INTERPRETIVE PRACTICE IN LAPTOP MUSIC PERFORMANCE

by

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ABSTRACT

Laptop music performance has proliferated as a new form of practice over the past decade, resulting in new approaches and challenges to musical norms. This paper describes issues in laptop music performance, and discusses approaches in computer music research in relation to a qualitative study of "minimal" electronic music practice. The research aims to understand the social and technological dimensions of laptop music performance through a synthesis of methodological frameworks found in Technology Studies including Andrew Feenberg's "Instrumentalization Theory" and Trevor Pinch and Weibe Bijker's "Social Construction of Technology" (SCOT) These perspectives are combined with first-person methodologies and will show how the "minimal" electronic music community of practice interprets laptop music performance as an extension of the recording studio-as-musical instrument, and the techniques and musical form of DJ culture. The research examines Robert Henke's *Monodeck* and Ableton Live as examples of the instantiation of interpretations in the "minimal" context.

Keywords:

Electronic music, Technology Studies, minimal music, computer music, laptop music, community of practice.

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1 INTRODUCTION

The music making potential of the computer was predicted by Lady Lovelace (1843) and made reality with digital sound research experiments such as Lejaren Hiller's *Illiac Suite* and Max Matthew's development of the Music I program at Bell Laboratories in 1957. [1] (Lehrman, 1999; Toole, 1992) With the development of more powerful and compact laptop computers and the exchange of information and tools via the internet, computer music performance became part of a broader spectrum of music practice. Previously identified issues for computer music performance were resurrected and presented challenges within the new contexts of production and reception. (e.g., DJ culture, club culture, artist-run-centres, electronic music festivals, and sound art contexts.) The last ten years have seen the proliferation of computer music performance outside the halls of academic and art-music contexts, and now new performers are working in multiple areas using many of the tools and techniques developed in earlier computer music research.

Use of the laptop in electronic music performance began surfacing in the mid-nineties when Yuko Nexus of Japan (1994) and Austrian group Farmer's Manual (Mathias Gmachi, Stefan Possert, Oswald Berthold, and Gert Brantner) (1996) began performing. (Loubet, 2000) Standalone laptop music performance generally involves a performer sitting or standing behind a computer screen making small movements of the hand on mouse or track-pad, and keyboard. The results are heard through loudspeakers but the audience does not necessarily know to what extent the sounds are being improvised or whether the performer is simply playing back an audio file of

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[1] Ada Lovelace states "Again, it [the Analytical Engine] might act upon other things besides numbers, where objects found whose mutual fundamental relations could be expressed by those of the abstract science of operations, and which should be also susceptible of adaptations to the action of the operating notation and mechanism of the engine . . . Supposing, for instance, that the fundamental relations of pitched sounds in the science of harmony and of musical composition were susceptible of such expression and adaptations, the engine might compose elaborate and scientific pieces of music of any degree of complexity or extent." In *Ada, The Enchantress of Numbers* (Toole, 1992, p. 260)

a finished composition. Presentation of electronic music compositions over a loudspeaker system had become common practice in academic settings and other electroacoustic and art-music contexts, but it did not translate as well for the new audiences of electronic music performance who were accustomed to experiencing a more visual and sometimes spectacular aspect in music performance. Laptop music performance did not fit well within the theatrical-stage model of popular Western performance, or at least challenged the normative basis from which it was evaluated.

It is not within the scope of this thesis to attempt a full comprehensive examination of all the possible interpretations of laptop music performance. Various performers have approached laptop music performance in a number of ways, but this research will focus on its interpretation by "minimal" electronic music performers. The research asks, "How is laptop music performance being interpreted in practice?" The research is not aimed at producing a definitive answer to this question, rather it is an exploratory question used to look at activity in the area of "minimal" electronic music practice. The question is approached from the perspective that the meaning of performance practice must be understood by examining the use of the technologies involved in context. (Pinch & Bijker, 1989; Pinch and Bijsterveld, 2003) Through the dynamics of use, artifacts disclose worlds that speak to their constructed identities and that of the context in which they are negotiated. (Feenberg, 1999, 2002)

The 50-year history of computer music performance research is extensive and involves both rigorous scientific research and experimental efforts by artists, hobbyists, and entrepreneurs. However, approaches to computer music performance have tended to treat the social and technical aspects as separate problem domains. The computer is often seen as a neutral means to achieving a desired goal, but computer music performance is connected to a history of music performance based on concepts of originality, authenticity, and personal expression. So music performance seems to require more than efficient solutions, and involves problems that may not be easily operationalized. We will see how the practices of laptop music performers of "post-digital", and "minimal" electronic music illuminate the ways in which technology is also inherently social, revealing the dialogical nature of technological development and social organization.[2]

This thesis synthesizes a critique of previous approaches to the topic of laptop music performance with an analysis of qualitative data gathered through first-person methodologies (auto-ethnography, and participant-observation), and interviews with experienced laptop music performers of minimal electronic music. The research will discuss the following themes: (1.) laptop music performance as an example of the under-determination of technology; (2.) laptop music performance as an extension of a new tradition of music based in electronic and recording technology in the minimal electronic music community of practice; and (3.) the concept of "concretization" in laptop music performance practice and technological development.

1.1 Overview

The thesis begins by defining key concepts and terms, including a perspective on the concepts of "performance" and "practice". This will be followed by providing some historical information in terms of the context in which computer music performance emerged and a literature review of issues and approaches in computer music research. Laptop music performance will be shown to share its lineage with the history of electroacoustic music, which includes activities of the avant-garde, *Musique Concrete*, *Elektronische Musik*, and "experimental" music, and also that of DJ culture. Perspectives from the field of Technology Studies including the work of Feenberg (1995, 1999, 2002, 2006) and Pinch and Bijker (1989) will be discussed to provide a critical framework for looking at technological development and practice in laptop music performance. Added to this is a discussion of qualitative methods that focus on the place of practice and the relevancy of first-person perspectives. In order to make

[2] The terms "minimal" and "post-digital" will not appear in quotations again until they are defined in chapter 10.

sense of first-person perspectives, interview data, and observations in the field, chapters 8 through 10 will feature a discussion of the "musical instrument", minimal electronic music, and an overview of relevant aspects of the history of recording technology, and electronic dance music development. Finally, I give an account of my own experience as a minimal electronic music performer and relate it to my observations in the field using the specific example of Robert Henke's involvement in the development of Ableton Live and the *Monodeck* MIDI controller interface.

1.2 Orientation & Working Definitions

1.2.1 "Computer music performance" & "Laptop music performance"

This research looks at laptop music performance practice with a focus on the performer's perspective. The interest is in the "how" and "why" of minimal laptop music performance practice. Although extensive work has been done in the field of computer music, laptop music performance is a new phenomenon of the past decade and there is not a large body of literature on the specific subject. The terms "laptop music performance" and "computer music performance" will be used throughout this paper. The former refers to a contemporary incarnation of computer music performance involving use of the laptop in music performance while the latter will largely refer to the use of the computer-as-musical instrument in its various incarnations of the last 50 years. While laptop music performance is often associated with a performer seated or standing behind the glowing screen of a standalone laptop, the history of computer music performance includes strategies that employ a variety of interface configurations and may not place the computer on stage with the performer at all. (e.g., digital instrument design, interactive computer music systems, and generative music systems.) I will use the term "standalone" laptop music performance to specify music performances that rely on the point-click-display interface of the laptop's mouse, keyboard, and display screen configuration.

1.2.2 De-limiting "performance" & "practice"

As a general working definition I describe "performance" as the execution of skills, or knowledge in action. The actual act of execution would be the verb form. A generic sense of performance as a noun sees it as the completion of the act of performing. (Merriam-Webster Online, 2005-2006) What we might call proper upper case "P" "Performance" denotes a hermeneutic dimension, one that is represented as the pre-dominant norm or hegemonic influence on what is understood as performance. This interpretive dimension includes assumptions about the meaning of acts, skills, devices, settings, and the terms of their formal relations. Upper case "P" Performance is what one might associate with the familiar codes of the proscenium. (e.g., The rock concert, symphony, or theatre.) Although, there is a normative dimension to Performance, it is one that is subject to continuous revision through interpretive practice. "Interpretive practice" denotes the application of skills, devices, and knowledge in specific contexts and environments, and means that general practices are particularized and adapted (interpreted) to fit specific situations. This means that Performance in various particular incarnations also becomes a range of "performances" that act on an environment, and through a dialogical relationship between knowledge in action and action in context, affect the constitution of performance itself.

Christopher Small (1998) evokes a similar definition of performance that sees it not as a fixed object of inquiry but as a process, an activity. For Small (1998) the concept of music is necessarily tied to the activity of its making in practice or performance. Music is "musiking", and "to music is to take part, in any capacity, in a musical performance, whether by performing, by listening, by rehearsing or practicing, by providing material for performance *(what we call composing*), or by dancing." (Small, 1998, p.137) In emphasizing music as practice and performance, Small (1998) adds that anything contributing to the event of music is also a part of *musiking* (performance).

His emphasis on understanding music as process, (musiking) situated within a set of relations between people, things, and ideology is echoed in the field of Performance Studies.

Performance Studies is linked to theoretical strategies developed in the social sciences (sociology and anthropology), and a synthesis with theatre studies. Important contributors include Richard Schechner, Victor Turner, Dwight Conquergood, and Erving Goffman. (Carlson, 1996) Dwight Conquergood's (1991) article "Rethinking Ethnography: Towards a Critical Cultural Politics" represents a useful summary of some of the main questions, concerns, and strategies forwarded in the field. Conquergood (1991) introduces four themes to frame his critique: (1.) The Return of the Body; (2.) Boundaries and Borderlands; (3.) The Rise of Performance; and (4.) Rhetorical Reflexivity.

The first thematic refers to the shift from the detached-observer of fixed objects, to the participant-observer that privileges the body as a site of knowing. Conquergood (1991) insists, "Ethnography is an embodied practice". (p. 180) The second thematic is related to the first in that it is used to describe a post-colonial and post-modern shift that displaces the idea of unified identities (of self and other), and fixed objects. "From a boundary perspective, identity is more like a performance in process than a postulate, premise, or originary principle. (Conquergood, 1991, p. 185) These first two points pave the way for what Conquergood sees as a shifting focus towards performance-centered research. Performance in this case is thought of as "cultural performance". In "Sound and Senses: Towards a Hermeneutics of Performance", Lawrence Sullivan (1986) shows that performances are said to "'contain a commonly acknowledged procedure' that orders their actions; a 'sense of collective or communal enactment that is purposive'; and a communal 'awareness' that the performed acts 'are different from 'ordinary' everyday events.'" (Stanely J. Tambiah in Sullivan, 1986, p. 3) In this way the interpretive dimension of performance can be considered cultural and rooted in shared knowledge that is then enacted and/or represented in the acts and conditions of the performance. Conquergood's fourth thematic, "rhetorical reflexivity", is used to acknowledge how an ethnography based in performance, must take into account the researchers own performativity in the process of experience, and writing. (Conquergood, 1991)

In terms of the topic of music in Performance Studies, Philip Auslander (2004) has pointed out that there is little said with regards to music performance specifically, despite the general usefulness of the framework that Performance Studies suggests for studying process through embodied practice. Auslander attributes this situation to the origins of the field in theatre arts and its tendency to exclude music from discussion.[3] He also points out that musicologists have neglected critical engagement with the performance aspects of music, and have instead come from a tradition of locating importance in the "musical work" and not in the performance of works.[4] Added to this is also a focus, in cultural theory, on the reception of musical performances within larger cultural frameworks, rather than the specific contexts and actions of the performers involved. (Auslander, 2004)

I wish to stress that this research does not attempt to challenge a "normative" notion of performance in the Western musical tradition, one based on the proscenium arch of theatrical stage performance. (Cascone 2004, Emmerson 2000) However, by examining performance activities within electroacoustic, post-digital and minimal electronic music communities, one begins to see the definition of and challenges to performance norms. These negotiations will be observed rather than debated as the research is concerned primarily with the performer's relationship to performance through performing.

1.2.3 Communities of practice

Computer music is linked to a lineage of sound exploration in one sense rooted in a relationship to the affordance of electronic and recording technologies, but also in the modernist avant-garde tradition and a culture fascinated by the potentials of science and technology. Several social groups including musicians, composers, performers, engineers, scientists, hobbyists,

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[3] For examples see *Performance Theory* (Schechner, 1988), and *From Ritual to Theatre: The human seriousness in play* (Turner, 1982).
[4] Christopher Small (1998) echoes this argument in calling for an analysis of music as process or what he terms "musiking".

entrepreneurs, and others have been involved with the development of computer music and performance. The relationship of these groups to computer music performance will be examined using the concept of "communities of practice". The work of Lave, Chaiklin, and Wenger (1993, 1998, 1999) introduces the concept of "communities of practice" to refer to social groups that form around a set of relations among people, their activities, and their environment, over time and in relation to other overlapping areas or communities of practice. They also stress the notion of activity over time which leads to habituated or embodied knowledge and action. I use the concept as a way of discussing the distinct but related social groups engaged in computer music performance, and also as a way of echoing Small's (1998) emphasis on relationships and relational processes in his concept of *musiking*.

To summarize, this research focuses on performance as an activity and therefore as practice, in that action always occurs within a set of contextual relations. More specifically, music performance practice in minimal electronic music is examined as a set of activities that occur within specific contexts and involve specific communities.

2 HISTORICAL BACKGROUND

2.1 Cage, Experimentalism, & The Avant-Garde

Although the technical pre-requisites for computer music performance were forged in the research laboratory, other changes in technical, social, and musical factors must be considered in constructing an understanding of the historical context from which laptop music performance originates. The development of recording technology, and the economic and social atmosphere of the West brought about new orientations to the production and reception of music. Although performances using electronic instruments including the *Theremin* (1924), *Ondes Martenot* (1928), and *Telharmonium* (1906) preceded the work of John Cage, the history of electronic music performance is generally traced back to his *Landscape #1*(1939) piece that featured two microphones, Chinese symbol, piano, and several variable speed turntables. Cage is often associated with avant-garde music, but he positioned himself as an "experimental" musician.[5] His use of the term specifies that "experimental" music is not concerned with the generation of a fixed composition (traditional score) or predetermined musical outcome, but is concerned with initiating musical processes, the outcome of which is unknown or indeterminate. (Nyman, 1974)

Cage contributed a re-orientation to music that opened it up to all sound possibilities even what was previously considered noise. Cage's interest in "found" sound, or letting sounds be themselves, also related to his re-invention of the concept of the musical instrument in his prepared piano pieces. Cage's innovation was that he saw the piano not as something to be "played" in the conventional sense, but as a sound source in general. He had abandoned tonal harmony as the basis for musical organization and instead based musical structures on rhythm or

[5] The term "experimental" has lost its more specific meaning over the years having been used to refer to music that is not strictly tied to mainstream forms or traditional instrumental music forms.

durations of events. Added to this was the implementation of chance procedures (indeterminacy) using the *I Ching* to specify rules that determined the structure of a composition. (Chadabe, 1997; Manning, 2004; Nyman, 1974) [6] Cage's treatment of all sound as musical material and the process of its structural organization anticipated both Pierre Schaeffer's development of *Musique Concrete*, and algorithmic composition in computer music.

Cage's experimentalism emerges within the inter-war and post World War II shift from an "historical" avant-garde to a "neo"avant-garde. Here it is important to identify the avant-garde as existing in two phases, an "historical" (Futurists, Constructivists, Dadaists, and Surrealists) avant-garde that maintained a connection between art and politics, and a "neo" avant-garde emerging by post-World War II. The neo-avant-garde had been increasingly de-politicized and absorbed into a two-track system of high vs. low, elite vs. popular, a condition that represented an ultimate failure to fully realize its ideals[7] For the neo-avante-garde the transformation of everyday life through art was thwarted by the co-optation of avant-garde strategies by Western mass mediated culture and in fact it was the cultural industry that succeeded in transforming everyday life. The avant-garde became distanced from the society it sought to transform and legitimation was sought through institutionalization in art institutions, and academic interpretations. (Huyssen, 1986) Although the effects of post-modernism and Pop art succeeded in blurring the boundaries between affirmative and vernacular cultures, until recently and despite pockets of cross-influence, there remained at least two discernable spheres of electronic music practice, one that was framed by the electroacoustic academy, and the other by DJ culture.

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[6] An example is Cage's *4'33*, a three part composition where the score indicates that there are three parts, and instructs the performer not to make any sound. The result is that the un-intentional sounds of the time and space of the performance fill the durations of the three parts, so that each time the piece is performed the way it sounds, its content, will be completely different.

[7] The historical avant-garde attempted to bridge the gap between art and life that had emerged since the Enlightenment's separation of art from religion and to dismantle "institutional art" and its insistency on the autonomy of art. (Huyssen, 1986)

Prior to Cage other re-orientations to music composition had emerged including the transition to atonal music through Schoenberg's Serialism and an interest in exploring timbre forwarded by Edgard Varese. Schoenberg developed a method of composition that was based on a "row" of twelve notes also known as a 12-tone row.[8] The 1950's Serialists, including Schoenberg's students Anton Webern, and Alban Berg, extended this system of musical organization to more than notes, but also timbre, loudness, duration, and other aspects of musical composition. Karlheinz Stockhausen (1953), applied Serialism to electronic music composition and the arrival of the computer seemed especially fitted to Serialist methods because of its inherent adeptness at processing numerical data parameters. (e.g., Gottfried Michael Koenig (1960s)) (Chadabe, 1997)

Despite the fascination for new sounds and instruments, avant-garde and experimental practice tended to refer to or utilize traditional instruments and instrumentation. What the composers of the inter and post World War II eras added was a focus on timbre, atonality, experimentation, and process (structure). Computer music shows an emphasis on timbre manipulation, a de-emphasis of traditional tonal harmony, and also the importance of structure (algorithmic) in computer music systems. Like Cage's separation of form and structure, the computer enables the creation of organizational structures that can manipulate any sound. Its precursor in the analog recording technology of disc and tape also exacted a separation between structural possibilities and the infinity of what could be stored and manipulated on the given medium.

2.2 Electronic Music, Electroacoustics, & "Art-music"

The history of electronic music is not only rooted in the new orientations to sound and music forwarded by Schoenberg, Varese, Cage, et al., but also in the affordance of new technologies. Electronic music is created through any electrical means including electrical

[8] This is not to be confused with the 12-note chromatic scale of Western music.

components such as oscillators, amplifiers, synthesizers, tape decks, and computers. Electronic music activity has often been referred to under the heading "electroacoustics". Although a precise definition of electroacoustic music is not possible, one definition sees it as music composed of sounds from the natural world that are represented electronically and presented over loud speakers. Pierre Schaeffer called the condition of presenting sound in a separate time and space from its original source of production "acousmatic". The presentation of electroacoustic music on loudspeakers is known as acousmatic presentation. Electroacoustic music is also correlated with Pierre Schaeffer's development of *Musique Concrete* (1948) in Paris, as well as the *Elektronische Musik* group founded by Herbert Eimert and Werner Meyer-Eppler in Cologne. (1952) (Chanan, 1994; Emmerson, 2000)

Musique Concrete was based on editing or creating compositions from recorded material stored on disc and tape, (e.g., environmental sounds and acoustic instruments) while the work of *Elektronische Musik* involved the construction of tones using pure sine waves. Eventually these two areas became associated with the general term electroacoustics. Although an historical account of how this came to be is not a simple one, the other explanation for how the two practices became associated with the term electroacoustics is based on the fact that both methods of electronic music production are presented acousmatically through loudspeakers. (Chadabe, 1997; Chanan, 1994; Emmerson, 2000)

Electroacoustic and computer music carry on from the traditions of the avant-garde, experimental music, and instrumental concert music. While each of these can be described as distinct communities of practice some also consider them as part of a community of practice known as "art-music". "Art-music" is generally thought of as music differentiated from folk, popular, and commercial music, and in some cases is seen in opposition to popular music as a mass-market commodity. It is often and arguably considered more serious and complex than folk, popular, and commercial music. (Tagg, 1982)

Electroacoustic music has also been considered a scientific discipline. Earlier work featured explorations in electroacoustic engineering or demonstrations of physical and psychoacoustic properties of sound as revealed through electronic and recording technology. These experimentations were sometimes interwoven into electroacoustic compositions. Typically these composers were not as concerned with traditional aspects of harmony and rhythm, but with manipulations of the frequency spectrum of sound, it's diffusion in space, and other properties of reproduction, especially timbre, made uniquely available for exploration with electronic technology. (Chadabe, 1997; Courchene, 2001) Other science oriented work in computer music occurred in research centres including Bell Labs where Max Matthews developed the MUSIC I-V programs while working on digital speech synthesis, and later the Radio Baton, Radio Drum, and also the real-time computer music control system GROOVE. (Lehrman, 1999; Manning, 2004) Other specialized scientific sound research contributed to the larger spectrum of computer music activity, so that developments involve not only composition and performance, but also developments and innovations in computer science, engineering, cognitive science, and cybernetics.

3 ISSUES

Despite the influence of experimental and avant-garde music performance, 50 years of electronic music and computer music research, and the emergence of a DJ culture that accepted the playback of recorded audio as a kind of performance, the emergence of laptop music performance has presented challenges to both audience and performer.[9] When computer music is taken into contexts that typically include concert halls, clubs, and art spaces, expectations of expression and musical skill attributed to normative notions of musical performance raise issues for computer and electronic music performance. The core issues identified include a loss of visual cues/physical gesture, a lack of expressive control, and a lack of intuitive interfaces. (Chu, 1996; Emmerson 2000; Kimura, 1995; Lazzetta, 2000; MacDonald, 1995; Watts, 2000)

In laptop music performance these issues are often linked to the limits of the physical interface of the laptop, however they are not exclusive to it, and have plagued computer music performance that does not utilize a point-click-display screen based interface. While the loss of the visual aspect of performance is more of an issue from an audience perspective, the subsequent lack of responsive physical (haptic) interaction with the computer is an issue in terms of the performer's experience. Issues in physical interaction are linked to a lack of expressive control and intuitive interfaces. This research focuses on the performer's experience, but considers audience perspectives in terms of how their expectations and critical feedback informs the performer's own relationship to laptop music performance.

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[9] The term "DJ culture" refers to the social practices and meanings associated with the role of the DJ (i.e., disc jockey) who typically performs music by selecting and mixing multiple recordings (e.g., vinyl, disc, or tape.) together in a sequence that is meant to evoke a particular effect in the social environment. (e.g., dancing, or relaxation)

3.1 Sound & Source

The separation of sound from source through its acousmatic presentation is significant in electronic and electroacoustic music performance. The separation of sound heard from the source of its original production means that the visual aspect, which includes the physical act of creating sounds with an instrument, is absent, a situation not possible before electronically represented audio. (Windsor, 2000) Both electroacoustic music and laptop music share issues in performance that can be understood in relation to the effects of acousmatic presentation (Emmerson, 2000) The literature shows how electroacoustic research attempted to negotiate the challenge of the separation of sound from source in the presentation of electroacoustic works through a variety of approaches including a focus on sound spatialization, integration with live instruments, and the development of physical control devices. (Jorda, 2004, 2005; MacDonald, 1995; Paradiso, 1997) Yet, Barry Truax (2003) points out that acousmatic presentation, typified by the formal presentation of electroacoustic compositions over loudspeakers where the performer is usually seated at a mixing console in the center or back of the room, generally became the norm for presentation of works in the academy. This does not mean that other types of performance and methods were not being explored, but that such efforts were not necessarily the concern of many electroacoustic musicians who were interested in composition more than issues of performance.

3.2 Haptic Feedback

In computer music performance two disjunctures are present including the separation of sound from source, and the separation of the performer's body from the cause of the sound itself. Sound is separated from source in the process of translating it into a storage medium. (The binary code stored in the computer's hard-disk), and the performer's body is separated from the physical cause of sound due to the mediation of the interface through its encoded representation, buttons and/or other control devices. Information tends to travel in one direction at a time, there is little haptic feedback travelling from the computer to the performer. The connection between sound and action is ill-defined in that the same action may produce many different auditory results. The click of a mouse or key could be used to trigger the playback of any sound file, synthesis process, effect, or other performance. With the point-click-display interface of the standalone laptop the audience has little means of connecting what the performer is doing to what they hear, at least according to a practical knowledge of instrumental music performance.

3.3 Lack of Visual Aspect

In many performance situations, the listener does not have a clear view of the performer, yet this does not seem to have a detrimental affect on their experience. With most traditional instruments, even if the listener does not actually see the physical interaction between performer and instrument, the listener is able to imagine it, based on their immersion within the context of Western instrumental music culture. (Ostertag, 2002) An awareness of this kind of aural environmental backdrop is hardly something held in the everyday person's immediate consciousness. With music performance the listener is generally involved in the process of imagining or identifying with the performer's physical gestures that are producing the music. (Emmerson, 2000; Lazzetta, 2000) Through the experience of music performance over time, the listener can perceive the trace of the performer's physical gesture in the music heard. So, although someone may not be able to play a violin they have accumulated a certain amount of embodied knowledge that permits them to be able to imagine that experience for themselves. The laptop is not a part of this one-to-one physical interaction form of instrumental music paradigm. It conceals the causal meaning of the actions of the performer behind a screen. One cannot imagine oneself in the place of the performer, or can they? It has been clearly pointed out in the literature that laptop audiences are all too aware of the experience of using the laptop and the possibility to simply play back files on programs like *iTunes*. (Stuart, 2003; van Veen, 2002) To a new audience of laptop music performance the laptop-as-musical instrument may appear novel, and at the same time its association with business and automated processes raises doubt about what a performer might really be doing behind the screen. To a more familiar audience who may be accustomed to laptop music performance the question of "musicianship" or what the performer is actually doing still remains.

How is musical skill assessed through the interpretation of the actions of the performer? The literature suggests three core affordances. (Cascone, 2002, 2004; Emmerson, 2000; Jorda, 2005; Ostertag, 2002; Stuart, 2003; Watts, 2000)

1. The ability to access skill level (virtuosity)
2. The ability to identify with the experience of the performer
3. The establishment of an idiomatic language of performance.

Focus on the skill of the performer is in part a construct of modern Western music that produced the virtuoso as well as the marriage of visual spectacle and music performance. It is not the purpose of this thesis to challenge this cultural meme, although forms of art-music of the 20th century have challenged it. For the performer of standalone laptop music, physically based instrumental play is largely replaced with a focus on analytical navigation of possible procedures in the composition and performance of music. (e.g., what sound samples or sound processes to initiate, sequence of events, increase and decrease of volume, effects, and other parameters.) These procedures are largely framed by organizational structures in the computer software architecture and represented in the Graphic User Interface (GUI). Selection and execution of the performative possibilities represented in the computer software are decisions mostly accessed through interaction with the screen display. The audience cannot link what they hear with the performer's decisions made using the point-click-display interface of the laptop. The performer may be physically present, but their activity is not present for the audience. In the following section I will give an overview of various approaches to negotiating these kinds of issues in computer and laptop music performance.

4 APPROACHES

Approaches in computer music research involve several areas of activity that could be considered under the term "communities of practice". Like the concept of "communities of practice" these areas can be described as distinct from one another but there is also some overlap between them in terms of interests, individuals involved, and strategies. These approaches can be described under three thematics: (1.) Specialized Research; (2.) Instrument Building; and (3.) Acousmatic Approaches.

4.1 Specialized Research Areas

Specialized research areas include activities necessary to the development of computer music technology. Work done in these areas does not represent distinct approaches in computer music performance but contributes tools, techniques, and theories that have influenced its development. Computer music development is and has been reliant on the fields of Electrical Engineering, Computer Science, Cognitive Science, and Cybernetics. This research generally defines problems "instrumentally" in that it identifies issues through processes of reduction and attempts to solve isolated problems. Efforts in these areas have seen the development of a range of tools and devices including algorithms, electrical components (circuits, microprocessors, chips), software, graphic-user-interfaces (GUI), cognitive design models, analysis tools, Digital Signal Processing (DSP) tools, communication protocols (e.g., MIDI), encoding formats, programming languages, and peripheral control devices. (Rabiner, 1984; Smith 1991; Tzanetakis

& Cook, 2000) Although these technical solutions and innovations are often applied across many fields they also have contributed to the computer-as-musical instrument. [10]

4.2 Instrument Building

Digital instrument design (instrument building) includes the design of alternatives to the point-click-display configuration of the general computer interface and virtual instruments. Instrument building has been an integral part of electronic music and electronic music performance. Martin Bartlett (1984) indicates that early electronic music had to involve performative activities because tape recorders had not been invented yet. Also, that with the arrival of tape, one sees that musicians who wanted more control and predictability preferred composing tape pieces, while those more aligned with the improvisational tradition of Cage and other experimentalists turned to instrument building and also to interactive computer music systems. (Bartlett, 1984)

Many of the early electronic music instruments created by engineers, hobbyists, and art-music experimenters reflected aspects of the Western music tradition with some including a

[10] Three contributions to the computer-as-musical instrument includes the follow: Digital Signal Processing (DSP) originates in the field of electrical engineering where a signal would be an electrical signal carried by some medium, usually a wire. Before an analog signal can be processed in the computer it must be converted into digital information by an electronic circuit called an Analog to Digital Converter (ADC). In computer music audio signals often need to be processed in a variety of ways to achieve desired results. (e.g., DSP techniques like the Fast Fourier Transform (FFT) that analysizes the frequency spectrum of a signal and can be used in digital filter design, and signal compression.) (Grover & Deller, 1999; Manning, 1988) DSP is also used to refer to "digital signal processors" that are specialized microprocessors; Musical Instrument Digital Interface (MIDI) protocol was established in 1982 (Manning, 2004) and represented an attempt by electronic musical instrument manufactures to introduce a means to standardizing the control and synchronization of musical devices, and parameters. It was ultimately a compromised format shaped by "cost, performance, market preferences, and many different things that many different people wanted to do. "(Manning, 2004; p.196) Many musicians working in Electro-acoustic and art-music contexts found the conformity forced by MIDI unacceptable. Its representation of musical possibilities is rather limited consisting of an 8 bit 5 pin serial communications protocol and a control increment range of 0 to 127 that was used to specify the value of parameters like volume, pitch, and velocity; and Cognitive Science takes a functionalist view of the mind and develops models of information processing. It has a dominant presence in cybernetic theory and artificial intelligence. (Simon & Kaplan, 1989) The major contributions of this field are in the development of models of human learning and Human-Computer-Interaction (HCI) These models inform the development of music software, graphic user interfaces, and peripheral control devices. (Balaban, Ebcioglu, & Laske, 1992; Grudin, 1990; Paradiso, 1997) The branch of Cognitive Science that applies to music is Cognitive Musicology. Michael Hamman and Otto Laske developed cognitive models of HCI for the composition and performance of computer music. (Hamman, 1999, 2000; Laske, 1999)

keyboard interface. (e.g., the *Telharmonium (*1906), *Ondes Martenot* (1928), *Hammond Organ* (1935), and *Electronic Sackbut* (1948)) Some exceptions included the *Theremin* (1924) and *Spharophon.* (1926) (Manning, 2004)

There was also an interest in building or discovering possibilities for new instruments that could produce new sounds. The precedent for these kinds of explorations was set with the *intonarumori* (1914); noise-making boxes designed by Futurist artists Luigi Russolo, and Ugo Piatti. (Chadabe, 1997) These noise-making devices reflected and anticipated the beginnings of ideas that would challenge the Western music tradition and expound on the possibility of perceiving noise or other sounds previously considered outside of music, as potential musical material. The Futurists called for the expansion of the limited timbre sounds of the orchestra to include the limitless number of noise sounds. (Nyman, 1974)

4.2.1 Early do-it-yourself

While the tradition of electronic instrument building continued, for instance in the area of synthesizer development, Cage's re-definition of the instrument as a "sound source" and his opening up of the world of music to all sound combined with a growing hobbyist tradition, influenced the emergence of a Do-It-Yourself (DIY) approach to instrument building. Activities of the experimental DIY community of practice of the 60's and 70's included artists such as Gordon Mumma, David Tudor, David Behrman, Don Buchla, and Martin Bartlett. (Chadabe, 1997; Manning, 2004; Nyman, 1974)[11]

Early DIY meant that experimenters built and hacked technology, and educated themselves as part of an exploration of what could be done with what was available to them. In these early days of electronic music, access to new technology was quite limited, and generally only accessible through university and research centres. Artists pooled knowledge and resources

[11] Mumma, Tudor and Behrman were known for designing their own electronic circuits that were used as electronic instruments in performance or to augment some other aspect of the performance like Mumma's extension of the Hornpipe.(Nyman, 1974)

as part of the DIY ethic.[12] The studio at Ann Arbor, Michigan established in 1958 by Gordon Mumma and Robert Ashley, and the San Francisco Tape Music Centre (SFTMC) established in 1959 by Ramon Sender and Morton Subotnick are two examples. The SFTMC particularly benefited from collaborations with electrical engineer Donald Buchla, and composer Pauline Oliveros.[13] (Manning, 2004)

In 1977 The League of Automatic Music Composers was founded. The League included David Behrman, Jim Horton, John Bischoff, and Rich Gold who extended the 60's and 70's DIY instrument building tradition to computers. The League used a network of hacked KIM-1 computers to form an interactive improvisational music system. In 1984 the work of the League was furthered in the development of The Hub by Tim Perkis and John Bishcoff, through the creation of a "connection box" and performance group. The idea of networked and interactive computer systems formed an area of interest that persists today. Artists like George Lewis, David Rosenboom, Martin Bartlett, Roger Dannenberg, Robert Rowe, and Joel Chadabe, continued exploring interactive computer music possibilities by developing "machine listening" (feature extraction) programs, biofeedback devices, physical interfaces, generative music systems, and complex interactivity networks. (Bartlett, 1984; Chadabe, 1997).

In the early days of instrument building there was great enthusiasm for discovery of the new and all forms of experimentation no matter how imaginative. However, by at least the mid-70s innovators from this era reflected on a turn toward more "practical" approaches. Many artists shifted from conceptually focused approaches to a concern for ideas of musicality. (Chadabe, 1997)

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[12] As Amy Spencer (2005) writes in *DIY: the rise of lo-fi culture*, "A crucial element of the independent scene has always been to radically transform the relations of production. "(p. 338) DIYers didn't just experiment with technology at hand but devised their own means to disseminating their work to an audience. Unlike the larger market, their micro-market was in its ideal form, not profit driven, but based on access.

[13] Buchla's expertise combined with his dedication to experimentation lead him to developing important innovations like the control voltage sequencer that formed a central part of the *Buchla Box* "synthesizer".(Pinch & Trocco, 2003)

4.2.2 Approaches to digital instrument design

Instrument building is today, in the context of computer music research, commonly known as digital instrument design. Digital instrument design may indicate design of the internal workings of the computer where algorithms are also considered "instruments", and design may also indicate creation of the outer interface. (e.g., Graphic User Interfaces (GUI), touch sensitive pads, sensors, joysticks, MIDI controllers and other physical control devices.)

Most digital instrument designs can be classified into the following groups: (1.) instrument-like controllers; (2.) extended controllers; and (3.) alternative controllers. Instrument like controllers include traditional instruments like the keyboard or guitar whose physical response functions have been adapted to control computer functions, usually through a protocol such as MIDI. Extended controllers or hyper-instruments usually incorporate the adaptations of instrument-like controllers but with the addition of extra sensors affording extended musical techniques and additional sound control possibilities. (Wanderley, 2001, as cited in Jorda 2005; Machover, 1994, 2002) Alternative controllers are not based on imitating traditional instruments, but vary in their use of various sensing technologies in their design. (Paradiso, 1997)

The design of digital instruments is also tied to the design of interactive and generative music systems where the digital instrument becomes a player or collaborator in performance. The computer is programmed to listen and respond to the performer's activity, or the performer may specify a series of automated rules that relate to their own ideas about performance that they can interact or play with. George Lewis was a forerunner in this area with his development of the *Voyager* system. Lewis developed pattern-recognition software that enabled the computer to listen to a soloist and play along, making decisions based on the input from the soloist's instrument. (Chadabe, 1997) In general, digital music control interfaces are designed to allow more intuitive control of sound manipulation in the computer, and also address the loss of physical gesture in performance. Work such as that done at Massachusetts Institute of Technology's (MIT) Media Lab and researchers associated with the more recent New Interfaces for Musical Expression (NIME) conference is representative of the kind of work currently being explored.[14]

In contrast to the instrument building approaches listed above commercial manufacturers (e.g., Roland, E-Mu, and Berhinger) have produced controllers typically composed of control knobs, sliders, trigger buttons, and keyboards. These control devices are based on earlier electronic music interface controls for synthesizers, drum machines, sequencers, mixing boards, and other kinds of electrical equipment. These types of controllers are and have been used by electroacoustic and various art-music performers, but they are generally regarded as unimaginative, inadequate, and too generic to represent a satisfying musical interface. (Jorda, 2005: Watts, 2001) Along with the mouse and keyboard, they still are one of the most common control interfaces in laptop music performance practice.

4.3 Acousmatic Approaches

4.3.1 Sound diffusion

Spatial diffusion, and "active listening" are two approaches related more directly to the concept of acousmatic presentation. Spatial diffusion involves the distribution of sounds or multiple tracks of audio over a group of loudspeakers positioned throughout a performance space. It has its roots in early electronic music performance of *Musique Concrete and Elektronische Musik.*[15] The development of multi-channel formats, for instance 5.1 and 8-channel diffusion, became the most common diffusion formats used. Spatial diffusion was inspired in part by the problem of sound distribution of inherently dry electronic signals in an auditorium and also added another dimension to electronic composition and performance. (Manning, 2004) Today sound diffusion remains a common performance practice in electroacoustics.

[14] For information on the MIT Media Lab see http://www.media.met.edu/research/ and Paradiso (1998)
[15] In the early 50's Jacque Poullin developed a multi-channel distribution system, *poentiometre d' espace*, and *the Elektronische Musik* group used a three-channel sound projection system. Eventually the two approaches were resolved into a quadraphonic arrangement for the extension of stereophony. (Chadabe, 1997: Manning, 2004)

4.3.2 Active listening

"Active listening" is based on the premise that the listener has a role in co-creating music performance through their active attentive interpretation of it. Barry Truax (1984) elaborates the concept in his communications approach to acoustics where "listening" is given particular emphasis. For Truax (1984) active listening can involve "listening-in-search", "listening-in-readiness", and "background listening". These three levels of listening describe the multi-faceted ways in which a listener may co-create a performance experience through the way they focus their attention, whether on background sounds, with an expectation of what should be heard, or a search for meaning or comprehension of the sounds heard. Electronic music performances influenced by the concept of active listening attempt to encourage the listener to focus their attention through psychoacoustic effects, sound spatialization, sound immersion, sound interaction and transformation, and attention to the overall quality of the sound listening environment. (Emmerson, 2001; Pachet, 1999; Stuart, 2003; Truax, 1984)

4.4 Summary of Computer Music Research: Jorda

Sergi Jorda (2004) provides a concise summary of the current landscape of computer music performance and digital instrument design. "New digital instrument design is a broad field, encompassing highly technological areas ... and disciplines related to the study of human behaviour (e.g. psychology, physiology, ergonomics, and human-computer-interaction components, etc). Much of this focused research attempts to solve independent parts of the problem: an approach essential to achieve any progress in this field. However, ...it is also clearly insufficient. I believe an approach dedicated to the integrated understanding of the whole is the key to achieving fruitful results. Integral studies and approaches, which consider not only ergonomic or technological but also psychological, philosophical, conceptual, musicological, historical and above all, musical issues, even if non-systematic by definition, are necessary for genuine progress."(p.59) Here Jorda (2004) alludes to the limits of specialized research and its tendency towards instrumentalizing problems that often results in isolating the research from specific contexts and practice.[16] He summarizes the current state of digital musical instrument research with the following points: (1.) the number of new instrument (digital instrument) virtuosi and musicians who use them extensively is small; (2.) laptop music performance is widespread but performers still prefer to rely on the mouse, or "generic and dull midi fader boxes"; (3.) commercially available new instruments are scarce and not very innovative; and (4.) a new standard electronic instrument is yet to arrive. (p. 59)

Jorda makes reference to the prevalence of laptop music performance, but seems to dismiss the tendency of its practitioners to prefer certain "generic" control interfaces. I hope to show that the popularity of the generic MIDI controller is not necessarily a phenomena one can attribute solely to arbitrary choice, laziness, or market influence, and that the minimal electronic music community has gravitated towards these controllers as part of a new tradition of music; one linked to the use of the recording studio and its technology as musical instruments.

4.5 Discussion of Approaches

What stands out in particular from this survey of computer music performance research is that the ubiquitous configuration of the general-use computer with its point-click-display interface was not judged a suitable configuration for a musical instrument, the League and the Hub being unique exceptions contextualized within the experimentalist tradition. Alternative design strategies generally focused on variations in physical interaction design that included a physical interface component and interactive algorithmic design. Both of these areas were typically developed in relation to traditional notions of musical instruments, forms and metaphors. Algorithmic modelling of traditional acoustic instruments and a focus on one-to-one

[16] I refer to Andrew Feenberg's (1999) concept of "Instrumentalization" defined as a process of reduction that attempts to solve isolated problems through the design of apparently neutral means of new technology including algorithms, software, graphical-user-interfaces (GUI), cognitive design models, and peripheral control devices.

haptic-gestural relations with an instrument's physical interface have formed the basis for much work done in the area of computer music performance. (Arfib, Couturier, & Kessous, 2005; Cook, 2001; Marrin & Paradiso, 1997; Paradiso, 1998)

Laptop music performance emerges under the influence of both an instrumental music tradition, and at the same time a new paradigm of music production and reception based in electronic and recording technology. In contrast to earlier computer music performance activities, laptop music performance struggles with the limitations of the point-click-display configuration of the personal computer (or laptop), and we will see how minimal laptop music performance practice negotiates performance less from an instrumental music perspective and more from the more recently established tradition of the recording studio.

5 COMPUTER MUSIC PERFORMANCE: THEN & NOW

In the mid to late nineties a new situation emerged within the domain of computer music. The tools and techniques developed by the electroacoustic, experimental, and other art-music communities had migrated from the institutions of art and research into a more popular and generally non-academic community of musicians. Computer music performance had been a relatively marginalized area of music practice up until this time. I say relatively because computer music practice relative to academic and art music contexts would not necessarily be considered marginal. Laptop music performance relative to a common notion of popular music, however, would be considered marginal and could more aptly be described as a sub-cultural phenomenon.

5.1 "Popular" & "popular"

There is no denying the influence "Popular" music represents as it is disseminated through mass media like top 40 radio. But it is misleading to see popular music and culture as one homogenous phenomenon that is defined as simply something other than affirmative or high-art and culture. The validity and reality of such distinctions has been in question for some time. 1950's Pop art emerged as an attack on the institutionalization of modern art and used the techniques and imagery of mass culture as part of its strategy of sublating art back into everyday life.[17] The folk music revival of the 50s and 60s and art-rock of the 60s and 70s can also be seen as examples of this challenge to institutional affirmative art and an attempt to validate popular cultural activity. Even though the strategies of these different areas were quickly co-opted by the mass cultural industry these efforts still managed to succeed in raising the question of what constituted legitimate cultural activity. (Huyssen, 1986)

[17] Pop art also happened at the same time that one sees the emergence of the youth counter-culture that was very much anti-institution and anti-authoritarian, a New Left. (Huyssen, 1986)

The situation that arises in computer music performance carries on part of this disruption to characterizations of affirmative art versus mass cultural commodity. Laptop music performance performs this extension with a twist. In the post digital and minimal sense, instead of an attack on affirmative art per se, these artists borrow both the tools and techniques of the academy and popular culture to create an alternative to mass consumer culture. The result is something that is not clearly a part of mass consumer culture or the "Popular", nor is it necessarily catagorisable as affirmative art, but yet it is clearly tied to "popular" culture in a way that institutional art is not. It is interesting how the sample in electronic music resembles Warhol's serial silk-screened Pop-art portraits of Marilyn Monroe in that in both cases, the process of production is based on reproduction as well as the tools and techniques of mass production.

While electronic music produced within institutional contexts has also borrowed techniques, and aesthetic strategies from popular music practice, the results are generally contained within the academy's structures of production, dissemination, and legitmation. However, this too is changing as laptop music performance itself has grown a community of practitioners operating in both popular and art-music contexts. (e.g., Kim Cascone, Christian Fennesz, Tim Hecker, Oval, Terre Theamlitz, and Kaffe Matthews.) Post-digital and minimal electronic music stands as a kind of popular art-music. For our purposes here "popular" music refers to music that is part of a vernacular culture, as opposed to the pre-packaged and generalized "Popular" music ubiquitous in mass consumer culture.[18]

5.2 Kim Cascone & Other Critical Voices

The results and implications of this new emergence of a kind of popular art-music within computer music practice is examined by several writers including some working in both

[18] This is perhaps what Lloyd Bradley(2000) means when talking about the history of the Dub sound systems of Jamaica. Bradley states "The defining aspect of them (the mobile sound systems) as the crux of ghetto life was that they were cultural, as opposed to being merely culture." (p.6)

academic and non-academic contexts. (Ashline, 2002, 2003; Bach, 2003; Cascone, 2000, 2002, 2004; Jaeger, 2003; Loubet, 2000; Monroe, 2001, 2003; Reddell, 2003; Stuart, 2003; Thomson, 2004; Turner, 2003; van Veen, 2001, 2002) One of the most prominent voices and one of the first to recognize the emergence of a new group of artists is Kim Cascone. In an article titled "The Aesthetics of Failure" Cascone (2000) coined a term for this new community of practice and its music, "post-digital".[19] "Post-digital" music is positioned as a "popular" music, one opposed to "Popular" mass consumer culture but also one whose concerns are not necessarily synonymous with those of art-music or electroacoustics. "Post-digital" music borrows from both camps. It also addresses a broader audience than academic and art-music typically had in the past.
Cascone (2004) captures the atmosphere surrounding laptop music performance stating that laptop music performers "...have blurred the boundaries separating studio and stage, as well as the corresponding authorial and performance modes of work. On the other hand, audiences experience the laptop's use as a musical instrument as a violation of the codes of musical performance." (p. 102).

This blurring of boundaries in performance had already been staged in the avant-garde traditions of theatre, and to an extent in music as well. What laptop music performance does is to replay a similar challenge with the addition of a new technological and historical context, and a new audience. However, the sense of contention in laptop music performance has decreased over the last 5 years, especially for audiences who have become more familiar with it. Indeed, laptop music performance has constructed its own structures of legitimation through the establishment of labels, distributors, and representation at festivals (e.g., Sonar, Barcelon; Mutek, Montreal; and

[19] Cascone (2000) also implemented the use of the term "microsound", originally coined by Curtis Roads, to refer to the affordance that digital tools offered in dealing with almost microscopic particles of sound. (e.g. Granular synthesis tools.) He founded microsound.org, a mailing list and web forum for the discussion of digital or what he calls "post-digital" music. For Cascone microsound does not connote a specific genre but the exploration of digital aesthetics generally, and "post-digital" refers to artists working outside of the electroacoustic academy. (Cascone, 2000)

Transmediale, Berlin), established music venues, and art institutions. Despite this post-digital and minimal laptop music performance retain a dialogue with a more diverse popular audience base.

While some audience members still find laptop music performance problematic or not completely satisfying, many have become acclimatized to it, but performers are still looking for ways to improve laptop music performance both for themselves and the audience. Again the issues of intuitive and expressive control, adaptability, and physical interfaces for better interaction resurface. Much of the literature on laptop music performance considers these problems from the audience's perspective. (Cascone, 2000, 2002, 2004; Emmerson, 2000,2001; Stuart, 2003) Cascone and Stuart situate the problematic reception of laptop music performance in our use-value exchange economy that plays on norms of performance based on the proscenium arch mass spectacle model of performance. In "Grain, Sequence, System" Cascone (2004) argues that the construction of controversy in laptop music performance reception is partially due to the growing amount of Do-It-Yourself (DIY) performers and their wider popular audiences who cannot accept so readily the acousmatic format of presentation familiar to electroacoustic audiences.[20] Audiences used to paying to see original musical interpretations and performances cannot verify the authenticity or originality of the performance because the process is hidden from them and the automated quality of the computer castes suspicion on that hidden process.

Cascone suggests that both the new audience for computer music performance and the post-digital musician need to shift their perspective rather than pander to the expectations of popular stage performance. Other writers echo his argument. (Bach, 2003; Stuart, 2003; Turner, 2003; Whitelaw, 2003) The approach advocated is one that encourages the performer to promote the listener to engage in "attentive listening". (active listening) (Stuart, 2003) Whether one agrees with the "active listening" approach or not, Cascone effectively identifies and then disregards the

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[20] The term DIY here referes to the fact that post-digital artists, although not necessarily academically trained in computer music, had acquired what technology they could and taught themselves how to use it. For instance many were experimenting and writing their own performance programs with Max/MSP or Pure Data (PD).

context in which the post-digital emerged. While it may be true that the acousmatic nature of laptop music performance challenges the performance norms familiar to popular audiences, I don't see how a rejection of those norms necessarily represents a step forward for laptop music performance or electronic music. The post-digital owes part of its popularity or cultural relevancy (meaning) to its close relationship to popular culture as well as to its lineage in the history of electronic art-music.

5.3 Performance or Presentation?

Part of the problem may be that in many cases within the electroacoustic context of electronic music performance the notion of acousmatic performance is conflated with the kind of negotiations being explored in the area of digital instrument design. While acousmatic "performance" of electroacoustic works is a common way for electroacoustic audiences to experience electronic music, in many cases, this kind of listening circumstance involves the play-back of a fixed composition that may be altered through spatialization, and slight volume and equalization changes through the mixing board. Generally musicians engaged with this kind of presentation are more concerned with the relationship of the composition to the acoustical space of the performance than issues more directly related to performance, for example, improvisation, interpretation, and audience interaction. Digital instrument design is overtly focused on these performance issues. [21]

Individuals involved in digital instrument design realized early on the kinds of problems that taking the generalized computer configuration on stage would introduce and instead turned to exploring other interface configurations that would circumvent those problems. (Convincing

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[21] Martin Bartlett (1997) writes "In any case, there's a real difference between performance and what I would call the majority practice in Canada, where what you do is listen to the tape, though maybe there's somebody tootling on the clarinet, or whatever, to go along with it. The other side of things is live performance-based. I am more involved with that. I've made a couple of tapes but it's not my thing at all. And partly, more than partly, that comes from having been in California from the period 1966 to 1972, and working with David Tudor and Pauline Oliveros at Mills College, and being exposed to the point of view of John Cage and all this rather anarchic stuff that was directed not only at performance but also instrument-building. " (p.11)

expressiveness, physical/visual aspect, and intuitive control) For those electroacoustic composers concerned with performance the theatrical stage model has been a formative influence. Electroacoustic performers generally chose not to bring the point-click-display computer configuration to the stage, but that is exactly what laptop music performers have done. The result looks very similar to electroacoustic acousmatic presentation of composed works, and in some cases laptop music performers are essentially playing back sound files while making minor adjustments to the volume, equalization, and spatialization of multiple tracks of a composition; yet laptop music performance in general has been concerned with more than this both in terms of performance techniques and the performers desire for certain kinds of audience interaction. Ben Neill (2002) writes, "One of the key ideas to come out of recent electronic pop culture is the "rave" sensibility in which the traditional notions of performer and audience are completely erased and redefined. In this type of event, the artists are not the center of attention; instead it is the role of the artist to channel the energy of the crowd and create the proper backdrop for their social interaction. The audience truly becomes the performance, an idea that was explored by the avant-garde for years but did not have the same impact as in the current electronic pop music because of the limited audience for classical avant-garde events." (p.4)

5.4 Summary of Current Perspectives on Laptop Music Performance

While computer music research has tended to focus on practical approaches to issues of performance, literature on the specific topic of laptop music performance focuses on a critique of its social aspects. Discussion of the role of technology looks at how acousmatic presentation and the point-click-display configuration of the laptop transgresses popular performance norms, but there is little analysis of the relationship between performer and technology in the dynamics of performance. On the one hand technology has been generally thought of either as a neutral means to the liberation of musical production or as oppressive deterministic tool that impedes human expression in its path to efficiency and control. Conversely, Cascone also asks nothing of technology, positioning it as a separate entity, one whose function and value is socially determined from without. Both positions consider technology as something external to social process, one to be taken up or put down, or one that acts on the other from without.

6 TECHNOLOGY STUDIES METHODOLOGIES

This thesis takes a critical view to technology that considers both the technical and social dimensions of technology as dialogically constituted in technology and practice. This perspective is drawn from the field of Technology Studies including the work of Andrew Feenberg (1995, 1999, 2002, 2006), and Trevor Pinch et al. (Pinch & Bijker, 1989; Pinch & Bijsterveld, 2003; Pinch & Trocco, 1998, 2002)

6.1 Andrew Feenberg's Critical Theory of Technology

Andrew Feenberg (1995, 1999, 2002, 2006) presents a view to technology that incorporates the dynamics of social and technical relations. In what he terms "Instrumentalization Theory", Feenberg (1999, 2002, 2006) outlines the limits of technological rationalism and posits the under-determination of technology. He cites the Duhem-Quine principle in science, which claims that "technical principles alone are insufficient to determine the design of an actual device". (Feenberg, 1999, p.78) Instead, social factors are always integral to the design of technologies, and embedded within them.

Feenberg's *Instrumentalization Theory* first outlines the under-determination of technology. He argues the ambivalence of technology on the following grounds: (1.) the introduction of new technologies tend to preserve and reproduce the social hierarchy into which they are introduced; and (2.) that conversely, the introduction of new technologies also exhibit the possibility for the social sphere to undermine the hierarchy and "determinist" functionalities of a new technology. The tendencies of the second point Feenberg (1999) calls "democratic rationalization", which in his view, consists of two *instrumentalizations*. The first *instrumentalization* or *primary instrumentalization* requires an object to be de-contextualized, and simplified in order to be functionalized toward a defined goal. The second *instrumentalization* (*secondary instrumentalization*), the "making of the thing" requires the object to be fit into a specific context. *Secondary instrumentalization* necessarily incorporates social norms into the design and purpose of the object. Decisions like size, weight, and shape are all determined by social, biological, economic, and other environmental factors that may have little to do with the basic functions of the device. (Feenberg, 1999, 2002, 2006)

To summarize, *primary instrumentalization* concerns the base functionality of a technology or what it does. For example, a turntable is for the playback of recorded sound. This function could be solved in any number of design configurations. *Secondary instrumentalization* effects a technology's overall form that speaks to its meaning as determined by the social context of its design and/or use. Due to its interpretation in the social sphere the turntable has taken on several different forms that refer to different contexts of use. (e.g., The DJ.) Indeed, the basic function of recorded sound playback has been resolved in a number of variations. (e.g., Open-reel and cassette tape; 78, 45, and 331/2 vinyl discs; and digital file formats.)

Agostino Di Scipio (1998) uses Feenberg's (1999) concept of democratic (subversive) rationalization to explain the dynamic relation between artists and the technologies they engage, in that their practices push the bounds of the norms inscribed in the base functionality of technology, to reveal other possibilities.[22] This implies that the practices surrounding a given technology, especially an art practice, can transform the prescribed(designed) meaning of the technology. There is a dynamic relation, although often concealed in modern technology, between form and function (material), between making and made, and that the determinist aspects of technology, while exacting a particular frame of reference, also reveal possibilities for unintended alternative meanings and uses. For example, the high torque of the Technics 1200 turntable direct drive motor was designed to eliminate the problem of drag that caused a pitch

[22] Di Scipio (1998) uses the term "subversive rationalisation" as an extension of the concept of "democratic rationalisation" that posits the ability of artists to subvert the pre-determined functionality of the tools they employ.

distortion when cuing a record. The function of the motor was highly regulated, yet its base determination was re-purposed and became the basis for extended turntable techniques such as beat juggling and scratching. (Technics)

The social dimension embedded in technological design and the under-determination of technology evidenced by the discovery of unintended uses through embodied practice touches on two concepts in Feenberg's *Instrumentalization Theory* that are particularly relevant to a discussion of laptop music performance: (1.) *Concretization*; and (2.) *Interpretive flexibility* of *secondary instrumentalization.*

6.1.1 Concretization

"Concretization" is a term Feenberg (1999, 2002, 2006) borrows from Gilbert Simondon to describe what he (Simondon) considers the fundamental law of technological development that sees a progression from abstract to increasingly "concrete" designs. "Concrete" designs are more adapted to their environment, and integrate a multiplicity of functions. Feenberg (1999) elaborates, "...concretization involves the reflexive accommodation of technologies to their social and natural environment", (p. 218) and constructivism shows that in incorporating multiple functions in a single device, concretized innovations in effect gather social groups around them.

I believe Feenberg's (1999) use of constructivism to re-frame Simondon's theory can be further emphasized to show that *concretization* not only gathers social groups around artifacts, but is constituted by such groups through practice. "Practice", in terms of how Feenberg applies the constructivist work of Trevor Pinch and Weibe Bijker(1989), can be considered under the concept of *interpretive flexibility*, which Feenberg uses to elaborate his concept *of secondary instrumentalization.*

6.1.2 "Interpretive flexibility": Pinch & Bijker

In *The Social Construction of Technological Systems* Pinch and Bijker (1989) propose The Social Construction of Technology (SCOT) method, a symmetrical approach to analysis that attempts to explain the success of an artifact by also analyzing unsuccessful iterations or approaches that usually emerge from controversy around the meaning or use of an artifact. They argue that an artifact in the course of its development will encounter a series of controversies in determining its final form; typically over time these controversies result in the "stabilization" of the artifact through closure; closure can be achieved as "rhetorical closure" or by "redefinition of the problem"; closure and stabilization do not mean all problems have been solved, but can mean that the relevant social groups see the problem as being solved; and the stabilization of an artifact also reserves the option for 'interpretive flexibility' that sees the potential for continued re-interpretation of an artifact in the social sphere.

For instance, Pinch & Bijker(1989) use the example of the early development of the bicycle. The study shows how competing social values were reflected in different interpretations of the bicycle. Early iterations of the bicycle included the large front-wheeled Penny-farthing interpreted as a sport or racing device, and the smaller front-wheeled "safety" version interpreted for safe transportation. Eventually, the "safety" iteration of bicycle design won out, and has influenced bicycle design until the present. (Pinch & Bijker, 1989) This was not a result of technical necessity or some internal deterministic logic of technology, but resulted from a dynamic process involving various social groups in the practice of riding the bicycle for certain purposes and in particular environmental contexts. The primary function of the bicycle can be described as two-wheeled human-powered transportation, but the form this takes is constrained by social and environmental factors.

Values are expressed through the practices of social groups in relation to technology and inform the design process. Through practice users of technology may impose new interpretations (*secondary instrumentalizations*) resulting in unintended uses and functionality. This can also be described as re-purposing. Because *concretization* involves the process of adapting the more abstract functionality of a device to more specific social and environmental conditions, it also relies on the dynamics of practice to inform the design process. *Interpretive flexibility* can then be seen as an important aspect of the development process of *concretized* technologies, and it is also possible to see how the practices of communities of practice become embedded in *concretized* devices. However, without a critical view of technology, the social construction of technology remains hidden, and instead technology seems to proceed along the path of autonomous determinacy.

6.2 Technology Studies & Musical Instruments

While one is not likely to engage in critical discourse with everyday household objects, the artist or musician, being concerned with the ability to make meaning by pushing and re-constructing the limits of their material, is in a unique position.[23] The application of SCOT to the study of musical instrument development has illuminated how users matter. In "'Should One Applaud?' Breaches and Boundaries in the Reception of New Technology in Music", Pinch and Bijsterveld (2003) show that the meaning of a musical instrument is not just determined by the manufacturers design, but also during the use or performance of the device. Through practice users undergo a process of fitting a device into the cultural horizon of the time, and this requires changes in both the interpretation of the device and cultural (value) horizon.[24] The success of an artifact is dependant on its integration of meanings constructed by users, and future iterations may incorporate these meanings by adding additional functionality to a device. (Pinch & Bijsterveld, 2003)

[23] Echoing aspects of Feenberg's (1999, 2002, 2006) *Instrumentalization Theory*, Di Scipio argues "that the work of art is always created by creating the technique of its making ... that there are hermeneutic dimensions of technology ... " (Di Scipio, 1998, p. 31)
[24] The term "horizon" is borrowed from Feenberg's use of it in *Questioning Technology* (1999) where he says it "refers to culturally general assumptions that form the unquestioned background to every aspect of life. Some of these supporting the prevailing hegemony" (p.86)

6.2.1 An example: Pinch & Trocco

An example is found in Pinch and Trocco's (1998, 2002) comprehensive look at the development of the Moog synthesizer. Early synthesizers were large modular systems that could take up the whole space of a sound studio. The synthesizer offered the possibility for creating an infinite amount of new sounds, but many musicians were frustrated with the unreliability of oscillator tunings, the complicated patching schemes of the large modular systems, and the difficulty of reproducing the interesting sounds they did design. All three of these issues combined with the awkward size of the modular synth presented problems for its use in live performance.

Robert Moog had a close working relationship with some of his early customers including Eric Siday, and attempted to adapt his designs in response to their feedback. Moog ultimately wanted his synthesizer to be accessible to a large variety of musicians(users), and so his design increasingly conformed more to the traditional instrumental music horizon of the time. This process lead to two main standardizations: (1.) the keyboard interface; and (2.) hardwired sound patches.[25] (Pinch & Bijsterveld, 2003, Pinch & Trocco, 2002) Although there were those who resisted the limitations such standardization imposed, especially Don Buchla, the configuration of keyboard interface and hardwired patches became the commercial standard. Both developments occurred despite the initial enthusiasm for the infinity of new sounds the synthesizer could produce. In the commercial sphere control, reproducibility, and the 12-note chromatic scale won out over the infinite potential of sound afforded by synthesizer technology.

The Moog synthesizer's form and function evolved in relation to the input of users working closely with Moog and the prevailing influence of the conventional Western music paradigm that also lead to marketability. At the same time other synthesizer developers were

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[25] It should be noted that although the synthesizer is most commonly associated with a keyboard as part of its configuration, this is not the only configuration. (e.g., Jomox, Doepfer, Buchla, and Waldorf offer non-keyboard based moduls)

guided by other values and interests. For example, Don Buchla's *Buchla Box* was created more in the tradition of the experimentalists with an interest in creating something new and alternative to the traditional Western conception of music. (Pinch & Trocco, 2002)

6.2.2 Summary of Pinch et al.

These perspectives from Technology Studies show that neither social interpretation nor technological function can be considered in isolation, and that one must consider technologies in terms of their "fit" in the context of use. Interpretations are constructed through the practices of social groups and suggest that the study of communities of practice be brought into the foreground in order to illuminate how the use of a technical artifact mediates the development of technologies and norms from one horizon to the next. In this respect practices utilizing "black-boxed" technologies with pre-determined primary functions becomes an important aspect of technological development.[26]

[26] Feenberg's (1995) analysis of the introduction and interpretation of the French Minitel system represents one example where a centralized information indexing technology is re-purposed and transformed into a networked communications medium.

7 LOOKING AT PRACTICE: QUALITATIVE METHODS

The Technology Studies framework combined with the application of the SCOT method to the study of musical instrument development suggests: (1.) the laptop-as-musical instrument is constructed through use; and (2.) interpretations of laptop music performance could be understood by examining the practices of laptop music performers. What are people actually doing, and how and why do they employ certain materials and ideologies as part of that activity?

7.1 Flyvbjerg's Phronesis

An analysis of practice as social science is advocated by Bent Flyvbjerg (2002). Flyvbjerg's perspective can be seen in relation to the work of Feenberg (1995, 1999, 2002, 2006) and Pinch et al. (1989, 1998, 2002, 2003) under a different title, "phronesis". *Phronesis* translates as "practical knowledge" or "practical wisdom". The concept of *phronesis* is used to show how social science cannot only look through the lens of exact science, but must consider things in context. Phronetic research asks how and why in relation to context. The research situates itself within a particular socio-historical context and looks at the particular to get at more general themes. However, not in terms of the replicability associated with natural science. Phronetic methodology emphasizes analysis of practices over discourse and is dialogical in its narrative form of understanding and explanation. Flyvbjerg's emphasis on practice in methodology draws on the work of Herbert Dreyfus and Stuart Dreyfus and bares particular relevance to a discussion of human performance and computers that I will return to later. (H. Dreyfus & S. Dreyfus, 1986, 1992; Flyvbjerg, 2002)

7.2 First, Second, & Third-Person Methods

My application of Flyvbjerg's phronetic research methodology manifests primarily through first-person methodologies including participant-observation and auto-ethnography. (Denzin & Lincoln, 1994; K. M. DeWalt & B. R. DeWalt, 2002; Ellis & Bochner, 2000; Gans, 1999) K.M. DeWalt and B.R. DeWalt (2002) state "For anthropologists and social scientists, participant-observation is a method in which a researcher takes part in the daily activities, rituals, interactions, and events of a group of people as one of the means of learning the explicit and tacit aspects of their life routines and their culture." (p.1) Participant-observation is a key method in cultural anthropology, but it is one that is also suited to social science research. In my case, as a minimal laptop music performer, I am already a part of the group under study, and so the process is also auto-ethnographic in that I am inquiring into the experiences and meanings within my own community, and looking at my own experiences and practices as part of the research data.

First-person methodologies consider the lived experience of the researcher as relevant research material. "Experience" refers to the lived account of the researcher's thoughts and actions in the world as immediate and embodied. The concept of "embodiment" recognizes that knowledge about the world is not situated as an object outside of our perceived experience but as something we engage with through our actions and senses. (Depraz, Varela, & Vermersch, 2003) First-person methodologies are concerned with collecting phenomenal data from the experiences of the researcher.[27]

As a minimal laptop music performer, and because this research aims to understand laptop music performance practices in the minimal electronic music community, a first-person perspective seemed appropriate to the research. However, I also incorporate other data including interviews with other laptop music performers, and a review of relevant literature on the subject. Phenomenological methods emphasize the necessity of the researcher to suspend any pre-

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[27] A "phenomenon" is an appearance, and is related to its apprehension by the subject for which it appears. (Depraz, Varela, & Vermersch, 2003)

understandings or assumptions about the research object in question by "bracketing" or separating themselves out in the research. (Conquergood, 1991; Creswell, 1998; Denzin & Lincoln, 2000; Finlay & Gough, 2003) First-person methodologies also focus on phenomenal data, and require this same suspension, but what becomes crucial with first-person phenomenal data is a re-directed interrogation of the data. Finlay & Gough (2003) purpose, a "reflexive" process arguing that "Interpretation is not something added to our engagement with an object of study, but constitutes our experience of it, our 'being-in-the-world'. Objects or phenomena appear to us through experience as a process of interpretation and hermeneutic reflections interrogate and revise those interpretations. Self-critique then , becomes essential to this method of understanding." (p. 108) Varela and Shear (1999) argue that first-person methods require more than self-critique for legitimization and validation. They call for a balanced approach that incorporates first-person experiences with other externally generated data. Inter-subjective feedback provided by second-person perspectives and potentially also third-person perspectives is seen as necessary to the process of validation. (Varela & Shear, 1999)

7.3 Implementation

My implementation of a first-person perspective in the research involved continual reflection and interrogation of my thoughts and actions as a performer and also audience member in the minimal community of practice. An awareness of the sensations of my own body in performance and as an audience member resulted in insights I may not have gained from more distanced forms of research. At the same time, it was important to consider my experience in relation to the subjects I interviewed and the literature reviewed.

The interview process I used asked participants to report on their experiences as performers, but also focused on how they performed or approached performance. My perspective is based on the idea that performance practice constructs meaning through action that in turn imposes meaning on the instruments involved, but the nature and characteristics of those acts also speak to a pre-conceived understanding of the instruments in relation to a larger cultural horizon. (Denora, 2003; Di Scipio, 1998)

I spent the last three years (2003-2005) as a participant-observer, reflecting in writing on my experiences as a performer and audience member. I attended and performed at international festivals, and venues. (Appendix A) Field notes were kept in a journal, and I interviewed and discussed performance experiences with established artists including Mitchell Akiyama, Douglas Benford (Si-cut.db), Iris Garrelfs, Robert Henke (Monolake), Bryce Kushnier, and Terre Thaemlitz. Five interviews were conducted via email correspondence, and two interviews were recorded face-to-face. The main objective of the interviews was to gather information about performers own experiences in laptop music performance. The interview style was semi-informal in that interviews began with several prepared questions and these were followed by questions arising more naturally from the flow of conversation.

7.4 Analysis

While many approaches to qualitative analysis rely on rigorous coding systems of interview transcripts, my approach was more fluid. This was possible because I did not need to rely on the interview material as a foundational basis for my findings, rather the interviews provided a concrete avenue into discussing more general observations made as a participant-observer and practitioner. I used the interviews to look more deeply into what I had observed in the field. The questions I asked during analysis included, "Did my observations resonate with the reports of my peers in the field?", and " What do the field notes, interviews, and self-reflexive practice reveal about the interpretation of laptop music performance practice by minimal electronic music artists?" Although several possible themes for discussion presented themselves I chose to focus on one that resonated particularly in relation to my own practice and that of many of my peers in the minimal electronic music community of practice; the use of "generic" physical control devices.

8 MUSICAL INSTRUMENTS

In looking at the practices of minimal electronic music artists the aim is to learn more about laptop music performance by looking at the implications of how these performers are negotiating issues related to the laptop-as-musical instrument in performance. First the question of the definition of a "musical instrument" must be addressed. If we hold that meaning and function of technological devices are socially constructed, then what counts, as "musical instrument" must be as well, although the normative definition will exact a particular influence. Musical instruments, according to a basic normative definition, share the function of transducing one form of energy into an audible vibration. For example, a wind instrument transforms wind energy into sound; a stringed instrument transforms physical excitation into sound through the amplification of a medium like wood. The specifications for what shape and form a musical instrument takes is determined by social and environmental conditions that include existing forms of music, relationships to other instruments and tuning systems, the nature of materials, and other social, economic, religious, and ideological concerns.

Musical instruments are more than sound making devices. They are also sources of knowledge that embody ideas about musical form, language, and technique as it relates to society at large. Multiple layers of meaning are involved. (Chanan, 1994; Waksman, 2003) In *Musica Practica* Chanan (1994) states "music becomes an expression of the society that produces it" (p.169) New musical instruments do not spring out of nowhere as some new sound making possibility, but evolve in relation to existing ideas about musical form, function, and instrumentation.[28] For many Western instruments the 12-note chromatic system became a deciding constraint in the development of instruments like the guitar or piano. However the 12-note system has undergone various alternations and interpretations in terms of temperament. Today equal temperament has influenced design details of instruments like the guitar specifying a theory of music and performance in the limits of the instrument's physical configuration and that its establishment of a specific tuning system.[29] The *primary instrumental* function of vibrating strings and the *secondary instrumental* meaning of musical form are *concretized* into a specific instrument that integrates a number of meanings and functions into one device. Knowledge encompassing the overall context of development including social, economic, and other valuative dimensions informs the overall practice associated with the use of the instrument including playing techniques, musical role, and normative dimensions of music performance in general.

8.1 Computer-As-Musical Instrument

Musicians who play acoustic instruments are not only playing the physical instrument, but also expressing musical form through the process of playing the instrument. How does this translate to the computer? The computer can be described as consisting of the following: (1.) a medium of representational logic (Binary encoding); (2.) the primary functions of translation, storage and retrieval. (The computer as an information-processing machine necessarily involves these three functions); and (3.) a structural configuration determined by the synergisms between musical form and knowledge about the medium engaged. The structural configuration includes both a physical structure and an encoded (algorithmic) structure. In the case of the general-purpose personal computer the structural configuration includes other ideas about what the

[28] For instance, the tonal range and tunings of stringed instruments were partially determined in order to separate the instrument voices when played together and to accommodate compositional style. (White, 1886)

[29] Although equal temperament is the dominant tuning for most Western instruments, it is really a 20th century development. Tuning systems such as meantone temperament were used previously. The emergence of polyphony and new instruments saw the need for a more regulated system, which equal temperament seemed to provide. However, the transition to this form of tuning continues to undergo debate by musicologists. (Goodall, 2000)

computer might be used for, ones not necessarily conducive to using the computer as a musical instrument. The personal computer's point-click-display interface was well suited for word-processing, and other editing applications based in decision-making procedures. (McCullough, 1998) However, in the context of music performance, having been rooted in embodied relations with instrument and musical form, the laptop challenges previous norms of what it means to play a musical instrument. With the computer, physical actions have little standardized relation to their audible outcome. If a computer music performer cannot always connect the physical aspect of playing to the audible result, what does it mean to play the computer-as-musical instrument? What is being played?

8.2 Limits

In the case of acoustic instruments there was a material basis for answering these questions. The performer was exciting the strings with his/her hand. They were producing sound from this activity. With the computer a performer may hit the mouse button, or keyboard, but the results have an independent relationship to these activities. The same action can produce any number of audible results. What the interface links to is a representation of sound and how it might be interacted with and made audible. (e.g., Playback, sound-processing effects, filtration techniques (low-pass, hi-pass, band-pass, stopband), auditory localization, and compression.) The concept of "musical instrument" has in a sense been de-materialized. Interaction with the computer-as-musical instrument is always mediated by its encoded representation. The digital medium differentiates the representations of sound qualities and possibilities of sound interaction and manipulation into discrete and structured possibilities. To play the computer-as-musical instrument is to play with this encoded logic that represents both the sound itself and the possible processes of interaction with it. As cognitive musicologist Michael Hamman (1999) argues, computer music systems objectify the process of human-computer interaction (HCI) through a chain of abstractions, which include algorithms, GUI, and software architecture.

8.3 Representation

Sound is created through two means in the computer, sampling and digital synthesis. Sampling allows sound sources from microphone input, electronic instruments, or other recordings to be stored (represented) digitally via analog to digital conversion. Digital synthesis techniques interpret algorithmic information and convert it into audible signals. Common types of digital synthesis include FM (frequency modulation), wavetable, additive, subtractive, analysis-based, and granular synthesis. (Dodge & Jerse, 1985) Synthesized and sampled sounds are given three identities through the process of digital representation: (1.) an encoded representation; (2.) a graphical representation; (3.) an audible representation. (Achieved through digital to analog conversion)

Notation has been the system of music representation in Western music and acted as a referent or visual set of instructions of how to play a particular piece of music. Michael Chanan (1994), referencing Max Weber, cites notation as perhaps the most significant development of Western music in that it became a means of rational organization not only of music itself but also of labour and production, as it applied the same principles of differentiation, reproduction, and calculation that also produced Western capitalism. Notation divided what had previously been inseparable, composition and performance. (Chanan, 1994) The computer treats musical representation (encoded and graphical representation) as self-identical to the sound itself. Whereas with notation there remained a space of indeterminacy and interpretation between musical score and the act of producing sound based on its "program". The computer collapses this space. The representation of sound, through a rational system of organization, is no longer an external referent to music; it is the music. Changes in the representation of sound in the computer results in direct changes to its composition and performance. Every playback of a digital composition is an exact reproduction of its encoded representation. This creates problems for performance practices that privilege improvisation over adherence to a score. The domain of interactive computer music systems has attempted to address this situation, but we will see how minimal laptop music performance approaches it from a different perspective, one that sees the computer less as a means to solving any definable problem through further encoding, and more as a digital recording technology or studio.

8.4 The Computer-As-Musical Instrument Summarized

If one agrees that musical instruments embody and reflect the social and ideological contexts in which they are formed, then the computer-as-musical instrument can be seen to incorporate aspects of the Western 12-note system, electronic and recording studio practice, and also the information-processing logic of the computer. These aspects are evidenced in the pitch control options of sound software, the use of studio metaphors in software architecture and GUI's, and the use of cognitive science models in the design of interactive components of sound software which privileges analytic navigational interaction and seems to lack a consideration of the role of embodied knowledge in performance.

9 RECORDING TECHNOLOGY

What does it mean to say recording studio practice is embodied in the computer-as-musical instrument? If notation represented one of the most significant developments and influences on Western music one could argue that in the 20th century recording technology is the most significant development. The introduction of recording technology meant the extension of the differentiation of music materials and processes to include audition from performance, playback from recording, and sound from source. Traditional notions of performance, and audience were altered. At the same time we see music put to work as "background muzak" for malls, offices, telephone lines and sound track design for film.

Recording technologies have become the quintessential form of musical expression of our time where captured sound, and its reproduction, becomes the material basis, the source of music making. The era of post-production in the studio becomes as important as the original performance. Recording studio practice assembles, constructs, and bends the performances of musicians through the use of special recording techniques and processing devices including the central control surface of the mixing board. For the studio engineer or "soundman" the reproduced becomes the source, the original material. The disconnection of sound from source in recorded audio has become the ubiquitous circumstance that now defines the dominant mode of listening. Performance is redefined in relation to this form of dissemination in that it is now considered in comparison to its representation in recording, and the listener arguably becomes an increasingly passive consumer. This social and technological reality inevitably altered conceptions of musical tradition, form and meaning. Because people could listen to “the stage” in their own homes, the meaning of performance had to change to offer audiences something more than they could get at home. Performances become more visually enhanced, theatrical, and spectacular events.

In differentiating composition and performance through notation and sound from source through electronic and recording technology, the processes involved in composition and performance become objects of exploration in their own right. The basis of music itself is opened to question, its formal characteristics, and constructions. Music becomes not only a vehicle for expression but also one for "objective" study and experimentation as evidenced in the work of avant-garde and experimental musicians.[30] In the popular or vernacular context of music practice other developments were taking place. While the various interpretations of electronic and recording technologies can be linked to the work of forerunners like Cage and Schaeffer, other paths of development can be traced including interpretations by musicians not necessarily aligned with avant-garde, experimentalist, or academic contexts. Even so, there is not necessarily a clear distinction between some of those working as experimentalists or avant-garde innovators and the more popular-vernacular contexts.

9.1 "Popular" Interpretations

The popular interpretation of electronic and recording technology in electronic music tends to involve a play on or re-purposing of the deterministic aspects of commercial and consumer-grade technologies. Some of these technologies, like the tape recorder and turntable, had become ubiquitous devices. Their basic functions were understood culturally. While it was initially research institutions that had access to the computer, magnet tape recorders, and synthesizers for sound research, eventually variations on all of these technologies found their way into general circulation. DIY artists aligned with the experimentalist and avant-garde traditions or art-music context of the 60s and 70s made use of what was available to them. Popular

[30] One must also consider other influences that informed the questioning of previously held beliefs and practices. For instance photography and film were also media that presented "objective" representations, and required re-examination of the definition and role of the arts.

interpretations also used what was available and being more closely aligned to popular music involved different concerns and contexts that resulted in new practices and aesthetics. In order to understand the contemporary electronic music practice of laptop music performance it is necessary to not only consider the history of computer music performance, but also to trace the development of electronic music practice in the popular sphere. Interestingly, this leads to a discussion of the recording studio and a history of re-purposing electronic and recording technologies.

9.2 The Recording Studio

The intent here is not to cover the whole of recording technology history and development but to contextualize aspects of that history and development that come to bare on laptop music performance. Avant-garde and *Musique Concrete* composers explored the affordances of recording technology by experimenting with its formal qualities, but early popular recording practices up until the late 1940s were concerned with replicating the acoustic experience of the concert hall. (Chanan, 1994) The growing experience of music as recording instead of live performance changed the nature of listening. Music became background sound (e.g., musak, film, and inattentive casual home listening), and at the same time background or environmental sounds found their way into recordings. With the transition to stereo and the addition of multi-track recording, the idea that performance was not the same as its recording and that it could be added to or manipulated took form. This changed the nature and role of studio work. The recording studio was now being used for "in-studio composition" both in experimental and popular contexts. (Eno, 2004)

For classical music recording, the new possibilities in recording and post-production were met with some controversy, as there was a desire to preserve the authenticity of the captured performance and its distinct acoustical space. However, popular music production began to base itself more and more in new multi-track recording and post-production techniques. Early figures of innovative studio production included: Phil Spector and his "Wall of Sound"(late 1960s) which involved building up layers of sound to achieve a dense and dramatic effect; Joe Meek's (1950s) use of physical sound separation and the re-compositing of separately recorded performances into one,; the mixing board experiments of Lee "Scratch" Perry and King Tubby (1970s); and Brian Wilson's (1960s) integration of synthesized sound effects and environmental sound into pop music productions. (Eno, 2004)

The innovative use of the mixing board by Dub studio artists has had a particular influence on electronic music production and development. Dub techniques and characteristics include "manipulating (the) instrumental arrangement(s) with techniques and effects; drop out, extreme equalisation, long delay, short delay, space echo, reverb, flange, phase, noise gates, echo feedback, shotgun snare drums, rubber bass, zipping highs, cavernous lows." (Toop, 1999, p. 356) Although on a functional level many of the same effects and post-production techniques like the addition of echo, reverb, and sub-mixing as a method of squeezing more tracks into one were being used in pop and rock music production, Dub used these techniques not as a means to making a recorded performance sound "real", but as sound generating material in their own right. Dub was less about the "original" instruments used as a sound source, but instead treated the recording as the primary sound source and something to be played using mixer controls, and various sound processing effects units. The use of the studio as a musical instrument for composition was being taken up in popular, art-music, and academic contexts resulting in the development of new techniques and musical forms.

In terms of popular recording practice, studio techniques remained within the realm of composition, but by the late 1970s the idea that recorded material was also the basis for new musical material saw aspects of studio practice brought out of the cubicle and onto the stage via the DJ. Studio techniques such as looping, layering, and mixing became a part of DJ practice that treated recorded sound and its technology as musical material. The face of music production and performance was changing.

9.3 Vinyl & The DJ

The DJ or disco jockey is someone who selects and plays records in a continuous uninterrupted stream. Early examples of DJing show it as a cheaper, more convenient substitute for a live band. Someone would play records in succession at a school dance, or as entertainment for troops during WWII. (Brester & Broughton, 1999; Hall, Lin, & Baker, 2004)[31] In the 1950s the 45 format was introduced. It was cheaper to make and transport. In Jamaica mobile sound system units were constructed to play R&B 45s. The soundman (DJ) culture grew in Jamaica, recording studios sprung up, and innovative recording techniques were used in the development of genres like Dancehall, Ska, Dub, Rocksteady and Reggae. (Bradley, 2000) The DIY interpretation of electronic and recording technology from the 1950's sound systems through to the 1960's and 1970's studio and DJ techniques in Jamaica hugely influenced the development of electronic music in terms of musical form and technique; Examples included dub-plate cutting, versioning (pre-curser to the remix), slip cuing, over-dubbing, and big bass sound. (Bradley, 2000) Jamaican studio techniques and aesthetics particularly influenced the development of German minimal "dub" techno in the 1990s. (e.g., Maurizio, Thomas Brinkmann, Wolfgang Voigt aka Mike Inc., and Stephan Betke (Pole).)

The DJ, as is known in electronic music culture of the present, didn't really emerge until the early 1970s. The phenomena of going out to listen to a DJ play records as opposed to a live band began at this time. Two main types of DJing emerged. The Hip-hop DJ not only played records, but developed special techniques including beat juggling, beat matching, and scratching. The Hip-hop DJ interpreted the turntable as an instrument based on one-to-one interaction. The forerunners of these "turntablist" techniques have been attributed to Kool Herc, Grand Wizard Theodore, and Grand Master Flash. (Jenkins, Williams, Mao, Alvarez, & Alos, 1999)

[31] It can also be linked to the first discos in Paris when during the Nazi era live music was banned and people were forced to listen to recorded music in underground venues. (Reynolds, 1999)

Rock and disco DJ Francis Grasso was a forerunner of another DJ practice that involved the technique of building up and breaking down the energy of the music through careful track selection and mixing over time. Generally this kind of DJing relied on music tracks with a steady 4-to-the-floor tempo emphasized by a bass line and kick drum. Francis Grasso's interpretive practice playing records in a club and developing new playing techniques in relation to the limits of his set-up, informed Alex Rosner's attempt to design technology that would streamline or *concretize* the functions involved in this emerging practice. Rosner's "Rosie" mixer incorporated several functions into one device including a cuing system, slider volume controls, and stereophony. Previously, mixers were mono and primarily used for broadcasting. Rosner's innovation was further developed by colleague Rudy T. Bozak and formed the basis of the first line of DJ mixers. (Brester & Broughton, 1999)

Hip-hop DJ Grand Master Flash is credited with the technical innovation of the crossfader, previous to its invention a DJ would have to create seamless mixes from one turntable source to another by using separate volume controls. Flash *concretized* these separate functions into one fader that would blend the signals between two channels. With this innovation DJs discovered other affordances besides seamless mixing. The crossfader also facilitated the practice of quickly cutting from one source to the other and a new range of scratching techniques. (e.g., flare, crab, and orbiter)

9.4 Development, Practice, & Context

In looking at DJ practice and the technology involved one sees how the DJ's interpretation or play on the base functionality of consumer technology results in a practice never intended by its original design. The determinist aspects, such as the regulated rotation of the turntable plate, open up a whole range of new possibilities. The high torque rotation of the Technics direct-drive turntable (1969) was successfully used in club contexts and later the SL 1200 MK2 was designed specifically with the demands of club use in mind. Vibration and sound feedback controls were put in place with the addition of rubber footpads, and a heavy rubber base. (Technics) Together with the high torque of the direct drive motor Technics unwittingly facilitated the development of scratching techniques and beat-juggling. In the case of the DJ mixer, practice is *concretized* in the process of development and we see the social dimension embedded into the construction of technology.

9.5 The Convergence of Electronic Instruments & The DJ

Recording technology was not the only mitigating factor in the development of DJ practice and popular electronic music. The synthesizer, which is not a recording technology, (originally) was also "black-boxed" for the commercial market. Robert Moog's configuration of the Moog synthesizer into a more portable and "playable" configuration of the Mini-Moog in 1970 is said to have revolutionized the electronic music instrument industry and was joined by other companies like ARP, Oberhiem, and Yamaha. (Pinch & Trocco, 2002) The capability of synthesizers and drum machines to produce regulated musical events found a "fit" with the regular rotation of the turntable and the mid-1970's 4-to-the-floor bass beat backed disco music. At this time DJs and producers began adding additional drum tracks over their recordings for added groove.

1970s disco music relied heavily on the role of the producer to create a mix from many tracks of recorded audio. The mix down process became as crucial as the recording process. As synthesizers, samplers, drum machines, and sequencers became commercially available in the 1980s, production fell into the hands of a new kind of DIY producer. The worlds of electronic music production and DJ performance converged. DJs no longer had to deal with the inconsistent rhythms of band-based recording. Even the 4-to-the-floor rhythms of disco could be hard to mix in a club as their tempos still tended to fluctuate. The arrival of commercial drum machines in the mid-1980s added another dimension to the 4-to-the-floor dance music sound that evolved out of disco into what became known as "House" music although it also influenced the development of other genres such as Electro and Garage. (Reynolds, 1999) Now DJs could improvise something else into their mixes with the edition of the bass drum and high hat sounds of the drum machine over top of various steady beat recordings. The deterministic rhythm of the machine was transformed from something strictly mechanistic into a reflection of bodily rhythms-the bass drum forming the basis of its heart rate pulse, generally between 120 to 140 beats-per-minute.

"House" music began in Chicago in the mid-1980s. The origin of its name is associated with the Warehouse nightclub in Chicago where early house producer Frankie Knuckles was a resident DJ. (Reynolds, 1999) House music was based on the 4-to-the-floor sound of disco but placed particular emphasis on the kick drum, high-hat, and bassline generally generated with drum machines and synthesizers. The elaborate orchestral and instrumental recording production associated with disco was replaced with the much more affordable process of using sampled or synthesized sounds for melody or other compositional elements. The sound was not only influenced by disco, but also synth-pop, punk, psychedelic space rock and earlier electronic music film soundtracks. (Reynolds, 1999)

Around the same time in the mid-1980s, "Techno", influenced by European electronic music like Kraftwerk, Italia Disco, and also early Hip-hop, was emerging out of Detroit. Juan Atkins, Derreck May, and Kevin Saunderson, were the first to develop the Detroit Techno sound using synthesizers and drum machines, notably the Yamaha DX-& and Roland TR-303. Unlike House music, Techno did not typically involve melodic vocals, but embraced a more industrial machine sound occasionally punctuated by more Hip-hop style vocal samples. (Reynolds, 1999; Sicko, 1998)

9.6 Rave & "post-Rave"

In the early days, Techno and House music was played in underground warehouses and club venues. By the late 1980s the music had become popular in Britain where large dance parties called "Raves" merged with a new drug culture based around the use of ecstasy.[32] By the mid-1990s electronic dance music culture, as typified by Rave, had become in many minds diluted by commercialization. The big-beat dance music of popularized groups like The Chemical Brothers, Fatboy Slim, and Prodigy had garnered much commercial interest. Rave had moved from being an underground phenomenon to a very visible and lucrative cultural product. The increasing availability of samplers, sequencers, and computers meant that the market had become saturated with producers. Rave music of this era was criticized for its unimaginative use of presets and the manipulative formulaic structures of the songs produced. (Reynolds, 1999) A new generation of artists wished to create alternatives to the popularized form of electronic dance music.

This "post-rave" music was considered experimental or at least eccentric with respect to much of the dance music being produced at the time. Experimentation was often a direct act of defiance against dance music and carried with it a theoretical or conceptual pretence with variable success. The pseudo-academic or intellectualized underpinnings of this "post-rave" or, in Cascone's (2000) words, post-digital music was embraced by some artists but also criticized. According to Simon Reynolds (1999) " This is less a hardcore dance scene than a mostly bourgeois-bohemian milieu of rootless cosmopolitans. In the structural non-pejorative sense of the word, the post-rave experimental fringe is parasitic on drug-and-dance-driven scenes, hijacking their ideas and giving them an avant-garde twist". (p. 360) While I believe that it is true that this new music existed in close relation to the dance and drug culture associated with Rave; the experimental nature of post-digital music was not necessarily a new phenomenon for popular electronic music. By experimental I do not mean the strict Cagean sense of the term but simply that there was a dynamic of exploration not solely driven by an appeal to the commercial market.

The early producers of House and Techno had little to go on in terms of how electronic dance music should sound. Although they were obviously influenced by the dance music of their

[32] The popularity of ecstacy is traced to its availability and place in the dance music culture of Ibiza, which was frequented by many British vacationers. (Sicko, 1999)

time (e.g., disco, R&B, ska, dub, reagge, and rock), incorporating the new electronic instruments meant experimentation. Despite increased commercialization of electronic dance music and the Rave context of performance many producers including Carl Craig, Moodyman (Kenny Dixon Jr.), Kenny Larkin, Underground Resistance, Model 500(Juan Atkins) and Richie Hawtin, continued to create innovative music that was not inspired by an appeal to a mass market, but still found a place in more underground dance music venues.

10 POST-DIGITAL & MINIMAL

During the first wave of post-rave genres like illbient, Ambient, Leftfield, and Experimental Techno emerged. Post-rave genre titles also showed a propensity for the use of lower-case titles. (E.g., glitch, minimal, and micro-house) Formative artists of this phase included Mouse on Mars, Oval, Fennesz, and Farmers Manuel. The second wave further instantiates its rejection of dance music culture and overtly links its activity to critical theory. In 1994, Achim Szepanski, founded Mille Plateaux which was conceived through the influence of the writings of Deleuze and Gutarri's, *A Thousand Plateaus* which forwarded the strategy of context-based subversion. (Szepanski, 2001) By this time the genre known as "glitch" had taken form. "glitch" referred to the treatment of errors, bugs, and other audible digital artifacts as musical material. Part of what "Glitch" artists do is to go beyond the basic functionalities inscribed in music software or digital hardware devices, and instead "'combat the determinism' within these machines by erasing the manufacturer's distinction between 'features' and 'bugs'" (Reynolds, 1999, p. 365)

Of course one could argue that this approach was a part of earlier approaches in Techno and House in that producers exploited or played on unintended sound making possibilities of various synthesizers and drum machines. For example, the "acid" sound of the Roland 303 was given particular attention by Phuture, Adonis, and Plastikman (Richie Hawtin). In these cases, the approach leads to a kind of sounding of the machine, and a play on the site of breakdown as limit. A distinction between the more experimental forms of Techno by artists such as Plastikman or Juan Atkins is that the new generation of post-digital artists were typically playing with computers, and so the term "glitch" is appropriately used as a descriptive for some of their activities. "glitch", as a spark of resistance against formulaic "Rave" Techno, was dibbed "the aesthetics of failure" by Kim Cascone (2000). Eventually however, the resistant subtext of post-digital, and glitch music once again embraced the electronic dance floor. Szepanski's second label, Force Inc. exemplified this post-digital dance project and inverts the story where dance music appropriates the strategies of post-digital music and instead suggests the reverse or at least a play between the two. A series of sub-genres results from post-digital music and its return to dance formats, these included, microhouse, IDM (Intelligent Dance Music), and minimal techno. However all three of these named sub-genres are often considered under the title of "minimal".

10.1 What is Minimal?

"Minimal" in particular established itself as the dominant "genre" of non-commercial, "cutting-edge" electronic music of the 4-to-the-floor variety. It can be seen as a stripped down version of early Chicago House and Detroit Techno with its focus on sparse elements and placement of kick-drum, hi-hat, and snare. Its mid to late 1990s incarnation often replaces traditional drum-synth sources of percussive elements with "clicks and cuts" of digitally sampled audio. DJ and music critic Philip Sherburne (2004) would call this the "skeletal" version of minimal where a track is reduced to a set of bare essentials. Another version of minimal he refers to as "massification", where a density of sound is built up from a sparse sonic palette. Sherburne sites Ricardo Villalobos as an example. Villalobos creates densely layered rhythms using a small set of percussive elements. (Sherburne, 2004)

Is there a connection to the "Minimalists" of the 20th century avant-garde and art-music composers like Lemont Younge, Philip Glass, and Steve Reich? The answer is yes and no. As Philip Sherburne (2004) points out, the strategies of dubbed out effects, recursive loops, and other forms of modulation through repetition in the tape works of Steve Reich reflect strategies of the contemporary meaning of minimal. Sherburne writes, "If the originators of House and Techno were unaware of Reich when they first began sampling and programming their tightly looped progressions, the definitive link was made retroactively when The Orb sampled Electric

Counterpoint for the club hit "Little Fluffy Clouds" in 1990." (Sherburne, 2004, p. 321) Although the term "minimal", as it is applied to certain strains of electronic music today, is associated with the migration of glitch and the post digital back to the dance-floor, "minimalism" in Techno and House music has been present since the early 1990's Techno of second generation of Techno producers including Carl Craig, Robert Hood, and also Finland's Sahko label. Perhaps the commercialization of Rave and its big-beat sound caste a shadow of amnesia over the earlier days of minimal.[33]

Part of the turn to minimalist production in the early nineties might be attributed to the mixing practices of the DJ where a track is viewed not so much as a finished work, but as part of a building block to become part of a larger work through the process of mixing. Minimal techno and House producers created tracks with this idea in mind. (e.g., Wolfgang Voigt's Studio 1 productions.) Here the mixing practice of the DJ is reflected in changes in musical form and production. At the same time, this particular "building block" method of music production does not represent the only compositional approach. There are many variations. In fact the term "minimal", although assuming a relatively recognizable aesthetic and being contextualized within a particular community of practice as evidenced by labels, festivals, and other related organizations, is still inadequate to describe all of the activity that is identified under its umbrella.

By the late 1990s the term was well established and could also be understood as a backlash against what was seen as an over-intellectualization of music. The backlash against the term IDM (Intelligent Dance Music) is an example.[34] But "minimal" would also be criticised from both sides. One the one hand it was considered over-intellectualized, and on the other hand not experimental enough. The release of the "Clicks-N-Cuts" complication by Mille Plateaux in 2000 marked for some, the definition and incumbent death of minimal, glitch, and microsound. (Reynolds, 1999; Sherburne, 2001; Thomson, 2004) For some the "Clicks-n-Cuts" compilations

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[33] Please see Appendix B for a discography of contemporary minimal electronic music artists.

[34] The term is also linked to the creation of a web forum in August, 1993 which seemed to spark immediate controversy. See http://elists.resynthesize.com/idm/1993/08. (Electronic Dance Music (IDM) Mailing List)

stood as examples of how the process of teasing out and working with the sounding limits of the computer had been reduced to empty signifiers. Software plug-ins were being pre-packaged to simulate instantaneously the glitch sound associated with the genre. This new minimal was considered devoid of real content; it was a simulation. (Cascone, 2004; Thaemlitz, 2001)

The post-digtal era of minimal emerges in a new context, one where the DJ has become a ubiquitous icon in mass consumer culture, and it is also a time when the computer-as-musical instrument is brought into arenas preceded by the DJ, the club, the underground warehouse, and electronic music festivals. Unlike earlier minimal Techno, today's minimal electronic music has closer ties to experimental music and electroacoustic traditions that allow it to crossover into art-music contexts. Post-digital and contemporary minimal electronic music sit rather uncomfortably at times between the worlds of art-music and a pejorative sense of popular music, but as Neill (2002) argues, the two areas have been increasingly drawn together over the last ten years. Minimal electronic music has become a community of activity permitted to double dip between the after-hours party scene and the realm of "high" art. Evidence of this blurring of boundaries is found in the inclusion of minimal and post-digital artists voices in scholarly publications like *Organized Sound, Contemporary Music Review,* and *Parachute*, and also representation by festivals such as *Ars Electronica.* (Cascone, 2004; Cranfield, 2002; Jaeger, 2003; Sherburne, 2002; Stuart, 2003; Szepanski, 2002; Thaemlitz, 2001; Thomson, 2004)

10.2 Laptop Performance

As stated earlier, one distinguisher between earlier minimal Techno and the later post-digital minimal is the use of the laptop as a musical instrument.[35] The fact that the computer was programmable lead to experiments in programming it for musical tasks. When affordable

[35] The laptop was not the first portable computer used for live music performance. Although the computer is commonly associated with the tower, keyboard, monitor, and mouse other configurations exist Underneath the black boxes of digital samplers, synthesizers, and drum machines one also finds the computer; in fact, as early as the introduction of digital samplers in the mid-1970s. (Chadabe, 1997) However, unlike the "personal computer", the digital sampler was not a generalized open system (programmable), but a particular digital instrument with limited functionality.

personal computers entered the market, hobbyists and entrepreneurs explored the music-making potential of the computer through experimentation and developing music software.[36] (e.g., Karl Steinberg and Manfred Rurup's Multitrack Recorder(1984), Pro 24(1986), and Cubase.(1989))

Even after the computer was being used for sound synthesis, experiments, and eventually music composition, its physical configuration was still not designed for live music performance; Yet laptop music performers chose to use the laptop as a live musical instrument. Earlier post-digital laptop music performances interpreted or re-purposed compositional/editing software as live performance tools, and many also turned to visual programming environments like Max/MSP, Pure Data (PD), and Supercollider to build their own real-time audio performance programs. Over time several software programs like Ableton Live, Audio Mulch, and Radial were developed to address the demands of performance and free the musician from the time-consuming task of building their own performance tools completely from scratch, but software design alone has not resulted in a completely satisfying performance system. There remains a search for alternatives to the standalone laptop's point-click-display configuration.

In the minimal electronic music community of practice, performers have tended to opt for "generic" MIDI controllers. For those coming from the tradition of instrument building in electronic music performance this trend may seem limited in terms of the potential variety of interface options that could be used with the computer. However, minimal laptop music performance, being connected to DJ practice, approaches performance from a perspective rooted in the re-purposing of electronic and recording technology as the basis for new musical instruments.

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[36] In the 1950s and 1960s computer music research was primarily institutionally based , including research facilities like, Groupe de Recherches Musicales(GRM) (France, 1948), West German National Radio (Cologne, 1951), NHK (Japan, 1953), Bell Labs (USA, 1957), and Columbia and Princeton Universities (New York, 1951)

11 PERFORMANCE PERSPECTIVES

11.1 Granny' ark: One Performer's Perspective

My own experience as a music performer under the artist moniker Granny' ark comes from this relatively new tradition of using electronic and recording technologies as musical instruments. I began using domestic quality turntables, a small mic/line mixer, and prepared vinyl in 1998 to create sound collages. I eventually became more aware of specific turntable techniques used in electroacoustic and DJ contexts and began using them in both art-music and DJ contexts. Experimentation included producing record loops, exploring different methods of sound collage using multiple sources, scratching, beat-matching, and beat-juggling. Sometimes I would perform DJ sets that combined sound collage techniques with cutting and scratching records. Often there would be a narrative, theme, or particular mood I was trying to convey. The basic process was one of track selection to construct some sort of progression or narrative, and mixing techniques to transition from one selection into another. Performing as a DJ meant playing the sound using my hands, turntables, and mixer to manipulate and transform it. There was a tactile and immediate physical relationship to the materials.

My music performance background also includes playing piano and several other acoustic instruments in rock and concert bands. From my experience I observed that in a solo piano performance one is typically focused on their relationship to the instrument and the music produced with it. The same can be said for playing an instrument in a band, but in this case one is also concerned with what is happening in relation to the other performers. While classical concert music tended to present works to an audience with little adaptation made in direct relation to their presence, popular music performance contexts, such as the rock concert, may adapt aspects of the performance based on the audience's response during the concert. The repertoire is not as fixed, and there is less concern about adhering to a score.[37] DJing presents yet another kind of performance that involves presenting fixed works, but also combines them to create something new. The DJ is especially interested in engaging and adapting to an audience because the aim is usually to keep them on the dance-floor or set the mood for a social space. In these cases the traditional authoritarian model of the proscenium is eroded. Music performance as an event becomes less about presenting a fixed work to a passive audience, or the one-to-one instrumental virtuosity of the performer, but instead it is based on the DJ's ability to create a shared and pleasurable experience by being responsive to the audience. (Neill, 2002)[38] A skilled DJ has the ability to select and skillfully mix different tracks of audio to create an experience that resonates with the audience. My own relationship to laptop music performance seeks to re-capture something similar to the embodied experience of physical interaction that analog and acoustic instruments offer and at the same time retain the ability to engage with and transform the experience of the audience.

11.2 Transition to Laptop Music Performance

In 2000 I put together a production studio that initially consisted of a Yamaha A3000, an Atari Mega St 4 with Cubase 1.5 for MIDI sequencing, and a Minidisc recorder. Instead of splicing tape or creating loops on records, I recorded material into the sampler. Memory was limited so the lengths were similar to the loops I had made in vinyl. The process of editing and effecting samples was still relatively linear and destructive. I had to listen and reflect intently as my decisions were not trivial. I could not "undo" them as easily as in the computer. I focused on the quality and relationship of sounds, transforming one sound over time as an important part of the composition. For example, I would often practice a sequence of transformations and record

[37] Noteable exceptions to this view of the rock concert would be a highly staged pop music concert by an artists like Brittany Spears.
[38] An exception is a Hip-hop or turntablist performance context where one-to-one virtuosity in relation to the turntable and mixer is highlighted.

the process as a compositional strategy. The source then referred back to itself, drawing a line, telling a story over time. In this way the composition was not just produced by editing MIDI blocks on a screen but also by playing the sound with the hardwired parameters established in the sampler. (e.g., controls for pitch, time shift, lfo, filtration, and equalization.)

Eventually I began to see the potential of bringing this compositional process into a live situation. I was attracted to the possibility of creating a very original performance this way, where I had a direct relationship with all the sounds produced. However, I found the rack-mount based Yamaha A3000 sampler and the sequencing software of Cubase 1.5 were not well suited to playing live if one wanted to do much improvising. The control interface of the sampler was not easy to navigate, and Cubase 1.5 was not designed to run programs long enough to do a full-uninterrupted performance. However, I created several work-arounds to these problems. Instead of creating a long linear sequence of sound events in Cubase, I used the ability to assign samples to any key on the virtual MIDI keyboard in Cubase to stack sample groups representing different songs, on top of each other. I would move into the next song by turning the appropriate samples on and off via the sampler interface. Even though I could only improvise on one control parameter at a time using the sampler, I found interesting methods of playing between two effects modes, and creating transitions.

Ultimately the sheer size of the set-up made the prospect of touring difficult, and in the face of more current technology, the performance practice I had developed within the limitations of my set-up seemed clearly impractical, and I switched to using a standalone laptop with Ableton Live software in 2002. This changed my relationship to how I played and composed music. My compositional process with the sampler set-up relied on manipulating sound samples mostly by interacting with the control knobs and buttons of the sampler. I played and considered one sample at a time through a one-to-one manipulation of a knob or button. I could connect my physical actions with what I heard, but with the laptop I lost this more intimate connection between action and audible result. With the laptop I could still connect my actions to what I heard, but the process had become further mediated by the point-click-display configuration. I was no longer as focused on playing individual sounds, but more on making a number of decisions and then choosing among those decisions. I could re-arrange and create multiple versions of sounds and sequences with little consequence. There was also more access to sound controls. The parameters were all displayed on the screen, accessible by mouse, and they could be adjusted in real-time without interrupting audio playback.

At first I was generally unaware of how the laptop was being criticized in the context of performance. For me it was a new instrument that I was getting to know, so I did not have a strategy or concept for how it should be used in performance. I just did what worked for me at the time, which meant doing live remixes of compositions I was working on. The general sequence of sound events over time was pre-determined. I would reinterpret these compositions by adjusting filtration, equalization, adding delay, or several other effects that did not greatly alter the structure of the composition but allowed me to alter or emphasize different parts. Over time, I combined this approach with designing sets of smaller samples that permitted more improvisation. I also discovered aspects of my software that assisted in "playing" the samples with more spontaneity.

11.2.1 Adaptation & embodiment

However, performing with the laptop was still not as satisfying as DJing, and to a certain extent the compositional process also seemed to become more tedious than it had with the older studio set-up, despite the benefits of increased efficiency. The difference for me is best described in terms of a sense of increased distance from my materials that the standalone laptop studio-instrument seemed to create. An analogy would be the difference in embodied sensation between writing text on a page and "cut and pasting" it within a computer document. As a DJ I felt I could adapt what I was doing during performance more immediately and dramatically, and my body played more of a role in the performance through the hands on control of vinyl, turntables, and mixer adjustments. In contrast, the sequences of my live sets were generally roughed out in advance. I could skip sections, but this meant that some transitions were compromised. Also, because my eyes were almost always glued to the screen, I often forgot to look at what was happening in the audience or would miss hearing what was going on in the music itself, as I may have become very focused on navigating some part of the software's GUI. As a laptop music performer my body felt restricted and relatively still, with only minimal movement of my hands, eyes, and maybe a bob of the head to the rhythm. However, I have had experiences that I would qualify as satisfying performances.

11.2.2 Audience interaction, physical feedback, & analytic navigation

What distinguished these experiences? I began to notice that performances that induced dancing were always more successful in terms of my own experience as a performer. I first noticed this in 2004 during a performance in Munich. I had been asked to play a club venue, so I prepared a set that was more geared for the dance floor. This was really the first time an audience danced during my performance, and I found that the physical activity and energy of the crowd informed how I played. I would repeat sections, create breakdowns, and attempt to increase intensity using various effects in response to my sense of the audience's energy on the dance floor. I experienced this dynamic again at a performance in Basel, Switzerland. At this event I played live and later I DJed and found both experiences satisfying in terms of audience engagement and my ability to connect what I was doing with what I heard and felt from the audience.

This dynamic of audience interaction allowed me to step out of my highly mediated relation to my musical materials, in that I was temporarily able to dissolve the division between myself and the audience, through the music. The mediation of the computers point-click-display interface was temporarily transcended. I had joined the audience in the shared experience of listening, not just conceptually, or imaginatively, but there was physical and sometimes vocal evidence, a feedback system to confirm that they were following me on an auditory journey.

The following year I performed in Basel again. Even though I was playing the same venue with a very similar crowd and a live set that had proven successful on other occasions, the response was not as engaged. As a performer I could sense that the crowd was not totally engaged. This in turn effected how I felt about my performance and the decisions I made to try to change the atmosphere. Many factors could have affected the crowd response that night. It was a different time of year, it was a Friday not a Saturday, etc. The main thing that stood out for me was that with this lack of audience enthusiasm, I was left with little ability to adapt to the situation in a truly dramatic way. My set consisted of a finite number of samples that were generally grouped together in a specific manner that would produce a particular mood and energy level. As a DJ I could have changed to a different genre of music, or a completely different mood of music as an attempt to adapt, or if I had been using a MIDI keyboard I could have improvised in a more traditionally instrumental manner.

Over time I had developed a number of strategies to increase adaptability in performance. These included using the "undo" and "redo" function as a method of playing, sliding the start/end points of a loop through a sample to play the sound more like an instrument, and using the key-control assignment in Ableton Live to trigger and re-trigger certain samples. These strategies provided me with a limited one-to-one relationship with certain samples. However, apart from the use of key-controls I could only do one thing at a time, and the logistics of mapping every sample to keyboard control was not really a workable solution. In both dance and ambient listening contexts of performance, there remains a sense of confinement where almost every choice made during performance directs me back to the procedural logic of the GUI of the laptop's point-click-display interface configuration.

My interest in understanding the standalone laptop as a musical instrument lead to a decision not to use any peripheral control devices like the MIDI control box and keyboard controllers commercially available. I was not convinced that being able to adjust two things at once could be substantially better than using a mouse or track-pad with a few key commands. I also was disinterested in control devices that mimicked traditional instruments (e.g., Keyboards), because I felt that such devices undermined the potentially unique possibilities of the computer-as-musical instrument itself; even though at the time what those unique possibilities might mean remained a mystery. I was determined to explore the possibilities afforded by the computer's point-click-display interface until something could convince me otherwise. This approach remained consistent until 2005, when I finally conceded to the appropriateness and relevance of external controllers.

11.3 Playing in The Information-Processing Model

What I eventually realized was that my relationship to the computers point-click-display interface while performing presented a barrier to connecting not only to the audience's experience, but also to my own experience of the music. For me, performance had become more a decision making process than a "playing" process. Minimal artist Ben Nevile echoes this sentiment stating that the decision-making nature of playing laptop music is part of the reason he has taken a hiatus from attempting to do anything more than playback files of his own music when asked to perform. (B. Nevile, personal communication, October 7, 2005).

During a performance I was choosing from a set of discrete possibilities of start, stop, effect on, effect off, more, and less, again, not again, do it, undo it, cut, paste, and double time. These activities were framed in an ongoing narrative of procedural logic that Robert Henke also identified when he stated that he created his *Monodeck* controller "so I wouldn't have to think". (R.Henke, personal communication, September 18, 2005) For example, during the performance my mind may be focused on sliding a fader to +3, and then clicking on a particular parameter, pressing "command" - "z", and getting ready to make other decisions. In standalone laptop music performance every one of these decisions is based on looking at the GUI display and navigating a single cursor to the right location with the mouse. This reduces performance to an information-processing model. The physical sensation of this is one of restriction, and I have to keep my eyes fixed on the display screen for most of the performance, limiting my engagement with the audience through a lack of eye contact. There is also a feeling of distance from the music itself in this process of moving graphical icons around with the mouse, and keyboard. The experience is similar to learning a new piano piece. At first one would have to rely on reading notes off the page and placing their fingers on the keys accordingly. Initially this is a slow and mentally intensive process of reading and acting. There is little room for expressive interpretation or emphasis until one has become more familiar with the piece and is less reliant on translating a read note to a physical action. Eventually one can glance at the page, and rather than reading individual notes read bars at a time, leaving room to direct their attention toward changes in dynamics with the weight and response of their hands. With the laptop I felt very much like I was always stuck at the early reading stage and that I was only experiencing things from the neck up, in my head. My "working" performing self was disconnected from my physically present self. The effects of this on human performance are elaborated by the work of Hubert and Stuart Dreyfus. (1986)

11.3.1 A model of human performance: Dreyfus & Dreyfus

Hubert and Stuart Dreyfus (1986) show that in human learning people pass through several phases in acquiring a skill. Execution of skill is equated with performance capacity. The Dreyfus model describes 5 levels of human learning: (performance of skills) (1.) Novice; (2.) Advanced Beginner; (3.) Competent Performer; (4.) Proficient Performer; and (5.) Expert (H. Dreyfus & S. Dreyfus, 1986). The levels are distinguished in that they specify qualitatively different ways of acting and performing. The *Novice* is experiencing a problem, and situation for the first time and bases their action on a set of context-independent rules that are supposed to apply universally. The *Advanced Beginner* learns through experience what rules to apply to what situations. The basis for action may contain both situational (context-dependant) and context-independent elements. The *Competent Performer* must integrate an overwhelming amount of individual pieces of information gathered from experience. At this stage the individual must learn to apply a prioritizing organizational structure to how they act based on the information they have acquired in experience. This means the learner moves from rule based levels to a level where the individual has an overview of the overall situation and can construct a plan of action based on all the situational and context-independent information available to reach a desired goal. *Proficient Performers* move beyond exclusive analytic decision making to a combination of applying rules and intuitive action. This general conception of performance distinguishes decision-making processes and intuitive-embodied action.

Citing the work of Hubert, and Stuart Dreyfus, Flyvbjerg (2002) states " Cognitivists and others who conceive of thinking as logical information-processing and analytical problem-solving concern themselves mainly with the kind of thinking processes which take place at the "competent performer" stage...people are generally seen as problem-solving beings who follow a sequential model of reasoning consisting of "elements-rules-goals-plans-decisions." (p.13) Hubert and Stuart Dreyfus (1986) reject the cognitivist view of human intelligence that sees humans acting only as analytical problem solvers. They show that exclusive use of analytical rationality (occurring in levels 1-3) often impedes further improvement in human performance because of its slow reasoning and emphasis on rules and fixed solutions. Experts and proficient performers combine intuitive decision-making based on a holistic view of a situation with rational decision-making. An expert given a normal circumstance will not think (e.g., make decisions according to rules), they will act. "The separation between person and machine, subject and object disappears." (Flyvbjerg, 2002, p.19)

The work of Hubert and Stuart Dreyfus (1986) shows the limits of the current standalone laptop configuration and how the logic of the point-click-display configuration of the computer contributes to problems in computer music performance. Presumably one cannot become an "expert" performer if reduced to procedural information-processing logic. The logic of the laptop's physical configuration works against implementation of intuitive embodied knowledge because the user must enter a procedural chain of interaction. In this light, the lack of the physical and visual aspect in laptop music performance seems first an issue for the performer, but one that then translates as an issue for the audience as well.

Despite how limited physical interaction is with the standalone configuration of the laptop, it is still possible to achieve moments of freedom from the procedural relation to the computer. For instance the use of assigned key-controls and commands can be learned and eventually executed on at least a *Competent* level. (e.g., the use of undo (command z), redo commands (command y), and key-control assignments) However the instances and degree of freedom is extremely limited, even though for some the restriction of the point-click-display interface is not a big issue, as they have fully accepted the limitations of this working environment. In fact many laptop performers are content to simply play back pre-recorded tracks making minor adjustments of track levels and equalization. For example, Si-cut.db's (Douglas Benford) approach privileges the musical composition over issues of performance that place importance on the computer-as-musical instrument. He feels that music can transcend such issues. Yet, even Benford has augmented his performance configuration with a MIDI controller to assist in controlling volume, equalization, and effects sends.

11.4 The Meaning of Generic Controllers

My evolution from standalone laptop music performance to experimentation with physical control devices mirrors trends in the minimal electronic music community as one witnesses the decrease in standalone laptop performance and an increase in the use of external control devices. Although MIDI control boxes of the generic and custom variety have been used since the very beginning, there has been a marked increase in their use over the last several years. Shortly after this trend takes hold we also see an increase in the availability of a variety of generic MIDI controllers by commercial manufacturers (e.g., Behringer; Doepfer; E-MU; M-Audio; and Roland). The supply reflects the demand.

In this sense minimal electronic music performers have "re-invented the wheel" in terms of the identified need for physical control devices in computer music performance, but they have done this along different lines than that which typically frames concerns for digital instrument design. While the MIDI control box is often considered inadequate and generic I believed that the increased popularity of the devices warrants closer inquiry. Considering that early experimental DIYers of the 1960s and 1970s took it upon themselves to create their own digital instruments and electronics, why was this minimal generation turning to "black-boxed" devices with such consistency?

What I began to realize is that MIDI control boxes are not as generic as they seem. True, many consist of generalized layouts of knobs and/or sliders and buttons, but many layout formats and functions of these devices resemble the role the mixing console has in the recording studio. One of the early MIDI control boxes is the Peavey PC 1600, which features 16 programmable buttons and sliders. Other MIDI controllers feature combinations of knobs, sliders, and buttons laid out in a similar fashion to mixing consoles, with the sliders at the bottom and the knobs at the top. Consistent with the functionality of mixing consoles, sliders are typically assigned to control volume levels to different tracks of audio, while knobs are often assigned to control effects sends, pan, and equalization parameters.[39] As with the mixer in the recording studio the MIDI control box becomes a hub for controlling, mixing, and processing sound.

The use of MIDI control boxes can be seen as an extension of the tradition of interpreting electronic and recording technology as musical instruments and an interesting development in what could be considered a *concretization* process. In earlier DIY of the late 1960s and early 1970s, DJ culture was in its infancy, and many techniques and equipment was just being developed. However, today the use of mixer-like MIDI control boxes can be looked on as part of a new musical tradition, one less interested in traditional instruments and instrumentation, but one that extends the Schaefferian techniques of *Musique Concrete* and Varese's interest in timbre.

[39] Note that knobs were also used as volume controllers on many broadcaste and House DJ mixers.

Still, MIDI controller boxes can be criticized for not being specific enough in that they generally do not share a specific relationship to the software architecture to which they are mapped in terms of layout.

11.5 Robert Henke: The *Monodeck*

Robert Henke's work represents an interesting example of the inadequacies of generic controllers but also a possible path of development that they point to. Henke is a mastering engineer, software programmer, and one of the most prominent figures of minimal electronic music of the last decade. Henke performs under the title Monolake and is also responsible for the development of critical aspects of Ableton Live's music software.[40] (www.ableton.com) Ableton Live was specifically designed for and has become one of the most popular software environments for laptop music performance. (Jorda, 2005) I first witnessed Henke performing at the 2003 Mutek Festival in Montreal, a performance which made an impact on me for its success in enveloping the audience in a world of sound and rhythm that not only enticed one to dance but was also aurally rich with variable textures, and rhythms. This was not commercial dance music but a combination of sound exploration and moving rhythms. In *Stylus Magazine* Henke is cited as claiming it to be one of his best performances in years. (Schepper, 2003) What of his experience as a performer?

Two years later I asked him this question during his visit to Vancouver as a performer and conference panellist at the fifth incarnation of the New Forms Festival. Henke explained that he had been looking for a way to get out of his head during his performances. This incentive lead him to have a custom controller constructed using some DIY MIDI control boards from Doepfer. (Doepfer) Henke had tried several different MIDI controllers but decided that a generalized solution was not sufficient. Henke states, "I wanted a controller which provides just the features I need and nothing else. I also wanted a layout which relates to the functionality, instead of having

[40] Monolake was originally a duo that included both Robert Henke and Gerhard Behles.

a single matrix of 4 x 16 knobs for controlling arbitrary parameters." (Monolake) Henke was referring to the functionality of the specific software he was using for performance, Ableton Live.

11.5.1 A closer look: The *Monodeck* & performance practice

The *Monodeck* was inspired as an attempt to create a more specific instrument, as Henke recognized that typically musical instruments are defined according to their specificity. When asked about his approach to performance, Henke explained how the general context of performance had "forced" him to adapt his choice of sound and process. He said often the quality of the sound system or space of performance is not conducive to translating the detailed work of sound design done in the studio because it becomes degraded and lost. (R. Henke, personal communication, September 18, 2005) There is often a great rift between the potential of the sound experience and the actual sound experience. For him this meant a focus on bare percussive elements as content and rhythmic manipulation and more extreme equalization as improvisational process. With Ableton Live, Henke relies on the automation of file playback and timed loop adjustments and at the same time must find a way to play on that automated system, to infuse his own voice into it. This is partially achieved through the addition of effects processing including some age-old digital versions of delay, filter (e.g., hi-cut, low-pass, band-pass, and notch), and reverb. In this way Henke can superimpose new variations of looped samples over one another to generate new iterations which may take on a dramatic structure of building up and breaking down over time. Equalization is used in a similar fashion to introduce change within the repetitive train of looped samples synchronized to a specified beats-per-minute.

One word that reappears throughout his discussion of performance process is "adaptation". It is important for him to be able to adapt what he is doing quickly in performance. With the standalone laptop Henke says, "I had the impression that I'm running after my files and not creating something...like really being a slave to my own tool". (R.Henke, personal communication, September 18, 2005). The creation of the *Monodeck* was part of a quest to move beyond the slow procedural exercises of performing with the laptop configuration.

The *Monodeck* reduced the need for constant hand-eye co-ordination, because of the physical feedback inherent in the control surface. During the Vancouver interview and also at the New Forms Festival panel discussion, Henke expressed that the *Monodeck* was created so he didn't have to think. (R. Henke, personal communication, September 18, 2005) Henke sought an embodied interaction with Ableton Live, one that would largely bypass a procedural orientation.

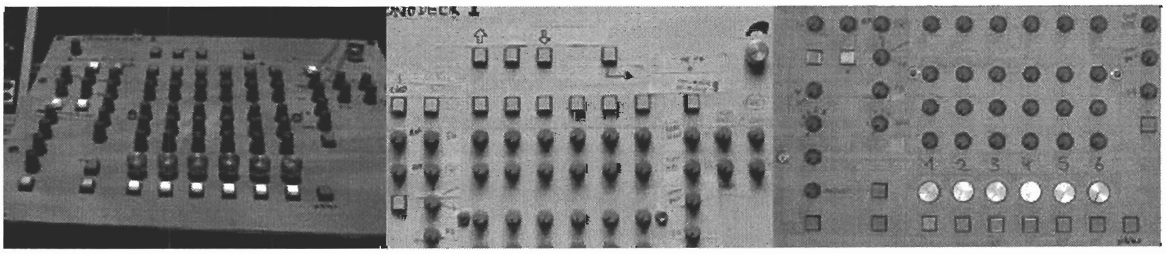
11.5.2 The *Monodeck* & the concretization of practice

From the outside the *Monodeck* looks like a standard controller, just another pre-packaged peripheral. What is significant about it is that the *Monodeck's* knobs, switches, and LEDs are laid out to reflect and assist the performance process that was specific to how Henke used Ableton Live and freed him from having to interact with the procedural logic enforced by the GUI. The result is comparable to the *concretization* of certain aspects of DJ practice in the development of the crossfader. The crossfader condenses the practice of blending two signals together using separate volume controls into one control element. The *Monodeck concretizes* many of the basic procedures completed individually with mouse and keyboard into a physical representation that embodies those practices. The mixing practice of the DJ was prescribed to the crossfader and so Henke's practice of performing with Ableton Live is reflected in and facilitated by the *Monodeck.* One did not need to think about "sliding track 6 fader to +3 db" one simply adjusted the volume with the interaction of hand and knob, the mind was free to think about other things. Ben Nevile articulates it as the difference between making a decision or making an action that was directly sound producing. Both involve decisions, but for instance if you push a volume fader up in the exact same way at two different times it doesn't make the exact same sound. With the GUI and mouse, decisions often imply discrete choices between this or that, but physical controllers introduce the variables of real time and space. Henke's addition of the *Monodeck* to the laptop-as-musical instrument helps to bridge the gap from decision-making processes to intuitive or embodied action that suggests the possibility of a higher level of performance skill and also a more immediate experience for the performer. (H.Dreyfus & S. Dreyfus, 1986).

11.5.3 A more specific instrument

The "meaning" of the *Monodeck* is also located in its specificity. It not only reflects the functions of a mixing console familiar to the recording studio and DJ practice, but it also reflects a specific mixing and selection configuration unique to Ableton Live. Henke's *Monodeck* is easily understood by someone fluent in Ableton Live without the aid of any labelling of the controls. I was able to guess that he had provided controls for six tracks of audio, the large knobs were for volume, the lone large knob was the master volume control, the groupings of three knobs in the six tracks were for the three band EQ, and additional knobs for effects sends. (Fig.1)

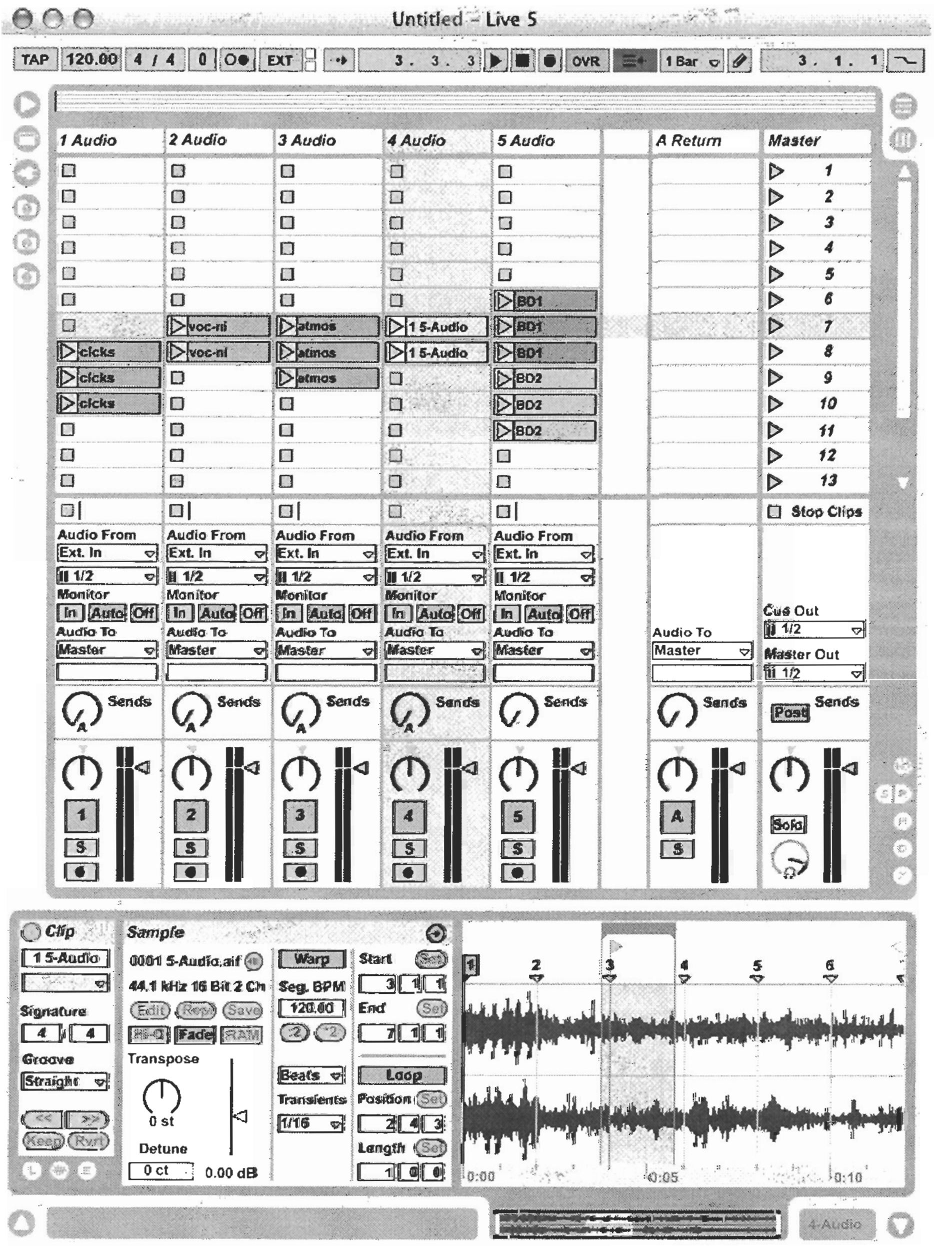
Figure 1. Robert Henke's *Monodeck*



The fact that I would have imagined a similar controller is not insignificant. In performance I change track volume, effects sends, effects parameters, equalization, and sample selection. These are the primary "decisions" made in performance. There are other possibilities but these are the main ones used in sample-based play. I imagined a controller that would provide hands-on control of these changes, very similar to Robert Henke's *Monodeck*. In addition I wanted a way to trigger/change the sample playing in each track without having to use the mouse.

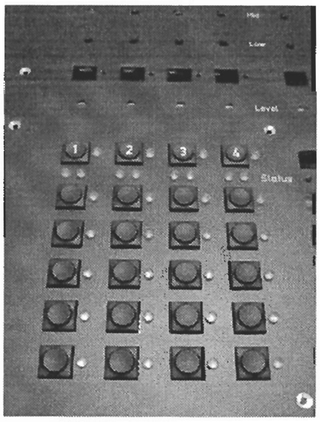
The samples are placed in tracks in cellular grid blocks. (Fig. 2) The problem is you can only trigger one at a time unless you map them to key commands. I experimented with this option and found that it did tend to enhance my ability to improvise, however, most of my live sets involved 100's of samples, and I only had about 40 keys.

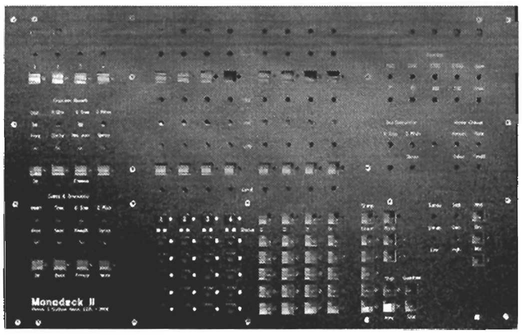
Figure 2. Ableton Live Session View



There was also the problem of remembering which key was assigned to what. My solution involved having a trigger button for each track with an up and down button for each one that would allow me to scroll through the samples installed in each track. This would streamline the whole process. Later, I found that Henke had been working on a new iteration of his *Monodeck*. *Monodeck II* is slated for completion in 2006. This iteration is meant to completely eliminate the need for interaction with the laptop's point-click-display interface. (Monolake, 2005) The main addition to this version is a trigger button system for sample selection very similar to the one I had imagined. However, Henke anticipated the scenario where you might want to move quickly back and forth between several samples on the same track. One button per track wouldn't do. Henke designed his module to have 5 buttons per track. Now Henke's *Monodeck* becomes an even deeper reflection of the Ableton Live software structure and *concretization* of his own performance practice in relation to it. (Fig. 3 & 4)

Figure 3. Monodeck II sample trigger pad (left). *Figure 4.* Monodeck II faceplate (right).





11.6 Other Approaches

Other artists have taken a similar approach. In the earlier days of laptop music performance there was no pre-packaged software designed specifically for live performance. While some used pre-packaged studio production software like Pro Tools, or Cubase to do live mixed playbacks of tracks in performance, many other artists were designing their own performance tools in programming environments like Max/MSP (mid-1980's *Patcher*, www.cycling74.com*)*, Pure Data (PD, 1997), and Audio Mulch (beta1999, www.audiomulch.com).[41] These programming environments had been developed in the context of computer music research as programming systems that composers could use in designing interactive computer music systems. Programs like Max/MSP and PD are object-oriented data flow languages that feature a visual programming environment allowing the user to connect higher-level abstractions to build interactive music programs, while at the same time having access to lower-level programming through command line inputs to the higher-level abstractions. Both programs come with a library of "objects" or abstractions representing higher-level musical structures. (e.g., sfplay~(play), record~(record), reson~(filter), metro~(metronome), env~(envelope generator), and many more.)

11.6.1 Jamie Lidell

Jamie Lidell developed his own software in the programming environment Supercollider. He then configured a series of controllers, including mixing consoles, and effects units in combination with the software architecture. The system is designed according to how he wishes to manipulate the live input of his voice through a microphone. Lidell's performances begin with "empty" boxes (i.e., computer and other devices.) meaning he is not using any pre-recorded samples. (Allen, 2005) Instead, Lidell builds up songs by sampling the sound of his own voice by

[41] Earlier programming environements like Csound, Lisp, and Forth were used to author interactive computer music performance systems.

singing, beat boxing, imitating bass lines, and making other noise. The system stores and plays back samples of his vocalizations. Lidell uses the controllers, mixer, and effects to control the sound and structure of these live input sounds.

Some might view this process as being quite different from Henke's. However, because Lidell is working within the context of sample-based performance and recording technology he must include certain functions within his configuration that would be consistent with the Ableton Live system. Lidell's customized performance system sits within the practice of sample-based music and using electronic and recording technologies as musical instruments. His relationship to these practices then informs the choices he will make with respect to the design of a performance system. I will relate an example from my own experience with the visual programming environment of Max/MSP.

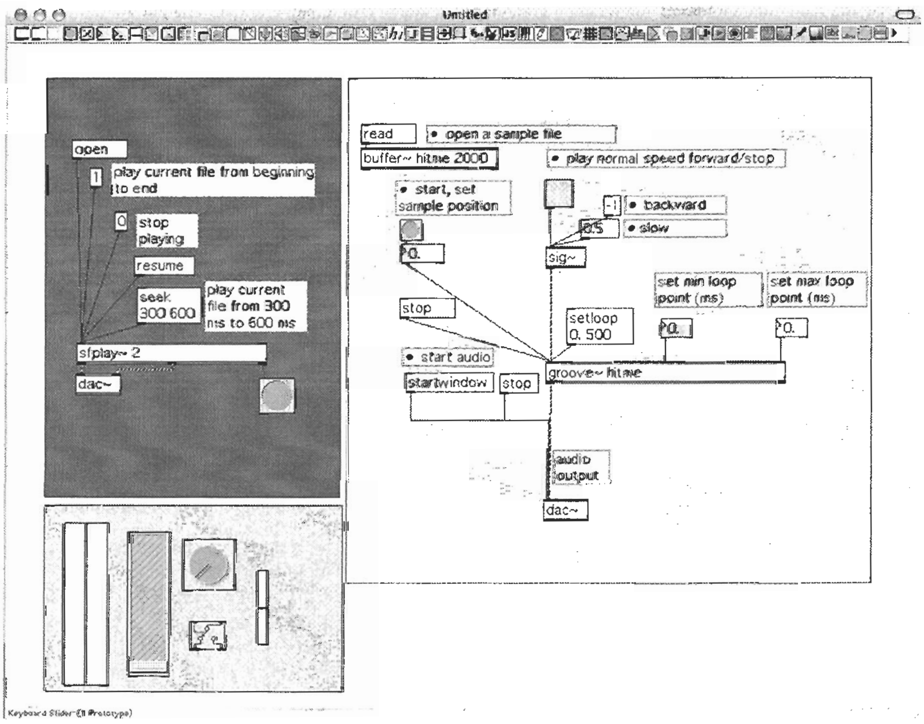
11.6.2 From Max/MSP to Ableton Live

I became interested in using Max/MSP as a way to realize my own ideas about how I might process sound in live performance. At the time I had little interest in the principles of sound synthesis. My work was based on manipulating samples and field recordings. I experimented with designing performances and sound processing systems in Max/MSP for three years. Some of this work involved creating specific patches for sound installations and small interactive music patches. I implemented machine listening patches, Fourier analysis, and automated record-playback engines that could create a generative composition from live input.

During this time I found myself "solving" the same programming problems as they related to record, playback, sequencing, time-stretch/compression, and the addition of effects. I was replicating the design of basic sound recording and manipulation functions found in many other audio software applications. Why would I spend so much time replicating sound playback engines, the problems of which had already been solved, and solved much better, than I could myself without expending considerable amounts of time? It seemed more appropriate to simply use open-source patches that had already solved these basic problems. The fact that most applications, custom programmed or not, solve these problems in very similar ways, suggested an underlying structure in computer music performance systems based on sample playback.

While Max/MSP was particularly suited for realizing new environments that could facilitate and define new practices, it didn't seem the best choice for replicating the basic functionality of an already established practice of sample-based play, which included a series of relatively well-designed tools. (e.g. play back engines, record buffers, sequencing structures) I began to see Max/MSP less as a means to creating a "general performance software environment", and more as a means (a very powerful one) to creating specific tools for very specific projects.[42] (Fig. 5)

Figure 5. Max/MSP



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[42] By "general performance software environment" I mean that which could be used in a variety of performance contexts, and be used to play different forms of electronic music, as opposed to an individual tool designed for one particular task.

A guitar is a guitar despite some nuanced differences in construction. The similar designs and functions of file playback engines suggest a kind of defining consistency in terms of treating the computer as a recording technology or using the digital sound studio as a musical instrument. A comparative analysis of the GUIs of Ableton Live and Reason detail the use of mixing and studio metaphors in audio software and how it relates to issues of usability. software (Duignan, M., Biddle, R., Noble, J., & Barr, P., 2004) Duignan, Noble, and Barr (2004) identify four key components of electronic music production systems (i.e., the digital studio), sound generators (e.g., synthesizers, drum machines, and sound file players), effects processors, mixers, and sequencers. They define user-interface metaphors as devices "for explaining some system functionality by asserting its similarity to another concept or thing already familiar to the user."(Duignan, Noble, & Barr, 2004, p. 1) Reason uses the metaphor of the recording studio in its GUI by representing hardware synthesizers, mixers, samplers, drum machines, and effects units including such interactive graphic control elements as knobs, LEDs, and patch cables. The different components are arranged on a virtual rack mount that is also visually represented in the GUI. (Duignan, Noble, & Barr, 2004) Reason condenses the functionality of audio processing, mixing, recording, and playback hardware that would fill a real-world studio, into a relatively small software package. The roles of these devices have been *concretized* into the virtual domain in the computer.

Ableton live uses the metaphor of a mixing console in its live playback session view, one that is a conventional choice in computer music tools. Ableton Live's use of the mixer metaphor is said to take advantage of the user's prior knowledge of real-world mixing consoles and their functionality in the recording studio. (Duignan, Noble, & Barr, 2004) Even though the metaphor of the recording studio is represented more literally through the graphic design of Reason, the functional aspects of the recording studio are given more emphasis in Ableton Live. Ableton Live's structural capabilities embody the mixing metaphor by allowing input from other music software through Rewire and also through the custom VST folder where smaller effects program patches and virtual instruments can be added and controlled through the mixer-based interface.[43]

Before there was Ableton Live there were programs like Protools and Cubase that also relied on the multi-track recording studio metaphor. However, not as many functions could be manipulated in real-time without disrupting signal flow and the structure of these programs, being more geared toward in-studio composition, proved inadequate for live performance for many electronic musicians. Again, many performers turned to visual programming environments like Max/MSP, PD, Audio Mulch, and SuperCollider. However, over the past 5 years, Ableton Live has become so wide spread that one is often surprised not to see it as the software of choice at a performance. At the Live! Festival, which I performed at in Zurich in 2005, and was dedicated to live electronic music performance, every performer at my stage, roughly 12, were using Ableton Live. Interestingly, Ableton Live was first sketched out in Max/MSP by Robert Henke, and Gerhard Behles. The design of the software was developed in direct relation to their experience writing and performing with Max/MSP. Ableton Live was inspired by a desire to get away from designing tools, and focus more on using well-designed tools to create music. Here we see another example of a musician's practical experience evolving into a device that concretizes the functions involved in that practice into the design of more refined and "concrete" tools. In this case, after years of working with performance environment variations in Max/MSP the artists opted for something with flexible yet definite limits in terms of HCI and GUI design.

Ableton Live has attempted to adapt the concept of the recording studio as musical instrument to the demands of live improvisation based largely on sampled audio. Although more recent variations have included a virtual synthesizer based on FM synthesis and all versions have provided a means to incorporating VSTi and VSTplugins. In essence, Ableton Live instantiates the working practices and interpretations that minimal artists had imposed on previous sound

[43] Rewire acts like a multi-track cable from the transfer of audio and information between sound software programs.

editing software, programming environments, and the studio in general. An example would be to compare Jamie Lidell's performance instrument and practice to Mitchell Akiyama's use of Ableton Live.

Like Lidell, Mitchell Akiyama also uses live input using microphone and guitar. He creates loops, overlaying them, processing them, and building up a composition over time. Although Lidell incorporates more external control devices, and has designed a more specifically structured processing environment, one could imagine how Akiyama could "replicate" many of the specificities that characterize Lidell's performance. In fact another performer, Kid Beyond has more or less achieved similar results. "While many people open their Ableton Live sets with a full set of session clips or a set arrangement, Kid Beyond prefers the empty slate approach: Onstage, I start each song with an empty Live set — empty of clips, that is, but full of pre-defined tracks and effects. Then, one by one, I record live audio clips into each track." (http://www.ableton.com)

What Ableton Live specifies is a refined environment for controlling basic audio record, playback, and manipulation according to a tradition of sound manipulation processes long established in the recording studio. When it comes to very specific sound processes a composer/performer might require something more customized. In these scenarios there is the option to design a VST or VSTi plugin in Max/MSP or some other program, or to use a Rewire link and run another processing program in tandem. This could be compared to the addition of effects racks in the studio or effects pedals to the guitar. Some basic functions remain while additional techniques can be added to augment, or transform the results entirely. Max/MSP of course is capable of much more than sample-based play and simple effects processing, but in the minimal community of practice artists have tended to move towards tools that allow them to make music according to a tradition of using recording technologies as musical instruments.

A program like Max/MSP, although initially used to create interactive computer music performance environments, has been interpreted more as the means to creating a digital recording studio adapted to live performance, than some completely new digital instrument with an equally new physical interface. The intro page to the programming environment Audio Mulch also reflects this concept. "Bringing together the popular with what has up to now been considered experimental, Audio Mulch merges the worlds of mainstream electronica and electro-acoustic sound composition to create a fluid sonic environment only limited by the artist's imagination. While many of the processes featured within Audio Mulch are not new to computer music programs, it is the software's ability to carry out these traditionally 'studio' or 'non-real-time' signal processing techniques in real-time that emerges as its major asset. With Audio Mulch, music that has for so long been limited to the pre & post-production practices of a studio can emerge in a new LIVE and interactive context." (www.audiomulch.com) This description particularly emphasizes the interpretation of laptop music performance along the lines of the tradition of using the recording studio as a musical instrument. In the case of Audio Mulch, Reaktor, Max/MSP, SuperCollider and PD, the metaphor of the studio is not just one that appeals to the user's familiarity through visual cues in the GUI, but also one that appeals to a low-level structural familiarity with the components and functionalities within a recording studio. (e.g., signal flow, level controls, envelope controls, gates, switches, and signal mixing.)

12 BASIC RECORDING TECHNOLOGY FUNCTIONS

While much research has been done and continues in terms of experimenting with possibilities for new digitally based instruments, a large community of practice has continued to interpret computer music performance in relation to the use of the studio as a musical instrument. The power and portability of the laptop makes it particularly feasible to bring studio practice to the stage. Yet, electroacoustic artists have been bringing certain aspects of the studio to performance contexts through acousmatic presentation for decades where a composer/performer would typically diffuse sound to a number of speakers, controlling certain aspects of the audio through the parameters of a mixing console. This practice continues with the addition of the real-time processing capabilities of the computer, but electronic music performance in this kind of acousmatic context tends to place an emphasis on the relationship of composition to the acoustic space of its presentation as opposed to a more improvisational performance practice. The digital studio and mixing console are treated more as a means to presenting a composition in a specific listening context, than as musical instruments in their own right. This is not to say that one approach is better than the other, but to indicate that there exists different orientations to the same technology.

12.1 Selection & Mixing in The Computer

Digital instrument design could take on almost any form, but the representation of the recording studio in the computer, its dematerialization into digital form, and the practices of the minimal laptop music performance community indicate a system of organization where processes are controlled by two main functions; *selection* of discrete possibilities and *mixing* of parameter variables. Engaging in these processes can result in changes to the timbre, texture, or colour of the sounds involved. While recording studio techniques were originally focused on reproducing the concert hall experience, we have seen how the recording studio was also interpreted as a creative instrument in its own right, which could be used to treat recorded audio as the basis for a new kind of sound production. A play on the process of selection and mixing also reflects the basic processes involved in DJ practice where the DJ selects at least two channels of audio together while adjusting control parameters such as volume, and equalization during the mixing process.

The computer extends this practice. This is evidenced in the structural similarities between software architecture with its graphic user interface, and the hardware technologies of the recording studio, especially the mixing console. Programming environments like Audio Mulch, Max/MSP, and PD also reflect the recording studio in providing basic playback and record engine "objects" as well as graphical representations of potentiometers, faders, and vu meters. Although this is not the only metaphor imbedded in such programming environments, Max/MSP also incorporates a synthesis metaphor with its set of objects including Osc~, Phaser~, and Cycle~. These visual object-oriented programming environments also contain a studio metaphor in their use of patch cables used to build relations and signal flow between various "object" abstractions. This is not to suggest that programs like these only reference the studio, but that some basic functions of the recording studio are embedded in the design of the programming environment.

The shift from the standalone laptop in minimal electronic music performance to the addition of MIDI control boxes resembling mixing consoles also reinforces this interpretation of computer music performance, and marks an interesting instance of *concretization.* The dematerialization of the recording studio into its digital incarnation meant that multiple functions performed by different sound devices could be combined into one software package. In terms of post-production and in-studio composition the digital studio offered many benefits including non-destructive editing, reproduction without signal loss, non-linear editing, portability, and increased efficiency. However, as we have seen, the digital studio proved inadequate for many laptop music performers that valued adaptation and improvisation. Eventually these performers turned to "generic" MIDI control boxes that at least partly reflected the performance processes they had been attempting to engage through the point-click-display interface. Even though these MIDI control boxes were non-specific to any particular software environment, their general reflection of mixing console controls seemed to resonate with the needs of minimal laptop music performers. In addition, we see that Robert Henke, in an attempt to free himself from the procedural logic of the point-click-display interface, does not create an entirely new kind of controller, but instead creates a MIDI control box specific to his working practice with Ableton Live. In this way the process of *concretization* that affects the overall practice of minimal laptop music performance has been applied to the modification of a MIDI control box, as opposed to the laptop itself, and we see the digital studio extended back into physical space.

13 CONCLUSION

The research indicates that minimal laptop music performance practice interpreted the digital studio as a potential instrument for live performance. This practice was developed in relation to the re-purposing of the turntable and mixer in DJ culture. At the same time work done in the field of computer music research had created programming tools to facilitate the design of more specific interactive music performance systems that were then used by minimal laptop music performers as alternative solutions to the inadequacies of sound software that was not well suited for improvised performance. After years of practice creating and performing with customized performance systems written in Max/MSP Robert Henke and Gerhard Behles create Ableton Live as a generalized solution which can be seen as one *concretization* of the artist's performance practice in relation to the laptop-as-digital studio or musical instrument. Continued minimal electronic music performance practice resulted in further refinement through the turn towards "generic" MIDI controllers that resemble the functions of mixing consoles, and also the design of a MIDI control box specific to the use of the Ableton Live software in performance. (e.g., the *Monodeck*)

The computer-as-musical instrument in terms of its interpretation as a digital recording studio absorbs the new traditions of using electronic and recording technologies as musical instruments, and provides new means of augmenting these traditions and techniques through its unique programmability. However, as this thesis has attempted to illustrate, the generalized point-click-display configuration of the laptop and personal computer have presented challenges in terms of computer-music-performance that technical solutions in software and GUI design alone have not fully been able to transcend to the satisfaction of many laptop music performers. Instead, one witnesses a unique inversion of the reduction of the hardware studio into the compact laptop and we see the studio re-expanded to include hardware peripheral control devices. These devices are not complete replicas of the analog recording studio's mixing console, the hub of musical post-production, but incorporate many of its functionalities with the addition of controls mapped to functions specific to the evolution of the electronic music studio in its digital incarnation. This iteration or path of development represents a refinement of one interpretation of the potential of the computer-as-musical instrument and also the recording studio as musical instrument. Developments in minimal laptop music performance also point to the emergence of a new musical paradigm based in electronic and recording technology. Computer music performance has yet many potential paths of development to explore, including the future of interactive computer music systems, and digital instrument designs. This thesis has attempted to outline developments in the minimal electronic music community of practice, and show the social dimension and place of practice in technological development.

APPENDICES

Appendix A

List of International Electronic Music Festivals Researcher Attended:

Live! Festival. (2005, March 23-25). Dachkantine, Zurich: Switzerland.

Mutek. (2004, June 2-6). *5th Edition: Music, Sound, and New Technologies.* Montreal: Quebec.

Mutek. (2003, May 18 - June 1). *4th Edition: Music, Sound, and New Technologies.* Montreal: Quebec.

Mutek. (2002, May 29 - June 2) *3th Edition: Music, Sound, and New Technologies.* Montreal: Quebec.

New Forms Festival. (2005, September 15-18). *New Forms Festival: Ecologies.* Vancouver: Canada.

New Forms Festival. (2004, September). *New Forms Festival: Technography.* Vancouver: Canada.

New Forms Festival. (2003, August). *New Forms Festival: Inter[sec/ac]tion: A convergence of music, new media and art.* Vancouver: Canada.

PopKomm. (2002, August, 15-17). *Trade Fair for Pop Music and Entertainment,* KolnMesse exhibition and conference centre, Cologne:Germany.

Sensible Festival. (2004, June 11-12). *Karat.* Nouveau Casino, Paris: France.

Sonar Festival. (2004, June 17-19). *11th Barcelona International Festival of Advanced Music and Multimedia Arts.* Barcelona: Spain.

Sonar Festival. (2002, June, 13-15). *9th Barcelona International Festival of Advanced Music and Multimedia Arts.* Barcelona: Spain.

World Electronic Music Festival(WEFM). (2003, July 25-27). Trudeau's Park, Tweed, Ontario, Canada.

Appendix B

Selected Discography of Works by "minimal" Electronic Music Artists:

Akiyama, Mitchell. (Producer). (2001). Hope That Lines Don't Cross. On *Substractif*, [cd]. Canada.

Akufen. (Producer). (2002). My Way. On *Force Inc. Music Works*, [3x12"/cd]. Germany.

Atom Heart. (Producer). (1991 -). Various works see http://www.discogs.com/artist/Atom+Heart.

Brinkmann, Thomas. (Producer). (1997). Studio 1 - Variationen. *Profan*. [12"/cd']. Germany.

Dinky. (Producer). (2003). Blackcabaret. On *Carpark Records*. [2x12"]. USA.

Dupree, Taylor. (Producer). (1998). Comma. On *12k*. [cd]. Germany.

Errorsmith. (Producer & Label). (2000). Errorsmith #2. On *Errorsmith*, [cd/lp]. Berlin:Germany.

Portable (Producer). (2006). The san. On *~scape , sc33* [12"]. Germany.

Jelinek, Jan. (Producer). (2003). la nouvelle pauvreté. On *~scape , sc16* [cd/lp]. Germany.

Monolake (Producer). (2001). Gravity. On *Imbalance Computer Music*. [cd]. Berlin:Germany.

Plastikman. (Producer). (1993). Sheet One. On *Plus 8 Records Ltd.* [2x12"]. Canada.

Si-{cut}. db. (Producer). (2001). Enthusiast. On *BipHop*, [cd].France.

Smith n Hack. (Producer). (2002). Tribute. On *Smith n Hack*, [2x12"]. Berlin:Germany.

Various Artists. (2000). Clicks n Cuts, *1.* On *Mille Plateaux*, [4x12"/2xcd]. Germany.

Villalobos, Ricardo. (Producer). (1999). 808 The Bass Queen. *On Lo-Fi Stereo*. [12"]. Germany.

Villalobos, Ricardo. (Producer). (2003). Alcachofa. On *Playhouse*. [3x12"/cd]. Germany.

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