Performing electroacoustic music: a wider view of interactivity

ELIZABETH McNUTT

Boulder, Colorado, USA
E-mail: emcnutt@ucsd.edu

For most electroacoustic composers, 'interactivity' refers to technology which responds to input from a performer. For performers, in contrast, performance may be described as 'interactive' on many levels: interacting with acoustic musical interfaces (their instruments), communicating with composers and audiences, mediating the data of a score, negotiating prosthetic devices (microphones, loudspeakers, pedals, sensors), and interacting with invisible chamber music partners (whether backing tracks or responsive computer programs). There has been little public discussion about these issues. This paper will therefore discuss various elements of interactivity in electroacoustic music from the performer's perspective, with the goal of promoting and facilitating satisfying collaborations for both composers and performers. Discussions of pieces for flute and electronics will demonstrate various issues in performing with electronics; describe ways in which works and systems have been designed to work effectively as chamber music; and offer insights into the process of collaboration between composers, technologists and performers.

1. THE SCHISM

Performing with technology requires players to develop new skills and flexibility. While most musicians are extremely flexible, altering their sounds, playing styles and performance attitudes as they move between a variety of events (orchestra concerts, recitals, wedding ceremonies, etc.), yet many have found the adaptations required by electroacoustic performance to be daunting. I am unusual in this respect: in the course of frequent collaborations with composers to create new works, the recording and release of a CD of music for flute and computer, and numerous electroacoustic performances (including touring recital programmes), I have become very comfortable working with composers and electronics. I am often asked why so few players share my passion for electroacoustic music. There is no simple explanation. However, a large part of the problem is caused by the schism between composers and performers, and between performers and machines. Composers have a strong vested interested in helping performers overcome their trepidation. This requires active engagement with performers to address the issues that make electroacoustic performance uncomfortable for classically trained musicians. It is mutually beneficial for composers and performers to develop strong collaborative ties, yet such ties are the exception rather than the rule. The reasons, ranging from the practical to the cultural, are at once obvious and elusive.

1.1. The comedy of errors

Consider this humorous description of an all-too-typical rehearsal scenario from the point of view of the performer, and its inevitable psychological and physiological effects:

> The composer . . . must first assemble the combination of local and flown-in gear which will permit the piece to be played. *If time remains, the piece will be rehearsed* and adapted to whatever hardware changes were made. It is at this moment that *the player meets her accompanist . . . for the first time* . . . Sometimes microphones and other detectors are attached to the performer's instrument. Part of the rehearsal is taken up by an extraordinary sound check in which sound engineers push the outputs all the way up to listen to hisses and hums. For the above reason, *the performer cannot move* while this is being done. The computer software and hardware extend the sound check into a debugging session. The computer is rebooted again. Will it work this time? (Puckette and Settel 1993: 136; emphasis added)

Electroacoustic music, even more than traditional composition, presents the composer with a complex world of aesthetic and technical considerations that often are given precedence over the performer's needs. Such stressful difficulties as crashing computers, skipping disks, unreliable software, bad cables, feedback, noise and clipping can make composers lose sight of other aspects of the music even during the critical dress rehearsal. Careful consideration of the performer's experience of a work, from the planning of instrumental and electronic resources through the final stage set-up, can dramatically improve the interaction between composer and performer, performer and work, and above all between performer and audience.

1.2. The paper trail

The written score ideally bridges the gap between composer and performer. However, in electroacoustic

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compositions in particular, the score is often a barrier the performer must overcome in order to 'find' the piece. Performers need to have a reasonable idea of what sounds they will hear and how to work with them, yet explanations of the technology involved seldom accomplish this goal. Scores of electronic music are often vague about the sounds and relationships they represent, or else explain them in terms most useful to engineers. Composers' comments and explanations in rehearsal are often similarly opaque to performers.

In the culture of tape music, where scores are unnecessary (and can be difficult to produce), notation has not been a key issue. Perhaps this is why many performance scores for electronic music consist of a minimal shorthand, which may omit or obfuscate crucial information. Some common problems include: failing to notate electronic sounds, omitting useful cues, writing cues incorrectly or unrecognisably, and failing to indicate crucial triggering events. A clear and helpful 'graphic user interface' for the player to read makes performing with electronics both easier and more effective.

When the terms of a piece are clearly understood by the performer, there is a corresponding increase in interpretive engagement and refinement. With live processing, for example, it is useful for a performer to understand the results of her actions on the processed sound output, so she can navigate these elements as part of her larger job of interpreting the music. Resulting interpretive decisions might include omitting *vibrato* during delay loops to produce a 'smoother' sound; carefully articulating and separating events during live sampling for maximal clarity; or waiting for gaps in processing to sniff, breathe, cough, or turn pages without contributing those sounds to the electronic effects. These sorts of details are very important, but are seldom notated.

Careful planning of the integration of live and electronic materials can also make for a more effective performance. For example, a dramatic outburst can also serve to indicate a new tempo. From the audience's standpoint, the gesture is of primary importance; for the performer, familiar with the score, the speed and placement of events is what counts. This kind of understanding establishes a valuable complicity between composer and performer.

2. PROSTHESIS

From the performer's point of view, a composer's use of electronics will always involve some prosthetic elements that complicate the practice of her art. These can stand in the way of the ideal collaboration between composers and performers. Often issues that seem self-evident to performers appear to be invisible to electroacoustic composers, and vice versa. This examination of the complex interaction between composers, electronic devices and performers is intended as a starting point for communication between collaborators; it cannot hope to be an exhaustive list of problems and their best solutions.

2.1. Disembodied sound

Interacting with such common technologies as microphones and loudspeakers is an important yet often overlooked challenge faced by the performer. At a recent electroacoustic festival, a respected composer with particular expertise in sound diffusion was quite baffled by my comments during dress rehearsal: I had said I couldn't hear, and that this was a serious problem. In the performance, I was to improvise with the computer; this presupposed I could hear the computer's sounds clearly. The multi-channel array in the hall was excellent, but the sound on stage was abysmal.

Loudspeakers place sounds at a distance from their source, removing the critical links between space, sound source and person that most musicians expect. For an electroacoustic composer, the fixed and artificial space of loudspeaker diffusion is the domain in which music is usually imagined. Concert music performers, in contrast, are trained to 'play the room', adapting physically in real time to acoustical phenomena. The two are mutually contradictory, particularly if the performer is amplified (which I prefer in electroacoustic music, as it improves the blend and balance of the sound). Performers spend their lives cultivating a gorgeous projecting tone, and are understandably dismayed when the microphone indiscriminately projects 'private' and normally inaudible sounds such as breathing, rushing air, bow noise, throat sounds and finger noises. Internal microphones, pickups and cables can drastically alter the weight and balance of an instrument, and hamper the performer's movement with a tangle of delicate wires. The player's physical and sonic identity is significantly altered by the prosthesis of amplification.

Because it is seldom possible to have extensive rehearsal with the audio system and acoustic environment of performance, a strong and trusting relationship between performer and sound engineer is vital. During the sound check, the first task should be getting the performer's sound to have proper tonal balance and projection in the hall, and making sure she can hear everything she must interact with, using a monitor speaker if necessary. Trivial as it might seem, starting the sound check from the stage can have a profound effect in removing barriers between performers and electroacoustic music.

Even at best, sound checks can be exhausting for performers, with repeated requests like 'play another *fortissimo* high note'. To save energy and physical stamina for the performance, a performer will often

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'mark' through a dress rehearsal. This can lead the unsuspecting composer to become quite agitated and make potentially disastrous changes to levels at the last minute. The performer and composer must communicate their needs clearly to one another, and should trust one another's intentions and judgement. Careful management of time improves both rehearsal and performance. It is unwise to schedule the sound check directly before the performance, and it is crucial to reserve enough time to document the stage set-up so it can be accurately reproduced. These steps allow the most vital equipment in a performance – that is, performers – to function properly!

2.2. New instruments

Prosthetic elements such as pedals, sensors, and other novel instrumentalities, can be even more invasive than amplification. The more unfamiliar the technology is to the musician, the more disruptive – even for a brilliant and skilled performer. Such difficulties can dramatically affect the success of a performance. Practising with the equipment is therefore every bit as important as practising with the score; the dress rehearsal is seldom a good time to introduce new prosthesis.

While it is hoped that prosthetics will solve more problems than they create, unforeseen physical limitations can further complicate performance. A continuous control foot pedal can be awkward for those who perform standing; attached sensors might fit one person or instrument, but not another; the layout of on-stage gear may be highly dependent on the performer's size and habitual stance. I worked with one composer whose piece required eight continuous controller pedals arranged in a semi-circle around my chair. Having previously tested this array, the composer was surprised to find that my 5'3" frame could not straddle pedals 1 and 8 simultaneously, as his larger body easily could! Both composers and performers need to be patient, flexible and creative in such situations.

I am currently collaborating with Joseph Butch Rovan on a piece in which I will use a glove-mounted sensor. In the early stages of this project, after Rovan custom-fitted the glove to my hand, I improvised with various patches he created, getting a feel for the device and its capabilities. By involving me in the first testing phase, Rovan increased my understanding and comfort with this new instrument. He also gained first-hand knowledge of the ways in which I can 'play' the sensor, rather than trying to guess how a flautist might possibly use it.

3. INVISIBLE PARTNERS

I have frequently heard composers say that whether a piece involves an interactive computer or uses fixed accompaniment is insignificant; all that matters is the quality of the composition. For the performer, conforming to backing tracks or click tracks is very different from interacting with responsive partners. Nevertheless, performers frame both as real-time interactions between instrumentalists, instruments, electronics and audiences. Live electroacoustic performance is a kind of chamber music, in which some ensemble members happen to be invisible. Whatever the technology, the mainstays of human interaction such as physical cueing, eye contact, and breathing together are impossible. Sound is the only measure of correlation, and even that sound is disembodied.

3.1. Temporal prisons

Compositions for performer and fixed accompaniment (tape, CD, etc.) are still the most common combinations of live performance and electronics. In a recent call for works for flute and electronics, thirty-seven out of forty pieces submitted used fixed accompaniment. For the player, performing with fixed accompaniment is like working with the worst human accompanist imaginable: inconsiderate, inflexible, unresponsive and utterly deaf. While the performer commands the audience's attention, she is in an ironically submissive relationship to her chamber music partner, focusing most of her attention on coordinating with her accompanist – since she has full responsibility for keeping the ensemble together! Many composers recognise the inherent difficulties; Pierre Boulez has stated bluntly, 'as a performer, you are a prisoner of the tape' (Ford 1993: 25).

3.1.1. Fixed but fluid

Two basic strategies can be identified in music with fixed accompaniment (though the two are often combined within a single work): fluid and rigid coordination. With fluid coordination, the temporal relationship between live and electronic parts is not strictly prescribed throughout. If the accompaniment is notated, it is typically in time–space or graphic notation rather than a traditional note-by-note score. An example is Mario Davidovsky's *Synchronisms No. 1* (1963), in which the flautist has a degree of freedom in between points of strict coordination: she may introduce *rubato*, but must arrive at the next point of coordination accurately. The score provides time frames and sporadic cues; to give the flautist greater freedom, the tape is stopped and then restarted at particular coordination points through the piece. In this type of performer–machine relationship, the player can maintain an illusion of interaction and temporal 'give and take' with the electronic sounds. At best, this can be a very convincing act. However, it is always just an act; the freedom is illusory.

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3.1.2. Fixed and rigid

Other compositions require ongoing and precise coordination between the live and recorded parts. These pieces are generally specifically and traditionally notated, with constant cues for the performer to follow. Scores such as Eric Chasalow's *Over the Edge* (1986) and Zack Browning's *Network Slammer* (1998) look quite 'normal', and are generally easier for the flautist to comprehend at first glance. The dynamics of their performance, however, are deceptively alien. Having learned her part as if it were normal chamber music, a performer can be shocked when unceremoniously thrust into the tape 'prison'. Phrasing and breathing must be replanned, tempi and dynamics readjusted. More dangerously, it can be surprisingly difficult to hear cues while playing: cues easily audible to the composer in the studio may be lost in the acoustics of a hall, or masked by the sounds of live performance. Experienced electroacoustic performers develop effective strategies for practising this sort of music; novices may be put off by the difficulty.

Sometimes a click-track will be made to assist the performer. This generally improves the coordination between live and recorded parts, but adds to the burden of prosthesis the performer carries, and can be musically unsatisfying. Consider how few musicians enjoy practising with a metronome; fewer still like performing with one. Using a click track also emphasises the reactive, rather than interactive, situation of the piece. Focused on accurately following the click, the performer is less able to inflect her timbres to suit the accompaniment, or to keep up the illusion of interactivity in other ways.

3.2. Escaping the prison

Composer Cort Lippe has written, 'I firmly believe that empowering performers with the ability to exercise control over an electronic part, based on a performer's musical expressiveness, is an important factor in computer music's future' (Lippe 1996: 23). Giving the performer control over the flow of time is crucial; control over dynamics and timbres is also valuable. Some composers have even created works that give the performer real-time influence over the actual form and materials of the piece. Electroacoustic music that invites these kinds of creative collaboration presents vastly more satisfying models of chamber music than fixed accompaniment.

3.2.1. Who cares if they listen?

In automated score-following systems, the computer is directly cued by the performer, who generates certain expected events. Score followers can put the performer in charge of time, enabling her to shape and phrase the music almost as if playing traditional chamber music. Using a footswitch pedal as an event source for score follower can be convenient for both the composer and performer. As with other prosthetics, the performer will need to practice with it; likewise, the composer must be judicious in its use. Kaija Saairaho's *NoaNoa* (1992) and Andrew May's *The Twittering Machine* (1995) are examples of compositions for flute and computer using this strategy. In these pieces, overlapping swathes of signal processing and sound file playback create a seamless and elegant texture that is nonetheless responsive to the player's shaping of time. I find the relationship with the machine in these pieces satisfying; I have great freedom and control because the pedal enables me to 'conduct' my accompanist. This gives me confidence that we will stay together, and allows me to focus on musical issues instead of following an inflexible partner. I can shape time and gesture to best expressive effect, and adjust the pacing as needed for a dramatically effective performance.

Unfortunately, a footswitch pedal is not a particularly agile instrument, so detailed synchronisation is difficult. Using the output of a pitch-tracking algorithm as an event source, either independently or in conjunction with other control strategies, allows much more detailed control from moment to moment. However, while pitch tracking and score following can give the performer more freedom to shape time, they build another kind of 'prison': the prison of perfection. Pitch trackers can be negatively affected by variations in acoustics, microphones and mic placement, instruments, performers, and specific performances. Any of these can produce unexpected data, which will jeopardise the working of the score follower as it tries to correlate input data with expected events. This can be highly disconcerting: no one would suffer an accompanist who might stop playing in the middle of a performance because of a wrong note! It can also create an unpleasant rehearsal environment, in which the performer's mechanical perfection is needed to achieve the goal of accurate following. Appropriate musicality and interpretation can become hindrances in this process (and in performance as well), creating an oppositional relationship between the needs of the music and of the computer itself. To prevent this, compensating mechanisms may be built in the follower, but these are unlikely to be foolproof. Zack Settel and Miller Puckette have described the problem as follows:

> We are never sure to what extent the pitch follower's output will resemble the stream of notes actually played by the performer. It is very frequently noticed that a pitch follower actually performs worse – sometimes much worse – in concert than in rehearsal. This is because the musician plays differently, more musically, in concert. The better the instrument is played, the worse the computer will track it. This has an interesting effect on the player. Often the player believes that, if the pitch

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> tracker makes a mistake, it is because the note was badly played (in contradiction to above). (Puckette and Settel 1993: 135)

3.2.2. An invisible orchestra

Despite the pitfalls mentioned above, pitch-based score following can be used to create an effective and highly responsive type of interaction. *Jupiter* (1987) by Philippe Manoury, the first work to rely on this technique, feels very much like a flute concerto in which the soloist is both performer and conductor. *Jupiter* uses pitch-based score following for both local interaction and large-scale following. It is lightning-fast in its response, and on the local level it provides excellent coordination between performer and machine. If a few cues are missed, error correction algorithms generally remedy the miscorrelation, much as human performers would. On a larger scale, segments of flute materials are recorded by the computer for transformation and playback much later in the piece, integrating interaction into the form of the work. This can add a degree of uncertainty to the performance: if any cues are missed during the recorded sections, the ramifications will only be felt much later in the piece.

Throughout this substantial work, Manoury is careful to keep shifting the relationship between flute and computer. Indeed, two sections, while generated in real time, are not at all interactive: they function essentially as rigid fixed accompaniment. In contrast, another section includes thirty different cued events within just ten seconds. To perform a piece with such varied and complex interaction, the flautist must know both her part and the accompaniment well. Pitch-based score followers respond only to momentary changes of sound, and thus present different challenges than human partners in performance. Their needs can nevertheless be integrated into an effective musical interpretation. Like traditional interaction with other musicians, the keys to success are careful thought and rehearsal.

3.2.3. Score following in practice

I was fortunate in being able to rehearse and perform *Jupiter* is collaboration with Miller Puckette, who was largely responsible for the creation of the computer part. In our extensive and careful rehearsals, much of our focus was on my interaction with the computer. When the computer failed to follow accurately, we carefully monitored its 'mis-hearings'. We realised, among other things, that the subtleties of an individual's sound and style have significant effects on the reliability of score-following. My *fortissimo* low notes, for example, in which I frequently bring out higher partials to strengthen the sound, were different from those on which the follower had been 'trained', and the computer often thought I was playing a higher pitch than I was. In rehearsal, I learned that I had to alter my tone (and thus my way of playing) in order to cue my invisible partner more effectively. This is an example of the way in which 'interactive' music, though more like chamber music than fixed accompaniment, is still largely one-sided: the performer must adjust to the computer rather than the other way around. This is quite different from the widely held belief that with score-following systems, the performer simply plays the score and the computer does all the 'interacting'.

When score following doesn't work, the consequences can be drastic; the subtleties of performing effectively with pitch-based score followers are such that performers are sometimes unable to use them effectively, particularly when rehearsal time is limited. This may well explain the surprising trend that, as the systems for interactive music have improved, many composers have turned back toward fixed accompaniment. This is unfortunate: interactivity tailored creatively to the needs of a piece provides valuable models of chamber music. The composer must recognise when the technology is helping the cause, and when it is hindering it. Cort Lippe's *Music for Flute and Computer* (1994) initially used a 'fully automated' system of pitch-based score following to synchronise the computer with the flautist. However, due to the vagaries of pitch following, a human operator was needed to oversee the score follower (and correct it when necessary). In my early performances of the piece, I always worried about the follower (especially after one 'overseer' panicked and cued the computer far ahead of me during a performance!). In recent years, Lippe has encouraged performers not to rely upon the score follower, but instead to have an assistant click through the major cues of the piece. This still allows for moment-to-moment score following and changes of processing and computer response within each section, but assures that the computer will not get lost, given appropriate rehearsal by the flautist and the computer operator. Recent performances with a trusted technical assistant following the score and the composer at the mixing board have been the most successful and rewarding I have given. Lippe has wisely recognised where score following was a useful feature, and where it raised a barrier between the performer and the work.

3.2.4. Following freely

It has been observed that 'true interactivity must involve mutual influence, and cannot be all deterministically programmed' (Dobrian 2002: 32). Traditional score following is primarily a reactive mechanism, though it may serve the cause of interactivity. Barry Moon's *Interact I* (1996–1997) crosses the boundary

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into true interactivity at all levels. The patch that runs the piece gives the performer influence, but not full control, over both small- and large-scale aspects of the composition using a technique Moon calls open form score following. According to the composer,

> The indeterminacy of pitch tracking is due to many variables, not only in the algorithm itself, but in the input signal strength and quality. The indeterminacy of human performance, on the other hand, is often criticised, because score following algorithms demand consistency. This is a fundamental contradiction of a so-called 'interactive' music, and is the main reason for developing an environment in which indeterminateness of human input becomes a positive, rather than a negative, aspect of score following. (Moon and Lawter 1998: 21)

Like traditional scores, most score followers assume a linear progression from A to Z, with a fixed relationship between instrument and the computer. Moon devised a compositional approach that doesn't require this linearity, and thus avoids the perils of a score follower that gets lost. This results in an exciting model of interaction using score following. In Moon's piece, the follower's 'mistakes' (or even the performer's) are an integral part of the computer's interaction. *Interact I* has room for spontaneity, even improvisation, within the confines of a completely noted score and a highly determinate set of response strategies from the computer. The performer's creativity is engaged as she navigates the various materials of the score in response to the moment of performance.

A significant opportunity afforded by open form score following is the use of extended techniques. These sounds (particularly multiphonics) are often unstable and difficult to identify as specific tones; hence they are rarely used in pieces which rely on pitch- based score following. Moon's strategy allows such sounds to be fully integrated into the work. The extension of flute timbres creates a middle ground between the flautist's sound and the computer's, in which the performer can subtly and flexibly adjust her playing to the computer's processing and synthesis. By welcoming the full range of the performer's expressive abilities, Moon does much to heal the schism of electroacoustic performance. The interactive loop is complete: computer and flautist listen to each other and make significant decisions based on one another's sounds.

An unusual and dense score such as *Interact I* might initially alienate some players. Fortunately, even before he began writing the score, Moon was in close contact with me regarding the piece, and we agreed upon many aesthetic goals in advance. Our working methods helped us as well: Moon studied recordings of my performances and regularly consulted me about various aspects of flute technique (and saved me much preparation time by providing comprehensive fingerings for the many multiphonics in the score, indexed to my recommended sources). I spent months practising the flute part before 'meeting' my electronic partner; likewise, Moon 'rehearsed' and adjusted the patch with recordings I had made, before I ever played with it. By focusing our rehearsals on playing the piece rather than tinkering with the patch, we were able to experiment with the shifting boundaries of control and collaboration between myself and the computer. This was musically satisfying, and highly instructive. I felt that my input, and our experiences rehearsing and performing the work, had a significant impact as Moon subsequently revised and refined the patch.

3.2.5. Joint improvisation

There is a vibrant tradition of improvisation involving traditional instruments and live electronics, typically various types of signal processing devices. Processing strategies may also be programmed into a computer system, and performed by computer operators responding to musicians' actions in performance. This creates a new model of joint improvisation, in which traditional roles are blurred, and the gaps between composer, technologist and performer can be bridged.

It is also possible, as with score-following techniques, to automate the computer's actions and make the machine itself an active collaborator in the performance. In *Retake* (2001) by Andrew May and myself, several algorithmic 'performers' respond to data from analysis of the flautist's sound. Their modes of listening and behaviour are correlated to a fixed 'score', a musical trajectory embodied in a nine-minute recording of an improvisation of mine. This is the 'spine' of the work, which the performer can traverse freely using a continuous control pedal to control the form of the piece. The algorithmic 'performers' are programmed with a wide variety of timbres and behaviours: organ-like sounds that ghost harmonics of the input sounds, imitative 'flute players' who echo the notes they hear, percussion sounds that build a 'groove' based on the tendencies of input duration, and 'creative' algorithmic flute players and flute choruses that create their own patterns, reflecting shapes and tendencies in the input stream. While a textual score and the experiences of rehearsal make the terms of this piece clear to the performer, most of the electronic elements of *Retake* are fully autonomous. They listen to the performer's improvisations and their own, and make new decisions in each performance. Like an ensemble of human improvisers, these artificial personae inform my decisions and contribute to the form of the piece.

The 'improvisers' in *Retake* are not surrogates for human performers. As in Moon's *Interact I*, the behaviours of the computer are vastly unlike those of humans. The most subordinate of the 'players' in

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Retake are much more accurate, immediate and self-denying than any human improviser I have known. In contrast, the 'renegade' players are less concerned with issues of imitation, correlation and 'blend' than most human players: when they strike out on their own, it is with inhuman confidence and often alien gestures, which feed my inventions in powerful ways.

While May and I framed the concept and goals of the piece together, he constructed and tested the electronic part largely without my input. During our first rehearsal of the piece, he was surprised by what he heard. Unbeknownst to me, he had imagined a much more melodic manner of improvisation, whereas I found the environment ideally suited to timbral explorations. In subsequent rehearsals, we made mutual accommodations: I learned to give the computer enough pitches and rhythms for it to 'use' without sacrificing my experiments with timbrally driven musical phrases. After his initial shock, May saw this as a valuable benefit of our collaboration: by working with another improviser, he heard a quite different and deeply satisfying side of the environment he had created.

4. BUILDING BRIDGES

In the pieces discussed above, collaboration was crucial to their success. Though each project involved the invention and integration of new technologies, technology was only one element. The solutions to the various issues of performance were largely the results of shared intelligence and imagination, not of technical innovation. While many composers and technologists expect to find answers in new software and hardware, technology alone will never bridge the gap between composers, performers and machines. I hope researchers will continue to devise new environments and methods of interaction. However, much of the schism that holds performers at bay may be repaired by simpler means: dialogue between composers and performers, education of performers in working with technology, and comprehension of performer's needs and expectations among composers.

When performers are fully engaged in the process of creating electroacoustic music, their contributions can be of great value. Composers acknowledge this, and often ask me what I most want from music technology. I personally prefer the musical opportunities provided by interactive systems, and hope that composers will continue to explore these directions. I relish working with interactive partners that open new musical territory no human could provide. I want the machine to respond to me and challenge me in ways I could not have imagined, and to nourish my creative expression in performance.

Performers are the most powerful advocates for composers and their music. As composers embrace the creative contributions of performers, new modes of collaboration develop that substantially benefit the art of electronic music. Collaborations with performers open new realms of possibility in terms of form, notation, interaction and improvisation. Instrumentalists who enjoy extending their abilities should embrace these experiments, as should composers. I hope that computer musicians will continue to develop systems that leave room for the creativity of human performers, and that the culture of computer music will turn from the studio toward the stage.

SELECTED DISCOGRAPHY OF WORKS CITED

Zack Browning, *Network Slammer* (Camilla Hoitenga, flute), *Banjaxed*. Capstone, 2001.

Eric Chasalow, *Over the Edge* (Patricia Spencer, flute), *Works of Eric Chasalow*. New World, 1993.

Mario Davidovsky, *Synchronisms No. 1* (Harvey Sollberger, flute), *Three Synchronisms for Instruments and Electronic Sounds*. CRI, 1966.

Cort Lippe, *Music for Flute and Computer* (Elizabeth McNutt, flute), *pipe wrench: flute and computer*. Electronic Music Foundation Media, 2000. mp3 excerpt: www.emfmedia.org/catalog/em125/index.html

Philippe Manoury, *Jupiter* (Elizabeth McNutt, flute), *pipe wrench: flute and computer*. Electronic Music Foundation Media, 2000.

Andrew May, *The Twittering Machine* (Elizabeth McNutt, flute), *pipe wrench: flute and computer*. Electronic Music Foundation Media, 2000. mp3 excerpt: www.emfmedia.org/catalog/em125/index.html

Andrew May and Elizabeth McNutt, *Retake* (Elizabeth McNutt, flute). mp3: imig.colorado.edu/~may/retake.mp3

Barry Moon, *Interact I* (Elizabeth McNutt, flute), *pipe wrench: flute and computer*. Electronic Music Foundation Media, 2000. mp3 excerpt: www.emfmedia.org/catalog/em125/index.html

Kaija Saariaho, *NoaNoa* (Camilla Hoitenga, flute), *Electro-Acoustic Music III*. Neuma, 1994.

REFERENCES

Belkin, A. 1991. Who's playing? The computer's role in music performance. *Proc. of the Int. Computer Music Conf. (ICMC)*, pp. 131–4.

Chadabe, J. 1997. *Electric Sound: The Past and Promise of Electronic Music*. Upper Saddle River, NJ: Prentice-Hall.

Dobrian, C. 2001. Aesthetic considerations in the use of 'virtual' music instruments. *Journal SEAMUS* **16**(2), Fall/Winter: 28–33.

Emmerson, S. 1991. Computers and live electronic music: some solutions, many problems. *Proc. ICMC*, pp. 135–8.

Ford, A. 1993. *Composer to Composer: Conversations about Contemporary Music.* London: Quartet Books Ltd.

Goebel, J. 1996. Freedom and precision of control, *Computer Music Journal* **20**(1), Spring: 46–8.

Heritage, A. P. 1994. Works for flute and live electronics. *Flutist Quarterly* (Spring): 53–6.

Horenstein, S. 1995. Interactive works: new problems and potentials. *Proc. ICMC*, pp. 164–6.

La Berge, A. 1994. Don't be afraid of interaction: an introduction to interactive flute and computer music. *Flutist Quarterly* (Spring): 44–6.

Lippe, C. 1996a. A look at performer/machine interaction using real-time systems. *Proc. ICMC*, pp. 116–17.

Lippe, C. 1996b. Real-time interactive digital signal processing: a view of computer music. *Computer Music Journal* **20**(4), Winter: 21–4.

McNutt, E. 2000. *Pipe Wrench*. University of California: DMA Dissertation.

McNutt, E. 2003. The switched-on flute: performing with amplification. *Flutist Quarterly* (Spring): 24–6.

Moon, B. 1997. Score following and real-time signal processing strategies in open-form compositions. *USA/Japan InterCollege Computer Music Festival Proc.*, pp. 11–19.

Moon, B., and Lawter, J. 1998. Score following in open form compositions. *Proc. ICMC*, pp. 21–4.

Morrill, D. 1989. Loudspeakers and performers: some problems and proposals. In C. Roads (ed.) *Music and Machine*, pp. 95–9. Cambridge, MA: MIT Press.

Puckette, M., and Lippe, C. 1992. Score following in practice. *Proc. ICMC*, pp. 182–5.

Puckette, M., and Settel, Z. 1993. Nonobvious roles for electronics in performance enhancement. *Proc. ICMC*, pp. 134–7.

Risset, J.-C., and Van Duyne, S. 1996. Real-time performance interaction with a computer-controlled acoustic piano. *Computer Music Journal* **20**(1), Spring: 62–75.

Rowe, R. 1993. *Interactive Music Systems: Machine Listening and Composing.* Cambridge, MA: MIT Press.