evaluation II - Emergent Meaning

In order to investigate the acoustic space represented by the *Lost* soundscape a small qualitative study was conducted with undergraduate student at SFU's School of Interactive Arts and Technology. The study involved a series of listening exercises followed by an informal group interview. The study was repeated with 3 groups of 3rd year interactive art students enrolled in a course entitled *Kinaesthetic Space*, from which they had derived a fluency in describing corporeal affect and expanded notions of space, such as virtual reality and liquid architecture. In total approximately 54 students participated in the study.

Method

The listeners were asked to make notes answering three broad questions while they freely moved in the installation space for approximately 10 minutes. The visual display was hidden and only revealed after they had disclosed their impressions of the soundscape to their peers and instructor. The soundscape mode was tested exclusively, that is, without the breathy interlude.

The questions were:

1. What kinds of real or imaginary place does the soundscape invoke?
2. How would you describe the soundscape; what adjectives come to mind?
3. How did it make you feel in your body, or what kinaesthetic qualities are present?

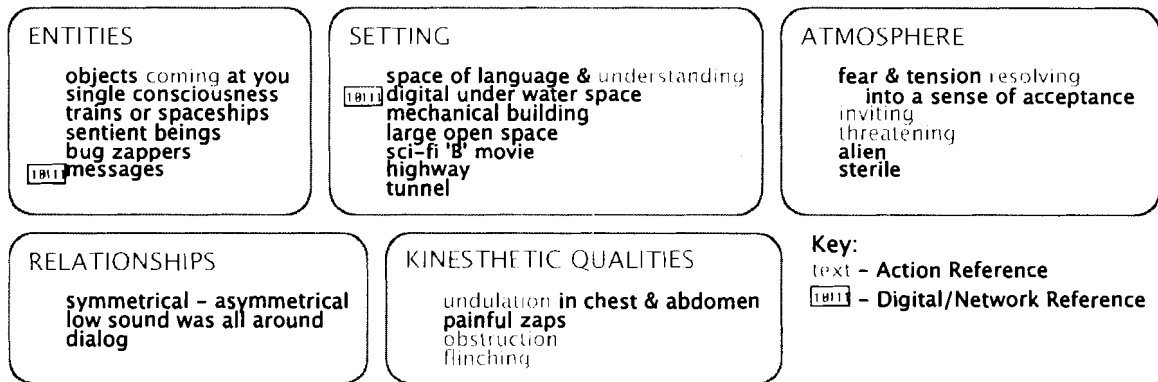
Results and Analysis

The audience's impressions are firstly presented in a taxonomy of affect; see Figure 4 below. The soundscape's affects uniquely fit in the following categories:

1. **Entities** – imagined entities that occupy the imaginary space, most often these are virtual sound sources.
2. **Setting** – general or specific description of the location or background.
3. **Atmosphere** – emotional tone experience by the listeners.
4. **Relationships** – relational interactions between listeners' imagined entities projected onto the sound objects.
5. **Kinaesthetic Qualities** – corporeal sensations experienced.

Additionally, in the figure, the impressions are tagged by a symbol depicting a digital number if there is an obvious reference to a digital or networked subject. The greyed words are indicating an action occurring.

Figure 4: Lost Affect Taxonomy

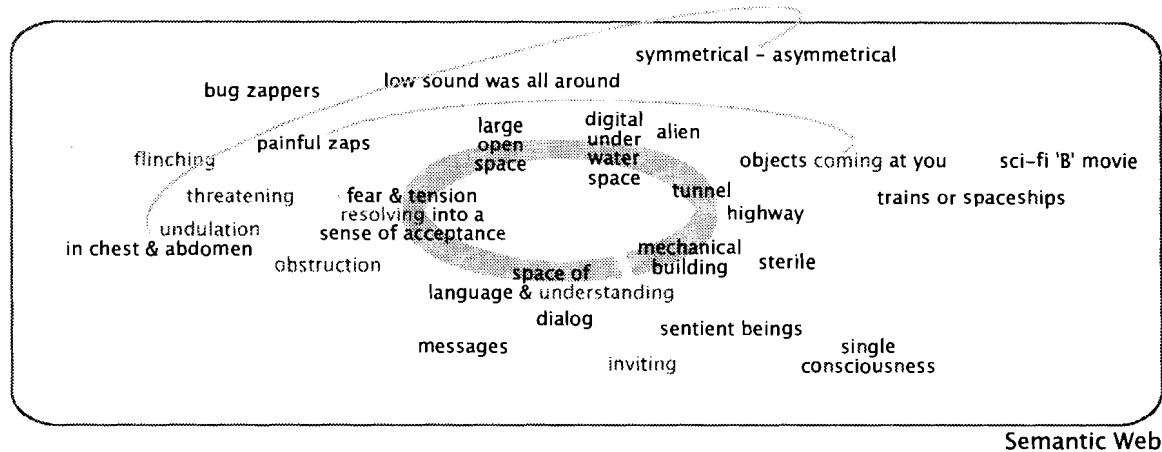


Affect Taxonomy

The entities perceived in the soundscape map semantically well back to the represented Gnutella network with the exception of the ‘bug zappers’ and maybe the ‘trains or spaceships’. We can see the object-oriented nature of listening, through the audience’s impressions of material objects being in the soundscape. For example a listener reports “*hearing a dog barking*”. This listener hears a dog, while other listeners, heard in a different sense — they “*heard the barking of a dog*, this listener hears barking without a dog. The distinction (Böhme 2000) is that in the second formulation the heard sound object detaches itself from the source. In this way they heard the *understanding, inviting and threatening*, which formed an atmosphere in between the listener and acousmatic sound environment. The whole *Lost* complex — that is the Gnutella Network plus the *Lost* sonification, illustrated in Figure 2: *Lost* Systematic View, is perceived as an *affective atmosphere* which modifies the installation space as the listener experiences it. An immersion into a remote space-time was not generally induced to the extent as would be evidenced in say a radio drama, though one listener described a complex narrative involving aliens and spaceships. Generally my impression was that the listeners were describing *Lost* as an abstract space using references to concrete examples only as metaphors. What was affected is a combination of another space and altered sense of the listener’s space, perhaps a portal? The soundscape describes a space that is tunnel-like and highway-like but does not really sound like any real tunnel or highway. While listeners heard this other space they also heard an alteration of perceived space they were moving in. They found themselves in a “large open space” with a “low sound all around”. Even more curiously they experienced an altered sense of themselves. Listeners where *invited, threatened* and encountered “fear and tension resolving into a sense of acceptance”. These are not attributes of a material, imaginary or virtual place at all but the listener’s expanded emotional space. Additionally, their corporeal space was expanded too encountering “chest and abdominal undulation” and “painful zaps”¹⁶, beyond the physical limits of sound effects.

¹⁶ No frequencies below ~20Hz where diffused into the space and peak levels did not approach dangerous loudness levels. dBA levels were not measures during the experiment.

Figure 5: Semantic Web

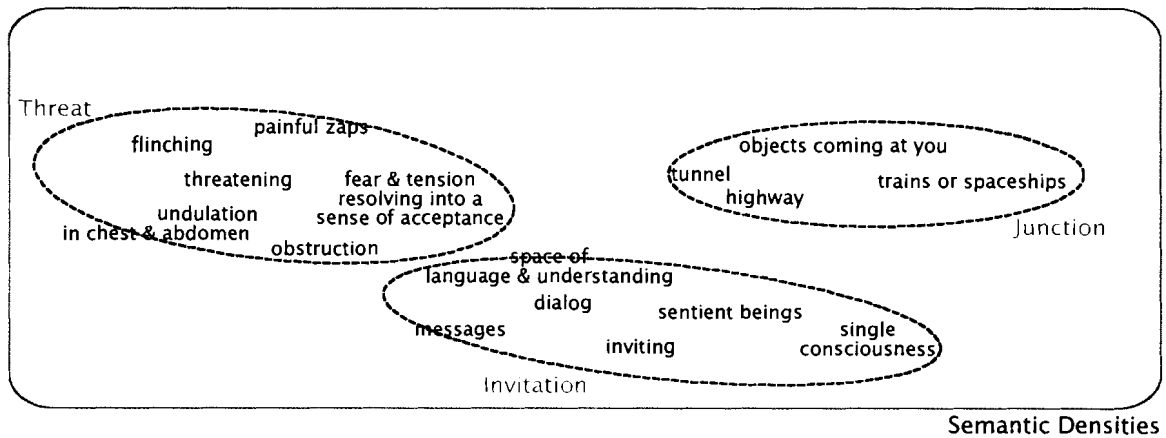


Semantic Web

Above is a depiction of the same impressions positioned in semantic proximity. As a starting point the central hub holds all the settings arranged from most specific to most abstract. Radiating outwards from the hub are the associated impressions. The placement was achieved using the WordNet¹⁷ project's semantic relatedness dictionary in combination with an automatic graphing tool. The final shape of the semantic web was influenced by my understanding of the listener's responses that were described to me in full. Two arcs are present indicating the relationships that could not be formed through proximity on a two dimensional page. Firstly the "painful zaps" were caused by the "objects coming at you". Secondly, the rotating "symmetrical – asymmetrical" oscillation was associated with the "undulations in the chest and abdomen". In analysis we can identify three densities or radial arms in this web, which seems to condense around the concepts of a *threat*, an *invitation* and a *junction*. They are circled below.

¹⁷ <http://wordnet.princeton.edu/>

Figure 6: Threat, Invitation & Junction



The installation’s Connection Hum can be perceived as a “threatening” and/or “inviting” atmosphere. The porn-related ‘shick’ sound seems to add to the disquieting reception and further to an almost violent connotation — the painful zaps. Interestingly the listeners seem to have resolved this tension in a narrative formation: the resolution of the fear into acceptance, or in an elaborate case a narrative involving alien creatures and spaceships. This is interesting because the algorithmic composition did not change its mode of presentation. There were no designed plot points. This resolution emerged from the activity of the network.

According to the listeners, the invitation came from “sentient beings” or a “single consciousness” who diffused the perceived threat. The “invitation” is composed of messages, language, dialog and even understanding. The only speaking voice, the byte narrator, seems to be the nexus of the invitation. Interestingly the blurring of the original actor’s voice by a comb filter has blurred the perception of the number of speakers — listeners identified many beings and a single consciousness speaking.

The last concentration is not an atmosphere or an entity, but again a place. This place is a kind of transport junction as a composite of a mechanical railway station and a sterile spaceport. This fits well with a view of the local Gnutella peer as a node in a large network transporting messages.

Intermission

We have examined the *Lost* project from two vantage points; a/ the quality of the sound design, and b/ the communicated dimensions of the emergent soundscape composition.

Lost as a member of the computer-mediated environment broadly fulfills the presented design criteria well. Except for two aspects, listening and reflecting internal complexity. No machine listening is included in *Lost*. While the soundscape’s sounds are complex, some of this complexity

is randomly generated and not tied to aspects of the discrete virtual environment. More work can be done in reflecting attributes of the virtual environment rather than adding meaningless random complexity. For example the length of the stream's queries could be used to envelope the query drip sounds, rather than using the current random modulation. The discrete nature of virtual environments makes such parameterization computationally and conceptually easy to extract. In the sonification of analogue phenomena such parameters have to be explicitly extracted as meta-features of the phenomena, which implies an abstraction and loss of direct reflection. This observation supports the continued use of analogue or digital filtering techniques as opposed to parameterization.

The study of the semantics of *Lost*, indicates a representation consistent with unnatural metaphors of virtuality. Alien environmental metaphors predominate, but there is a strong indication of dialogue occurring with this other plane. The themes of dialog and listening are integral to the following project.

CASE STUDY - *FOUND*

The event attempts to reveal a relationship between human and virtual collaborators, in a process of collective sound-making.

— *Found* Event Program Note, Sonic Design Evening, Western Front Artist Run Center, Lux Hall, New Forms Festival, 2004

After completing *Lost*, my research goals shifted slightly. I felt that *Lost* represented an uncritical point of view because while giving a voice to a technological system, I had positioned the humans as either mute listeners to this new voice or unwitting interactors; unaware of the part they were playing. Little direct agency was present in this context. In my questioning of technology, the technology had become central and the humans had become naïve generators or an engaged unheard audience. I had regressed toward the linear stimulus-response model, exemplary of the Audible Display point of view. My broader objective of exploring interaction between humans and technology was unbalanced, as it did not open equal space for dialog between the technological and human spheres. *Found* then became a way reframing my exploration of the relationship between the virtual phenomena and human interactors as equal cohabitating members of the acoustic ecology. The new soundscape would become a site for mutual discovery, a bridge for forming communicative connections — a kind of dialog of sound makers. In essence my model changed from one of representation to one of dialogical resonance, not reflecting the virtual but a search for acoustic dialogue between players, both virtual and human.

Case Study Rationale

On a personal level the *Found* project is an attempt to integrate two poles of art activity; the public collaborative work founded in the Intermission collective in 1998, and my academic program of studies. Practically it fulfils my desire to produce, show and participate in the media art discourse, in this case through the vehicle of the New Forms Festival.

In terms of research goals, the following case study of the *Lost* Project reveals an understanding of the participants' perspectives on the compositional process and performance.

Specifically I would like to highlight:

- Reasons for decisions made and actions taken in the compositional process and performance.

- Bridging *communicative connections* as evidence of acoustic resonance or dialog between the players.
- The meaning of *Found* in terms of the cognition, affect and intentions for the performers.
- How *Found* represents a critical response to technical virtual phenomena, exemplified in the Gnutella network.

We will not be looking at the audience's response as we did for *Found* but concentrate on the performer's processes, discoveries, and motivations.

Igor Santizo

I chose to collaborate with a peer of mine Igor Santizo because he embodies a different approach to art making than my own. I had encountered his ceremonial, organic and most clearly playful approach to sound making in performances by *Diagon*, a previous collaborative sound project of Igor's with Shane Baron. Igor had also taken part in a number of Intermission¹⁸ sponsored improvised music performances. Initially I envisioned him providing a vocal counterpoint to a reworked audible display of the Gnutella network, perhaps free-associating in response to the stream of queries. I was not fully aware of Igor's considered work such as his art writing projects with the Or Gallery¹⁹. His biographical statement at the start of this collaboration read:

As an artist Igor Santizo is an interdisciplinarian. Through his drawings, found object work, conceptual projects and sound experiments, he attempts to map consciousness, body, object and document as stratas of attention, experience and artmaking. His is a production of play and formulation as inquiry.

— Igor Santizo

Collaboration as Compositional Process

Igor and I worked on the *Found* composition from 22 August 2004, toward the first performance on 14 October 2004, in the *Sonic Design Evening*, New Forms Festival, 2004. During this period we meet twice each week. Our initial discussions were loose and informal. We related to each other our initial experiences with technology as high school scholars and our thinking around sound and art making. We proceeded by slowly narrowing in the scope of our discussion. I showed Igor the Gnutella query stream, and the *Lost* and *Babble Online* projects. Igor played me a sparse *Diagon* recording entitled, *flotsam and jetsam*, and we swapped readings. Particularly influential was the writings of Erik Davis, from which a quote was taken (Davis 1996) for the performance

¹⁸ Intermission Artists Society is a collaborative art collective based in Vancouver, of which the author is a founding member, see <http://www.inter-mission.org/> for details.

¹⁹ Igor's writing are hosted at <http://orgallery.org/autologues.html>

program note (Figure 7), and the idea of resonance as an alternative to linear cause and effect was initially articulated (Davis 1997).

We worked together as peers, fellow art makers with different knowledge, skills and approaches but always moving outside ourselves to find a common understanding between us. This collaborative practice took the form of an iterative show and tell process, starting informally but constantly gaining focus. As we shared theory, past experiences and ways to proceed a skeleton began to emerge. We were less involved in producing or constructing something, than shaving down the possibilities of what we could do into a smaller and smaller set of options of what we should do. These decisions were informed by theory but also a wandering awareness of the moment that remained open to suggestions of form that emerged from the content — the investigation at hand.

We found a common intersection in acoustic ecology theory and practices, in particular the writings and sound walks presented by Hildegard Westerkamp. This interest, combined with Igor's reflections on Quietest music, prompted our decision to keep the *Lost* algorithmic soundscape composition, and reframe it as an instrument. Igor's found instruments and toys that he had recently slimmed down to a smaller set became his primary percussive acoustic instrumentation. This was the beginning of a decision not to use his voice in the performance, as I had first envisaged.

The next phase started as we listened to the combination of sounds that were produced by these instruments. We modified the porn 'shick' sound, which to our ears did not fit with the other sounds and convolved it with the sound of one of Igor's bells to create sonic linkage, a new hybrid of a *Lost* and *Found* sound. This was the only modification of the *Lost* algorithmic composition required for *Found*. Iteratively again we experimented together listening to the combination of sounds in experimental rehearsals adding and discarding instruments that resonated to our open ear-minds. The final list of instruments included toys[●], found objects[●], bells[●], cymbals[●], a harmonica[●], unplugged keyboard[●], moonglow lights^{●■}, a computer fan[■], an audio mixer[■], a modified version of the Max/MSP algorithmic composition performance interface[■], Festival speech synthesis[■], a whistle[■], and the Max/MSP algorithmic composition mappings[▲] via a modified Gtk-Gnutella peer[▲]. In some of the listening experiments we paused to reflect and share points of attention. We discovered that correspondences were emerging between the sounds. These correspondences can be generalized into four somewhat overlapping categories:

● Used by Igor
■ Used by Mark
▲ Used by incidental performers

1. Atmospheric Context / Key Note / Frame of Reference

Emotionally toned and imaginary atmospheric settings formed a contextual background in which other foreground sounds could take place. These sounds came to be viewed as layers or coloured filters washing over the performance. This role of sound coincides well with the idea of frames of reference in AD and the keynote in acoustic ecology and traditional western music.

An example of this can be heard in the use of the equalized computer fan wide-band noise to carry an atmosphere reminiscent of a torrential down pour, in which Igor's bell-birds became foreground elements.

2. Metaphorical Linkage

These sounds share a correspondence based on the listener's knowledge and experience of classes of sounds, means of production or other non-physical similarity which allows a metaphorical linkage to be formed. For example two sounds might be both considered as scraping sounds but not share any direct similarity in duration or spectrum. An example of such linkage, in *Found*, is Igor's rhythmic beating of his cymbals and the Connection Hum which both have a shared ceremonial quality.

3. Morphological Similarity

Sounds that share internal structural similarities can be described as having a similar shape. This can be traced directly to measurable correspondences in duration and/or spectral distribution. However such a direct physical correspondence is not always evident. A similarity may be attributable to a pattern within the sound's structure, such as a sinusoidal modulation.

In *Found* Igor's bell sounds and my convolved bell exhibit striking morphological similarity as does the "pulling the lid off the tube" sound related to plopping of synthetic 'drip' sound.

4. Symbolic Connotation

Sounds may be iconic due to their cultural significance or ritual use. Most notably Igor's Buddhist bowls carry a spiritual and meditative referent. In contrast the synthetic Festival voice synthesis is iconic of a digital-machine world, replicated in robotic uninflected computer voices of television and film epics such as *Battlestar Galactica* and *2001: A Space Odyssey*.

The above correspondences become features of the *Found* performance reoccurring in different ways as each improvisation unfolds in time. The improvisation is most successful however when it reveals new correspondences, because this indicates that it is still being

conducted not as a scripted routine but in the original spirit of asking the question: How can sounds and sound-making mediate between people and the virtual network?

Figure 7: *Found* Program Note

Found

Mark Brady
Igor Santizo

New Forms Festival
Sonic Design
October 14, 2004

"The whole motive force of the commodity spectacle derives from its ability to invade and rewrite the imaginal. What's happening on the Net and throughout our culture of the simulacrum is the extraordinary technical intervention, manipulation, and externalization of the imagination."
- Erik Davis

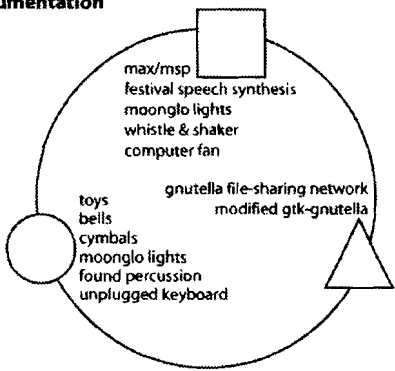
Program Note

Found is a collaborative project between Mark Brady, Igor Santizo and a computer network phenomena. The performers witness and respond to the activity of a community of "netizens." Using sound to represent and relate to this activity, they see themselves as interpreters of mediated desire.

By monitoring a global computer network, live requests for information are extracted and 'performed' by network users. During the performance, users are freely downloading and exchanging the files of their desire: music, software & pornography.

The event attempts to reveal a relationship between human and virtual collaborators, in a process of collective sound-making.

Instrumentation



max/msp
festival speech synthesis
moonglo lights
whistle & shaker
computer fan

gnutella file-sharing network
modified gtk-gnutella

toys
bells
cymbals
moonglo lights
found percussion
unplugged keyboard

Artists Talk
October 23, Round House Exhibition Hall, 2pm

Presented in partial fulfillment of Mark Brady's Masters of Applied Science Program at the Department of Computing Arts and Design Sciences, SFU

Performance Roles

Since Igor and myself, but also the network of peers, were implicated sound-makers we came to view the piece as a performance by three players — two human and one virtual in a process of collective sound making. Since the virtual “player”, i.e. the network, could not hear and respond to what Igor and I were doing, my role became a combination of instrumentalist and mediator. As instrumentalists Igor and I viewed our instruments as a palette of possible sonic masses, layers and phrases. As sonic mass a sound is revealed as one might uncover a sculpture. As a layer it provides an atmospheric background for complementary foreground sounds. Sonic phrases appear in *call and response* pairs or lyrical sequences. Igor also explored his instrumentation in terms of small rhythmic or tonal patterns.

My role as mediator meant that I selected the modes of representation that the algorithmic composition was engaged in. I view this as similar to moving a magnifying lens over a map of the Gnutella network. In this way I was able to focus on the various places defined by different modes of the audible display and indirectly for a sense of the terrain. I was guiding the audience through a tour of different views of the network as I searched for sonic correspondences with Igor’s sound making. For example on some occasions we would only hear the speech synthesis of the queries or the connection hum. In this way I felt I was bridging the performance and virtual spaces, searching for appropriate sonic vantage points that would resonate with Igor’s sounding. Such resonances could either complement or inspire Igor’s soundings. This role was termed an act of *technographic divination*. Technography²⁰ is formulated here as an ethnographic tracing of technology that reveals an inscription of culture in technology. Divination is relevant here because my actions were not producing the sounds directly. Rather I was channelling the actions of the Gnutella Network through a mapping network — the algorithmic composition system. This system became an extension of the Gnutella network. My role was not directing actions but acting as a probing sense organ of the network — its ears and hearing and its voice, composed in relation to the performance space. During the performance I felt my awareness becoming diffused, stretched between an awareness of what was going on “out there” in the Gnutella network and “in here” in the collaborative performance space. Metaphorically speaking I was standing with each hand on a different drum skin feeling the vibrations. My lips became pursed, in an unconscious movement, always present when I am listening attentively. My attention moved back and forth between these two places listening to my sounds and Igor’s. To resolve the dilemma of these two spaces competing for my attention, my awareness needed to enlarge to surround these two points so that I could effect actions related to both of them. This activity has been framed as a sonic meditation (Oliveros 1984, p.140). Without this expansion of awareness my exclusive attention to either set of sounds would deafen my perception of the

²⁰ Technography was the theme of 2004 New Forms Festival.

soundscape as a whole. This was the origin of the idea of *Atmospheric Contents* as I started to think of my sound making as creating open sound spaces in which Igor's sound events might rest.

Reflection

a conception of technology open to a wider range of values remains essential to any real break with "technological thinking"

- Feenberg (1999, p. 224)

After presenting *Found* Igor and I interviewed each other. The full interviews maybe found on the accompanying DVD. This pair of interviews provides an abundance of efferent connections to explore. Here we will focus on those that shed light on the interaction between virtual and human subjects. In particular two important questions emerged during the interviews reflecting on *Found*. The first is a direct reiteration of the research question; what light does *Found* cast on human-virtual interaction? Secondly Igor asked me; why, if the poetics of technological art is not "in the technology" but in the reading of the art, is it important for technology to be engaged in poetic works? We have already spoken at length on the importance of this 2nd question in the general framework of Wilson's *Information Arts* (2001). More specifically we have noted with reference to Feenberg's *Questioning Technology* (1999) that the hacking of the technical code is strengthened by a critical reflexivity when technology is turned to comment on itself.

What can *Found* add to this discussion? The two questions can be viewed as implicated with each other via an important construct in human-computer interaction, the interface, which we will repurpose in the theoretical context of *Found*. Once repurposed the interface blurs, becoming a porous context for interaction with the virtual, dubbed a *resonant environment*.

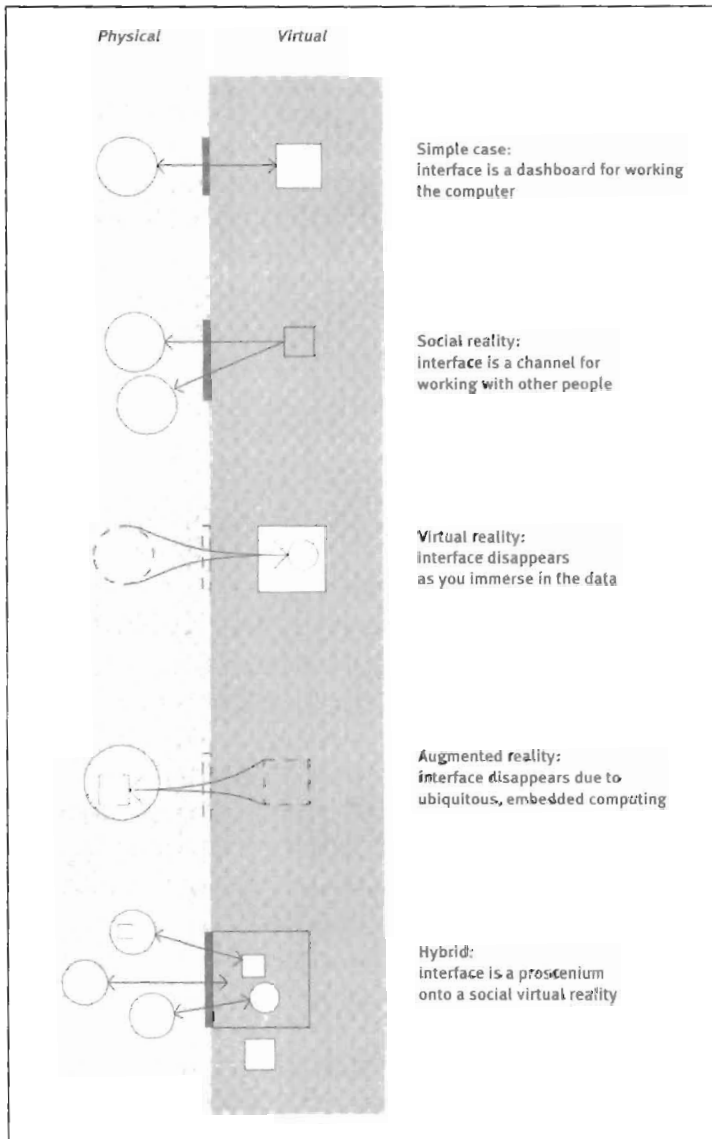
Recurring Mystical References

Before we venture forward I would like to briefly acknowledge another recurring human-virtual theme encountered in the performance. In *Found*, as in *Lost*, we have again set up a correspondence between the physical and virtual, but through Igor's considered performance countenance and ceremonial bells & bowls and we witness another association. While it is clearly stated in the performance hand bill that my sound making has its origin in the virtual, it is not clear where or from what Igor's sound making derives its inspiration. The symmetry of the performance poses a question: Mark and the network on the right — Igor and what on the left? My sound making is representative of a technological bridging of a virtual-material complex. Igor's sound making becomes a representation of some otherness bridging the immaterial-material complex. Visually the performance projects these two complexes in contrast, but resolves them in harmonic sound making. What is this immaterial realm and otherness? It is not clear but these esoteric themes do keep recurring with reference to the virtual (Davis 1998 pp.190-224).

Interface Reconsidered

Found comments on the notion of interface in two ways. Firstly extending slightly the notion of an audible display to an acoustic interface, i.e. a way of interacting with a virtual system via sound. Secondly, in the disciplines of Human-Computer Interaction (HCI) and Interactive Design, including sonic performance and composition, human-virtual interactions have come to be viewed with reference to a generalized concept of the interface as presented in Figure 8. *Found* provides an example of the problematization of the interface concept, viewing composition as means to structure interaction, without reference to the cultural and cognitive preconceptions employed in HCI and Interaction Design (Hamman 1999).

Figure 8: Bridging the Physical & Virtual via an Interface²¹



A/ Acoustic Interface as Resonant Ecology

Further to our discussion with respect to *Lost* on virtuality as a bridging of the image world and the physical world, we recall that *Lost* is a soundscape representation of a virtual space in a physical space that blurs their borders. *Lost* is an augmented reality system as pictured in Figure 8. The audible display or physical-virtual interface is reinforcing the cultural perception of virtuality as information is embedded in the physical world. Referring back to Figure 2 we can see that *Lost*'s mapping from the virtual space to physical soundscape is linear and unidirectional across the

²¹ Figure used by permission from Malcolm McCullough, *Abstracting Craft*, The MIT Press, 1998

acoustic interface. This is in conflict with the soundscape model which is explicitly communicational (Truax 2001, p 12). Real dialog is two-way involving actors who are listeners and sound makers. Reflection on *Found* reveals not a linguistic dialog but moving further along this route we might fruitfully settle on a notion of resonance for a model.

Implicit in the idea of resonance are linkages that are non-linear and multi-directional. This distinction breaks with the lines of linear causality implicit in the image world's representational model, where light flows in unidirectional rays from an object to the single point of view of the subject. This view is a Renaissance received notion already deconstructed in visual art, by Cubist reconceptions of vision through multiple points of view. The resonance model posits a world of *context sensitive* backwards-forwards interactions between subject and object. For example, in acoustics resonance occurs not only in the vocal cavities of a singer, but also in a shattering glass and the opera hall, all of which have *qualities* that amplify each other.

This model exhibits an inter-relatedness which can be described as ecological, by reference to an ecological model of direct perception (Michaels & Carello 1981) in which both human and environment form a unit in which they are mutually identified. In this model acoustic sensation is conceptualized as rich in information about the environment that it reflects. The listener perceives events, objects and places *directly* — that is without embellishment or elaboration by an information processing system that adds data to it. The data from the environment is sufficient for perception and does not require additional knowledge to be added to by the brain. Rather listeners know their specific environmental niche through the detection of information in the sensorial stimuli of their niche. In turn the listener is identified by the structural and functional methods they employ in this exploration (Michaels & Carello 1981, p.14).

Following this formulation our everyday interaction with the virtual environment would identify us in the navigational habits we employ in it. Humans and their environments are mutually identified and cannot be logically separated. From this ecological view of perception the *enrichment* of the acoustic interface between the virtual and us, as realized in *Found*, allows us to know it, but also identifies us to that other. So then enrichment of our perception of the virtual extends the limits of human identity and changes who we are. These ideas are summarized in the following quote:

Information is the structured light, sound or other medium that specifies, objects, places and events to an animal. As such, information is a bi-directional arrow, one pointing to the environment and the other pointing the animal; it is a bridge connecting the knower and the known.

— Michaels & Carello (1981 p.17)

We can now name the model of communication in *Found* in full as *acoustic ecological resonance*.

Davis (1997) also points out that the resonance model not only makes sense acoustically, but also fits in with our post-modern sensibility of a fragmented electronic media image world. As does *Found* with its exploration of virtual subjects. In *Found* the resonances are the communicational bridges discovered in the collaboration and documented above as atmospheric, metaphorical, morphological and symbolic. The harmony formed in all these dimensions of the performance is evidence of a new cultural and cognitive hypothesis in action — a performance of music as the pattern that connects. The resonance model blurs the traditional hard interface between the virtual and physical because it sets up a complex ecology of knowing between the two. *Found* is then a context for the perception of a diffuse awareness that re-conceptualizes the imaginal and virtual realms in relation to ourselves.

This reflection has arrived at the idea of *acoustic ecological resonance*, as a reframing of the acoustic interface or audible display from the listener-environment perspective.

B/ Interface Aesthetics

Next we will look at the non-acoustic virtual-human interfaces which occur in *Found's* performance and composition processes.

Subversive Aesthetics of Emergent Algorithmic Composition

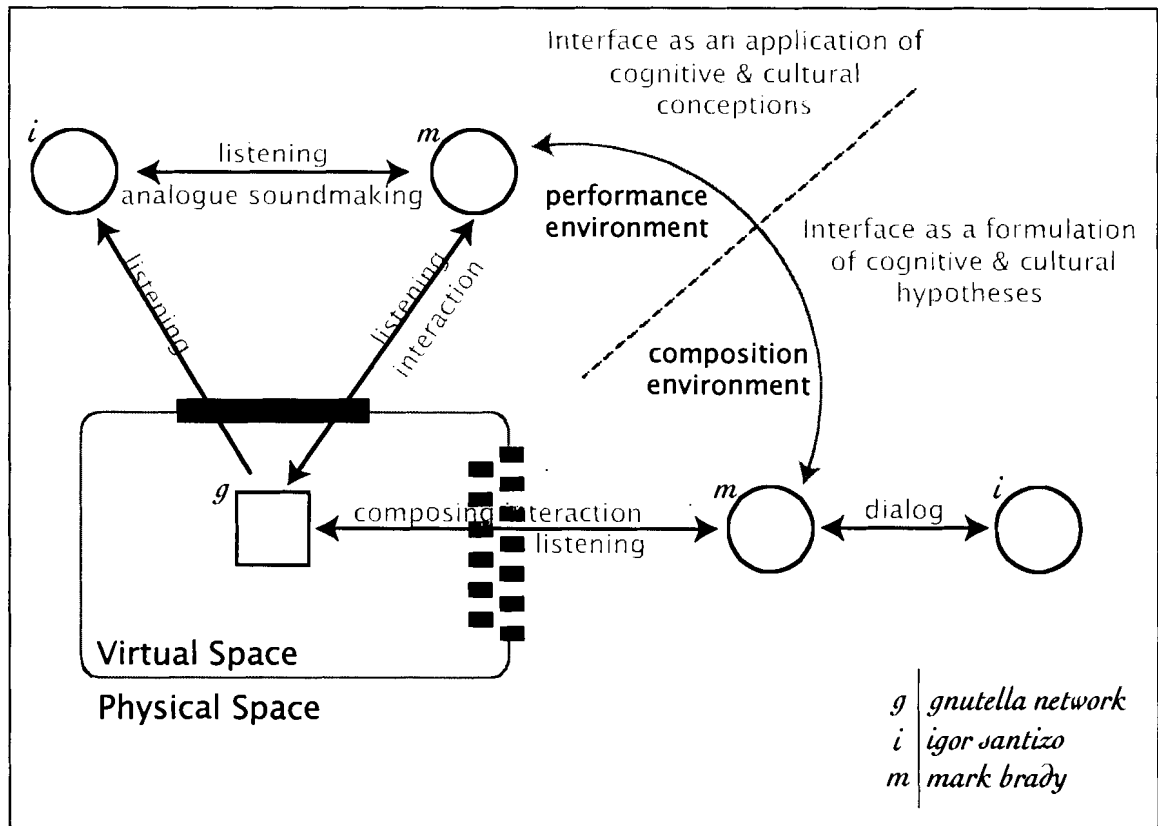
The graphical user interface has its basis in cultural and cognitive preconceptions, which ground the design of physical and virtual artefacts in human-computer interaction (Norman 1990). These cultural and cognitive preconceptions are incorporated in the human-computer interfaces in an attempt at reducing the cognitive load in integrating with the virtual system by leveraging preconceived models of interaction. Software interfaces are thus constructed to replicate familiar material objects, and in doing so create a metaphorical context for easy interaction. For example a CD playing software program that is designed to resemble CD decks is easy to use for people who have previously used common CD decks. This is not the situation in *Found's* compositional environment where the interface to the algorithmic composition instrument does not resemble any physical instrument. In the compositional process the reduction of cognitive load is not a value. Flexibility of representation is more highly valued over ease of use. As is common in art production, we are not tasked with solving problems, but revealing them. As Michael Hamman (2002) points out, music composition can form an active context for the formulation of a cultural and cognitive hypothesis of human computer interaction. Instead of being derived from cultural and cognitive preconceptions it posits a new social reality. In our case this is a new way of thinking and acting in the performance and composition environment. Such a shift is consistent with Feenberg's notion of subversion (Hamman 2002) in which the technological black-box is opened up and its meaning is re-negotiated. At a general level the black-box is the computer as

tool of domination, previously an expression of preconceived social interaction codified in immutable interfaces.

Secondly *Found* critiques the black box of a totalizing virtual reality or an invasion of the life world by hidden ubiquitous information exchange agents. In *Found* we see an alternative of human-virtual interaction as a site for a negotiated dialog of peers highlighting interactions brought to light by shared resonating qualities. This is possible only because the technology is underdetermined, and social values can be expressed through it (Feenberg 1999, p.163).

This is as an answer to Igor's question, asking why technological art is important. Technological art can embody a critique of technological rationality by forming a fully reflexive statement on the alternatives of its own nature. What then are the specific alternative values exemplified in *Found's* aesthetics?

Figure 9: Virtual - Human Interaction in *Found*



Subversive Aesthetics of *Found*

Selectively Permeable Boundaries I: Breaches, Gaps & Flow

Figure 9 illustrates the virtual-human interactions in *Found*. The composers/collaborators alternate between the performance and composition environment in essence creating and testing social hypotheses. The compositional interface is a porous and malleable construct that can be breached and reconfigured. During composition the Max/MSP programming language provided an open platform that could be composed to support the type of interactions the performers desired. For example 3rd party objects were subsumed into the algorithmic composition/instrument and *Lost*'s sounds were hybridized with sounds from Igor's instruments. These compositional choices are implicitly encoded which affords reflection and documented modification between performance iterations. The open source encoding of the Gnutella peer afforded the access to the lower software layer, breaching its interface with a spigot from which the activities of the virtual space were tapped into. The *Found* collaborative art practice demands an environment in which flexible representations can be constructed.

Sonic gaps, both in terms of spectrum and time are essential to provide space for new sonic movements to occur. In performance these gaps illustrate the potential for new sonic

directions and an attitude of “being in the moment” or allowing connections to reveal themselves. These silence gaps account for the sparseness of the *Found* performances. As a cultural hypothesis this aesthetic demands a world formulated at a human scale, with affordable²² access to multiple interior levels open to investigation.

Selectively Permeable Boundaries II: Complementarity of Analogue and Digital Qualities

During the performance, Igor performs exclusively with all acoustic instruments, except for a found toy sampler. I perform with all digital instruments, except for a whistle. In this way we intentionally cross over into each other’s domains to incorporate a little of each other’s perspective into the performance. The performance interface allows for the query events to be mapped to either the original (*Lost*) sounds or the hybridized versions. In fact a slider allows a smooth blend of sound between these two extremes to be realized. The performer can choose the amount of transformation on a continuum between a synthetic and more acoustic representation of these events.

Selectively Permeable Boundaries III: Indra’s Net

Interconnectedness is demonstrated in the interdisciplinary nature of the collaboration. Widely efferent topics and approaches were incorporated. For example Igor asked me to reflect on my childhood experience with technology. Both theory and technology were viewed as underdetermining our process, but were engaged with not as prescriptive but as suggestive of performance actions and compositional decisions. In the performance environment a feedback cycle is set up in a clockwise cycle between Igor, myself and the network. The image of Indra’s Net is articulated in *Found*’s interconnectedness and this feedback cycle, which removes the need for a central origin. Unfortunately the cycle does not flow in the anti-clockwise direction too, because the network is not listening to Igor (see Figure 9).

Multiple Perspectives

Found exhibits multiple modes of representation. During the performance different combinations of these modes were selected which reveal alternative aspects of the Gnutella network activity. This reflects the value that no one point of view is deemed authoritative.

Emergence

Both in terms of the performance and collaboration *Found* extols the values of emergent or self-organising structural features. During the compositional collaboration patterns of

²² Affordable in the general, not only in monetary sense.

performance emerged from the discussion, dialog and sonic improvisations. The details of the performance emerge directly from the activity of the Gnutella Network and the human interactions with it. This allows each performance to reveal itself in its own way which is relevant to the mood of the players (virtual and human). The performance is not predetermined, but emerges from a set of possibilities in which the unknown subject (virtual-human interaction) is allowed to reveal itself, as the outcome. *Found* maintains its reflective capacity as new correspondences are always possible. Finally the performance ends when silence emerges — what has been found is complete.

Simplicity of Representation: Mapping and Tracing

Initially in approaching *Found* I expected to do major adjustments to *Lost*'s algorithmic composition. Igor and I did not find any reason to develop more complex mapping strategies beyond one-to-one mapping of events to sounds and the mapping of efferent connections to the connection hum. This maintains the ecological perceptual frame and reinforces the spatial awareness aspects originally displayed in *Lost*. In terms of our performance presentation we added little ornamentation to the performance. The only exception was the use of the MoonGlo lights as a communicational device to indicate non-verbal cues that we were reorienting our instrumentation.

Practice Based

The practices of listening and sound making as an experimental practice cannot be overvalued in this exploration. Process, practice and embodiment in development of technique was emphasised over notation, theory or deduction in the collaboration. Those practices that emerged from the collaborative process of making and doing have been analysed in terms of their theoretical and practical relationship to the research questions.

Coda

We have documented and reflected on the compositional process and performance of the *Found* collaboration as a case study from a participant's point of view.

The reflection revealed a model that illustrates the way the participants view acoustic communication. Acoustic ecological resonance is a mode of communication between virtual and human counter parts, which engenders an awareness of each other and is incrementally distinguishable from acoustic ecology in that it is not limited to the awareness of space, as typified by natural soundscape, but is communicational in a poetic sense too. This distinction is viewed as not significant enough to warrant new terminology, although the term *organized sound* exists and

is useful to imply an organizer or composer. In *Found* ecological resonance communicates atmospheric, metaphorical, morphological and symbolic correspondences through organized sound.

The notion of a smooth hard interface for human-virtual interaction has been challenged. We showed how the need to hide details, reduce cognitive load and leverage cultural traditions is not necessary in a sound composition environment. Rather a flexible representation-structuring environment allows for a set of values to be encoded in a performance interface. The encoding forms a cognitive and cultural hypothesis.

In the case of *Found* the performance interface revealed the following key values that are an attempt at establishing a common ground in the Computer Mediated Environment, which resonates with human sensibilities.

- Loose or Selectively Permeable Boundaries facilitating Access, Complementarity & Interconnectedness
- Multiple Mutually Authoritative Perspectives
- Emergence
- Simple Mapping and Tracing as modes of Representation
- Practice (Listening & Doing)

CONCLUSION

Folding Remarks

In closing we should reiterate the answers to the research questions. The first was: How can a sonic artwork be made which represents virtual events or process so that the significance or emergent meaning of everyday human-virtual interactions is revealed? The initial project entitled *Lost* and documented here hypothesises a model of representation based on acoustic ecology's design criteria, which encourages analogic rather than symbolic representation. In support of this assertion we presented a detailed breakdown (see page 39) of these design criteria applied to the Computer Mediated Environment and evaluated *Lost* in terms of these criteria.

Additionally, we explored the connections between the notions of the virtual as present in both Deleuze's philosophy and in the computer-mediated environment. Is this virtual the same? Not directly. Both are informed by a distinction between the actual and the virtual. While Deleuze recognizes this distinction ontologically, he unites the virtual and actual again in images. These images form an ontological base — images are — the virtual or actual distinction comes later. The CME's virtual is based on simulation. The virtual simulates the actual. The distinction is only moot at specific levels of abstraction when a systematic view is formed through an interface. Both the virtual and actual present identical interfaces to such a system. The concept of simulated image-world, or *simulacrum* — is the totalizing intersection of these two concepts of the virtual. In this world the simulacra and the actual are indistinguishable. *Lost* brings this distinction into sharp focus by juxtaposing virtual and actual spaces. The superimposition of a simulated space — the Gnutella network — onto an actual space, by means of a virtual soundscape, was received as a rich spatial representation interwoven with a tension between alien and native environments. In this way it defines a critical space for enquiry into the nature of virtuality.

The 2nd research question asked: Furthermore, how can such an artwork be situated so that a techno-centric practice is placed in a broader critical framework? In other words; how can technology be addressed without assuming the dominant technological point of view but rather reveal unrepresented implications which afford new cultural forces to grow?

Subversion or democratic rationalization, based on a constructivist view of technology was presented as a philosophical framework which supports such a critique. In this framework technology is exposed as socially underdetermined, and is thus open for alternative re-

conceptualization. As such technology is an artist's medium. Presented here is an argument and demonstration of how an artistic exploration develops and encodes alternative sets of values or aesthetics. The *Found* project was examined to reveal both the aesthetic it proposes and how it was developed. We traced this development through the practice of *iterative collaboration* with *attention to difference*. Collaboration is seen as means to go beyond one's own perspective. Attention to difference raises features of process that are significant to the touch of human sensibilities while iteration affords an opportunity for reflection. In summary *Lost and Found*, highlight contemporary subversive aesthetic values not found in majoritan technical innovation. The values may be broadly called ecological aesthetics after Böhme (2000) and specifically engage:

- Tracing and Mapping, Self-Organization and Emergent Structures
- Loose or Selectively Permeable Boundaries facilitating Access, Complementarity and Interconnectedness
- Multiple Mutually Authoritative Perspectives

By "hacking" the technical code the critical reflexivity of these projects is complete. The projects project a critique onto themselves, because they are defined in a technological medium (algorithmic sound composition). Enrolling new actors (artists previously not engaged with technology) and a shift of the site of debate from authoritative scenes of scientific academia and corporate R&D to performance in public venues reframes the dominant view of technology.

The 1st contribution of this thesis then is the novel and cohesive fusion of communicative and ecological perspectives to the human-virtual acoustic interface. This thesis then aligns itself with a general view of music as performative sound making or musicking (Small 1998), which is not patterns of sound, but actions which explore, reaffirm and celebrate patterns of relationships (Small 1995). This work has sonically explored, reaffirmed and celebrated patterns of relationships between virtual and human parties.

Secondly, the concluding view engendered in this thesis is an alternative concept of human-computer interface. In contrast to that articulated by graphical user interface theorist Alan Kay as "Doing with images makes symbols" (McCullough 1998 p. 119). This statement summarised his observation that the manipulation of images facilitates people's engagement with abstract possibilities. Action with the GUI as opposed to the command line interface eases the construction of mental maps which can be used to perform abstract tasks. The alternative and complementary formulation is that *doing* (organizing and listening) *with sound formulates a diffuse awareness*. Doing with sound enlarges our field of awareness *around* tasks rather than facilitating engagement *into* the task at hand.

These two conclusions generalize and blur our conception of interface that is largely informed by dominant visual notions. Fields of ecologically perceived acoustic-semantic

resonances describe the range of human-virtual interactions with reference to *both* awareness and attention.

Re-opening Remarks

In retrospect the work described here opens up further research explorations. Most obvious is the need for machine listening to be explored. The three “players” described in the *Found* performance are not equivalent, since the network is not listening to the human player’s activities. Such listening could be accomplished using machine listening techniques, such as demonstrated in George Lewis’ *Voyager* (2000). This study adds support for the ecological approach to perception which emphasizes multiple levels and two-way analysis of acoustic events as presented in Stephen Handel’s *Listening* (1993). It remains to be seen if this approach is applicable to machine listening.

An alternative way of making the virtual player “listen” could be achieved by populating the network with data that reflects the human players’ actions. For example live-recorded sound bites of the performance could be made available to the network by masquerading them as popular searched for items.

This sound work places tensions between the notions of representation and analogic reflection in the foreground. As previously noted acoustic phenomena are strongly tied to the minutia of their production, and as such are rich reflections of the physical world. In contrast, the sonification of virtual phenomena relies on mappings to give voice to phenomena with little physical presence. The result is that mappings may be arbitrarily composed. Indeed a recent qualitative study of six algorithmic composers’ mapping strategies (Doornbusch, 2002) revealed no generalizable concepts or techniques. This thesis however demonstrates support for the concepts found in the theories of direct perception and acoustic ecology on which to base mapping strategies. The challenge is to further develop mapping techniques, which analogically reflect rather than represent sonic perceptual elements of events, objects and place

Lastly and most generally this thesis begs the further question: what sciences might emerge under an alternative but rigorously developed sense of aesthetics? This is a bold question which implies that science is an art of the aesthetics of objectivity and predictability. Can science accept a diversity of aesthetic values?

APPENDICES

Appendix A: *Lost* | *Found* Documentation

Audio and video documentation of the *Lost* and *Found* works is included in the inside back cover of this thesis.

Lost (42:00)

The collapsed stereo audio and video output of the *Lost* composition was captured on April 18, 2005 starting in the early hours of the morning.

Found (15:09)

The *Found* performance documented on the Digital Video Disc (DVD) is from the October 14, 2004 New Forms Festival 2004 *Sonic Design Evening* performed at the Western Front Artist Run Center, Lux Hall, Vancouver.

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