CHAPTER 3:
INTERACTIVE ELECTROACOUSTIC MUSIC AND THE PROBLEM OF TECHNOLOGICAL OBSOLESCENCE

In 1991, Karlheinz Stockhausen, speaking in the context of a recent performance of his 1964 work *Mikrophonie I* and the difficulties associated with digitally reconstructing the specially designed filters used in the original performance, seems to make a case for the preservation of electroacoustic works only in their original state:

> It is extremely important to comprehend works, which were born to a particular historical moment, for their uniqueness. It just won't do to be continually discarding everything and making something different, but rather we should be preserving things and adding new ones. Anyway, it is my experience of music that every instrument, every item of equipment, every technique can produce something unique, which can be achieved in no other way. Since that is the case, then we can speak of an original technique, and thus deal with an original instrument. If it is imitable, then it is also not worth much.[30]

Stockhausen's position poses a problem for the performer who would like to play an existing electroacoustic work, but is unable to obtain the original equipment used by the composer. If a technique truly cannot be achieved any other way than the original, then there is not much point in attempting a new realization or interpretation, and the work must therefore exist only at its moment of creation. Of course Stockhausen is speaking here of the unique sound qualities and tactile response of specific instruments used in one of his own works, and one can certainly sympathize with the desire to maintain the special qualities of an instrument that so compelled the composer in the first

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[30] Karlheinz Stockhausen, "Electroacoustic Performance Practice" *Perspectives of New Music* 34, no. 1 (1996), 97

place. On the other hand, some balance is necessary if the composer also desires a work to be open to continued interpretation by a wider pool of performers.

Technological innovation is a two-edged sword when it comes to musical works that incorporate interactive electronics. On the one hand, the passage of time has given us a body of new musical works. On the other hand, it has led to the obsolescence or disappearance of many of the instruments required to play them. Global communication via Internet has vastly increased awareness of existing works among interested performers and has also provided easy access to them. However, the extremely rapid development of computer technology has also greatly accelerated the turnover of electronic equipment and software used in musical applications. This has led to the rapid abandonment of devices and systems that were once considered "cutting-edge," many of which even served as the basis for certain key compositional processes. Simultaneously, the rapid development of technology has given rise to extremely powerful general-purpose computing systems that can accomplish many of the same things that previously required special-purpose proprietary equipment or software. This last development now makes it possible to incorporate the functions of older interactive electroacoustic works into more standardized and portable systems. The final result of all this technological advancement is, I believe, a net gain for the prospects of a functional electroacoustic repertoire. A number of researchers have already begun efforts in this direction, attempting to identify important works of interactive electroacoustic music literature, and adapting them to current technological resources.

Joel Chadabe describes new realizations of John Cage's *Bird Cage* (1972), David Tudor's *Rainforest* (1958), and his own *Solo* (1978) using various synthesis and signal processing software systems including Kyma and SuperCollider.[31] Benny Sluchin, working at IRCAM in Paris, has created computer-based realizations of Stockhausen's 1966 *Solo for Melody Instrument with Feedback,* first using Max on the NeXT computer (in 1992, in collaboration with Cort Lippe), and later in Max/MSP on a Macintosh computer (in 1998 with Carl Harrison-Faia).[32] Christopher Burns, working at Stanford University, developed new performance realizations of classic electroacoustic works by Alvin Lucier (*I am Sitting in a Room*, 1969) and Stockhausen (*Mikrophonie I*) using both Pd (Linux) and Max/MSP (Macintosh) software.[33] Clarinetist Bruce Bullock has documented his experiences in creating a performance implementation of Thea Musgrave's *Narcissus* using alternate digital delay hardware.[34]

Perhaps the most interesting work to date in this new field of preserving and re-implementing older electroacoustic works, and most relevant to this study, is that of Miller Puckette and his team at the University of California at San Diego. Puckette's approach is to create "reference realizations" of interactive works using the Pd software

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[31] Chadabe, Joel. "Preserving Performances of Electronic Music." *Journal of New Music Research* 30 no. 4 (2001): 303 – 305.

[32] Benny Sluchin, "A Computer-Assisted Version of Stockhausen's *Solo for Melody Instrument with Feedback," Computer Music Journal* 24, no. 2 (2000),

[33] Christopher Burns, "Realizing Lucier and Stockhausen: Case Studies in the Performance Practice of Electronic Music." *Journal of New Music Research* 31, no. 1 (2002): 59 – 68.

[34] Bruce Lloyd Bullock and Ron Burns, "A Performance Realization of Thea Musgrave's *Narcissus* for Amplified Solo Clarinet and Digital Delay." *The Clarinet* 22, no. 4 (1995): 48–49.

environment running on Linux (and other) computers.[35] Pd offers a high degree of flexibility and sound quality, but it usefulness in terms of preserving and distributing realizations of older electroacoustic works among researchers comes from its relative transparency, due to the nature of open-source computing systems such as Linux and Pd.[36] Puckette describes four works realized in this manner: Stockhausen's 1970 *Mantra* (two pianos and ring modulators), Boulez' 1985 *Dialogue de l'Ombre Double* (two clarinets and special processing), Philippe Manoury's 1988 *Pluton* (solo piano and live electronics), and Kaija Saariaho's 1991 *Noanoa* (flute and live electronics).[37]

Puckette is the creator of the Pd software environment, and is also one of the inventors of object-oriented interactive music programming. His efforts in this area are therefore bound to carry a great deal of influence in the computer music community. His aim is to establish a performable repertoire of interactive electroacoustic works, which is also the ultimate goal of my own work presented in this document. Puckette's project bodes well (especially in the short term) for the emerging field of interactive electroacoustic performance and for the preservation of electroacoustic repertoire.

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[35] Miller Puckette, "New Public-Domain Realizations of Standard Pieces for Instruments and Live Electronics" Paper given at the 2001 International Computer Music Conference (Havana, Cuba), and <http://www.crca.ucsd.edu/~msp/Publications/icmc01-rep/> (accessed June 30, 2004)

[36] The Open Source Initiative (OSI) is a non-profit organization that maintains the Open Source Definition for software development. Open Source software is characterized by freely available executable programs along with source code. The Open source definition specifies licensing standards designed to allow modifications to source code by other programmers, and to promote the shared development of software while avoiding the proprietary model followed by most commercial software developers. The Open Source Definition is available from the OSI web site: http://www.opensource.org

[37] Puckette "New Public Domain Realizations"

However, Linux and Pd are not universally accepted performance systems among performers of electroacoustic music, and their adoption by the majority of performers is far from inevitable. In the long run, I do not believe it is sufficient to transcribe these works from one specific system to another, even if the newer system is more generalized and accessible. Transcriptions are ultimately limited in their longevity because new implementations must always conform to the specific limitations of the chosen instrument. This is as true of open-source systems such as Linux and Pd as it is of any proprietary hardware or software. At some point, Pd will become outmoded, and these works will once again have to be adapted to newer technologies. If the only reference source is itself a transcription, a greater potential exists for a departure from the composer's intentions in subsequent updates.

Therefore, I have adopted the approach of describing interactive electronic systems in a prose format, with supporting material in the form of mathematical equations, pseudo-code outlines of specialized algorithms, and generalized block diagrams of complex synthesis and signal processing instruments. I leave it to individual performers and technicians to choose the equipment and programming environments that best suit their preferences and budgets. As much as possible, I have attempted to base my analysis on the original systems, or at least on the composers' own updated versions of the required electronics. My goal is to describe the interactive electroacoustic systems in sufficient detail to guide new realizations that are as faithful to the composers' intentions as possible and to create a resource that could be used repeatedly to create accurate realizations of these works, regardless of the state of computer music technology.