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Computers and Live Performance: Interactive, or Interference?

ABSTRACT

Computers are becoming increasingly common in live musical performance, bringing a new set of considerations and challenges to the forefront. Nonetheless, computers also allow for a new kind of interactivity between performer and technology in the blossoming field of electroacoustic music. In this struggle between the compromises and the rewards of interactive composition, composers new to the genre are often left to repeat the struggles of others. Scholarship on this subject tends to be very specialized, focusing upon a particular type of interaction, or upon a certain technical approach or software application, and is therefore of little use in dealing with the large-scale issues of composing interactive electroacoustic music. This article is intended to serve as a starting point for discussion and consideration of some of the fundamental concepts and problems in interactive electroacoustic music, and to initiate a dialogue on methods and means of achieving interactive musical expression. Although a number of the ideas, methods, and practices described herein may appear simple and fundamental, I have discovered through experience in composing interactive music that it is useful to maintain these fundamental guides.

Introduction

Throughout human history, artists have sought to utilize contemporary and current technologies in their works. Artists innately recognize the similarities between art and technology as extensions of the human existence: both are fueled by imagination and bounded by practicality. Within music, it is an elementary exercise to review history and see the effect of technological innovation upon the practice of the art. For instance, the development of the pianoforte at the turn of the 18th century led to significant stylistic changes in composition of keyboard music. And, until Adolph Sax unveiled his new creation in 1841, there was no music for saxophone. The saxophone has now become a valuable part of the composers' palette and is particularly prominent in contemporary music, be it music for the concert hall, jazz, or other styles.

At present, computer technology is becoming intertwined within all aspects of society, and it is only natural that contemporary composers and artists are exploring the new possibilities. Advances in

computers are occurring so quickly that it is difficult to comprehend the scope and significance of the changes that are taking place. Only twenty-five years ago, the idea of a "personal computer" was in its infancy, and most computers in use at the time filled entire rooms. Today, many people rely upon portable computers for their daily activities, some to the point of dependency. Such a shift in the relationship between man and technology not only impacts our cultural zeitgeist, but leads to new artistic possibilities and ideas.

There is an interesting paradox about the cutting edge: that which is new and revolutionary in one period, and the people who single-mindedly carry its banner, often appear dated and frozen in time in the retrospective of history. Lasting trends often do emerge from the avant-garde, but in many cases the forerunners become the footnotes to those who follow as a result of the forerunners' myopic focus on the technique rather than the art.

I have discovered in perusals of library shelves and scholarly journals that writings on music technology often become hopelessly outdated from a

practical standpoint. The cutting edge becomes blunt history, and does so very quickly. It is a somber lesson in both biological and ideological mortality, that our diligent work today may barely raise eyebrows in the not-so-distant future.

Thus, it is important, for our historical record, that those of us working in electroacoustic music today to capture this moment in time: how we work, how we think, and how we have arrived at where we are. Furthermore, it is vital for us as composers to strive for the humanity of expression in our music so as to imbue our work with a timeless human quality.

Interactive vs. Interference

Interactive

This article will discuss one specific aspect of electroacoustic music technology: use of computers with live performers in an interactive concert setting. It is necessary to establish a working definition of the word “interactive”, and consequently the types of works under consideration, before proceeding with the initial discussion. The definition I will use is one of many possible definitions, and is not intended as a definitive statement as to codification of the genre. Rather, my definition will simply restrict the scope of this article to a manageable and cohesive unit.

It is useful to consider other definitions of interactivity in music. Guy Garnett states:

Interaction has two aspects: either the performer's actions affect the computer's output, or the computer's actions affect the performer's output. (Garnett, 2001)

This definition is elegant in its simplicity, yet it lacks specificity. Cort Lippe offers another perspective:

Fortunately, a composer can assign a variety of roles to a computer in an interactive music environment. The computer can be given the role of instrument, performer, conductor, and/or composer. These roles can exist simultaneously and/or change continually, and it is not necessary to conceive of this continuum horizontally. (Lippe, 2002)

Mr. Lippe goes on to hedge his bets, however, wisely suggesting a few sentences later that “we are probably only at the beginnings of a discussion of human/machine relationships, which I suspect will continue to develop over many years.” (Lippe, 2002)

The definitions offered by Dr. Garnett and Mr. Lippe are but two of many variations that have been proposed in recent years. I suspect that in time that the quest for this particular definition will be supplanted or abandoned. Nonetheless, for this moment a working definition will aid in analysis and discussion.

For the purposes of this article, “interactive” will refer to works in which a computer functions as a partner in performance with the musician(s) involved in the work, in a role requiring the data manipulation or signal processing capability of a computer. Thus, works involving computers as a performance instrument, or compositions with computers providing signal processing, manipulation of data from alternative control devices, algorithmic feedback to the performer(s), and other similar roles in which a computer is indispensable will fall under this definition. Works that utilize a computer merely as a means of playback for pre-recorded sound, with or without live performer(s), will not receive any special mention or attention, since in those instances the role of the computer could also be filled by a compact disc player or other playback device. Nonetheless, there will be some common considerations between the playback-only works and those deemed to be interactive, and these similarities will be addressed as they arise.

Interference

Subsequently, a definition for “interference” must be established. In the context of this article, interference refers to the unique considerations and challenges presented in the creation and performance of interactive music. Certainly, using this definition, the notion of interference could be similarly defined for other kinds of musical performance, but such a comparison or extension is not the intent of this article.

In many cases this interference is unavoidable, and directly emerges from necessary components of the creation of the work or in the preparation of the performance. With interference as a known quantity, one that is anticipated and regulated, the composer and performer can strive to lessen the impact and hindrance involved.

The importance of reducing interference is obvious from a logistical standpoint, because care must be taken to ensure that the obstructions do not prevent the performance of the piece. But more importantly, this same interference can interrupt or garble the communication between composer, performer, and listener, and therefore strip the humanity from the art.

Organization

This article is constructed in three primary sections: performance, compositional process, and the development of the composer. Thus, the general trajectory of examination will be from the stage and moving out; this same orientation will be used for focused discussion within each of the three main sections.

As a matter of convenience, the word “performer” will be used exclusively in the singular, though certainly there is no unique restriction as to the number of performers who may participate in an interactive work.

Performance

In this section the discussion will be centered on the factors that arise before and during performance, particularly the considerations of the performer and the logistics of performance.

Performer freedom

The interpretive and musical freedom available to performers of interactive compositions marks a significant reduction of interference from prior means of integrating technology into live performance. Interactive works often free the performer from a number of problems that arise in performance of works involving prerecorded sound.

Rather than being required to follow a stopwatch, read along with a graphic score, or memorize an entire pre-recorded accompaniment, in an interactive work the performer is free to proceed through the composition with no greater limitations than those presented by purely acoustic works (tempo, phrasing, form, etc.). This freedom allows the performer to inject more expression and vitality into the performance.

Computer autonomy: Performance instrument, score-following, or computer operator?

Depending upon the type of interactive work created, it is possible for the computer itself to have varying degrees of autonomy during the performance. There are three general distinctions that can be drawn.

The performer can directly manipulate a computer as part of the performance, in essence playing the computer like a solo instrument. This manner of performance may or may not include improvisation. Clearly, performance on such an

instrument assumes a certain amount of skill of the performer, a consideration that must be taken as the work is created. Often, in works such as these, the composer is also the performer, performing in public what has likely been an ongoing ritual of rehearsal and refinement. The voyeuristic intimacy of these works often provides an engaging performance. There is little that is more human than the things that people do when they are by themselves.

Another possibility is that the computer receives input from an instrumental performer, either through audio analysis or through a control mechanism, which subsequently algorithmically manipulates the activity of the computer without any other means of control. This process is commonly known as score-following. In general, this makes for an unpredictable performance environment, since introduction of erroneous data into the algorithm can lead to unexpected and possibly undesirable results.

For instance, if the computer is tracking pitch output from the performer, and has an instruction to initiate a certain type of audio processing once the performer plays a B-flat, what happens if the performer makes an error and plays a B-natural? Unless there has been an error-correcting mechanism built into the algorithm, the will likely remain errors in the computer output. Although research continues in score-following, many people who work with interactive media often designate that there is constant human supervision over the computer to intervene in case of error.

This scenario leads us to the third option: there is a participant in the performance who is responsible for the output of the computer and ensuring that the computer does the right things at the right times. This type of arrangement occurs when there is a computer interacting with a number of performers who do not have responsibility for the computer. In this instance, the computer operator becomes another performer, and is often treated as such, with a particular set of instructions in the score. This means of performance is becoming increasingly prevalent.

Monitoring and feedback

This is a simple logistical issue, but one that must be managed very carefully. In most musical works, regardless of genre, the performer must also be a focused listener during performance. The auditory feedback received by a performer often shapes the ongoing musical performance.

With interactive works in which a computer or other technical device produces audio to which a performer must respond, a means of enabling the

performer to hear the entirety of the musical output is necessary. Sometimes the ambience of the performance space is sufficient, and sometimes it is not. In the latter instances, a performer must be provided with some sort of on-stage monitoring system, usually either speakers or headphones.

It must also be noted that when a microphone is used to reinforce the sound of the performer or deliver the sound into a computer or processing device, care must be taken to minimize the amount that the monitoring system pollutes the input to the microphone. Otherwise, the figurative feedback to the performer may become literal audio feedback, a situation that is not always desirable.

Logistics of setup

This is a significant area of consideration, one that often encompasses much more of the performance space than just the stage, thus heightening the possibility for a variety of types of interference. There are often a number of interrelated systems that must function together: sound reinforcement/monitoring, communication and audio between the performer and the computer, and even the simple matter of getting all of the necessary cables run throughout the space and securing them in a manner that does not leave them vulnerable nor endanger the audience or performer.

Clearly, the potential for interference arising from the setup is tremendous and can affect a number of different facets of the presentation of the work. It is often very important to keep this particular aspect of interactive works as transparent as possible to the audience, as the more attention that is paid to the technology, the less that is paid to the music. Depending upon the nature of the work and the intent of the composer and performer, there may be a degree to which awareness of the technology itself is part of the performance.

Regardless of the exact nature of this balance, awareness and control over it allows the composer and performer better opportunity to convey the intent of the composition with the smallest amount of interference.

Available equipment

Depending upon the resources available at a particular performance space, the composer and performer may need to make allowances for desired equipment that may not be available.

For instance, in electroacoustic music, works are created that utilize a variety of possible ways of

setting up the sound reinforcement system. Most obvious is the number of speakers and where these speakers are located in the performance space.

For instance, there is a growing trend in electroacoustic music toward use of arrays of eight or more speakers, with each speaker dedicated to a particular discrete audio signal. However, not all facilities are able to offer such an arrangement, for a wide variety of reasons. Interactive composers that utilize such a setup must have means of compensating for the difference, or lose the performance opportunity.

There are a number of other considerations: the way the speakers interact with the space, the type of mixing console available, the kinds and number of microphones available and how the microphones are connected to the entire system, and so on. Fortunately, interactive music often provides flexibility that aids in managing these kinds of interference.

Potential for disaster

The most destructive interference occurs when there is a breakdown in part of the system, preventing the performance of the composition. There are numerous possible causes for such situations, ranging from the small and elusive issue of a defective cable, to the large and obvious problem of a computer crash or malfunctioning software.

Clearly, prevention is the best medicine, and the composer must shoulder responsibility for ensuring that all technical matters are properly overseen. It is crucial to have redundant backups of data, software, and programming on hand.

Rehearsal limitations

One particularly difficult issue for composers of interactive works is rehearsing the work, as often the system on which the work will be performed is not set up until immediately prior to the performance, allowing little rehearsal time on the actual system that will be used for performance. This problem may be further compounded by the complexity of the performance requirements. As with any performance situation, restrictions in potential for rehearsal place an extra burden upon the performer, particularly when the musical interaction involves technology and is therefore non-traditional.

Again, the unique flexibility provided by working in the interactive medium often allows for rapid adjustment to these sorts of circumstances. Ideally, rehearsal time is used merely to test levels and connections, as all other aspects of the composition are ready to go.

Compositional Process

The act of composing a work for interactive media presents a challenging set of problems. Some of these problems have parallels with acoustic composition, and some of the problems are particular to the genre.

Balance

Balance in a composition can refer to a variety of structures. Management of balance is a trait common to all musical compositions, and not unique to a particular genre.

In interactive electroacoustic compositions, careful control of balance between the live performer and the interactive component is a crucial part of the compositional process. Composers are well advised to consider whether the interactive element functions as an equal partner with or as accompaniment to the live performance aspect of the work.

This consideration returns us to the very definitions of interactivity that were discussed earlier in this article, each of which addressed the function and role of live performers and computers within a composition. In a way, this definition is re-established with each new composition, taking on a local meaning that extends, modifies, or reinforces these pre-existing ideas.

Nature of interaction

There is a broad variety of ways in which an interactive element may be incorporated into a musical work, as was discussed earlier in this article under the heading *Computer autonomy: Performance instrument, score-following, or computer operator?* and also in the paragraph preceding this one which cites a return to contemplation of the very definition of interactivity.

This consideration is especially important within the compositional process, as each solution provides a unique set of advantages and limitations. Depending upon the work processes of individual composers, the amount of pre-planning that can go into composition can vary greatly. In my observation, composers who engage in extensive pre-planning when composing an interactive composition are rewarded with an easing of interference at many subsequent steps in the process. Choosing the nature of the interaction is a crucial early step of pre-planning.

Once this decision of how to incorporate the interactive element is made, a number of compositional pathways are opened or closed as a

result, as happens with any large-scale decision regarding a musical composition.

Notation and score

One of the trickiest problems to solve in interactive composition is how, or even if, to notate the interactive element on a written score. Too much or too little information may create problems in performance of the work.

Often, musical structures that arise from interactive and electroacoustic means cannot be adequately communicated through traditional music notation. This leaves the composer with the task of creating original notation for these elements. The burden is then placed upon the performer to learn and interpret the graphic score, a task that may or may not be necessary in the performance of an interactive composition. This burden may very well translate into interference if the intended communication is not completely clear.

One solution that is often effective is to construct two scores: a performance score, which gives the performer only the information necessary to perform the work, and a master score, which unifies and catalogs all information utilized in the work. The master score can be quite useful to the composer throughout the compositional process as well. This approach essentially follows the model used in music for acoustic ensembles, with a full score and individual parts prepared for the performers, and as such is a tried-and-true method that presents a known set of limitations and problems.

This issue of imprecision and uncertainty in notation is a direct reflection of the relative youth of the genre. Over time, a more standardized practice of notation will likely develop from the successes and failures of current and past efforts.

The Composer

Finally, I will focus my attention upon the composer, and how one learns to compose interactive music. Again, there are numerous angles and possibilities to consider, as well as tradeoffs that result from yet new levels of interference.

Technical study at expense of musical study

Although the notion of “multi-tasking” has entered our collective lexicon, we can only do one thing at a time. This is an important matter to consider when a composer undertakes study of the techniques involved

in electroacoustic music, particularly the unique demands of interactive music. There is no escaping the trade-offs.

Time spent by a composer learning software, designing interactive systems, creating computer programs, and performing other tasks involved in creation of interactive music is time that cannot be spent studying orchestration texts, practicing counterpoint, or engaging in score study. The composer must remain focused upon the study that will best enhance the kind of work that the composer wishes to create, and to do that the composer must first identify the nature of the musical goals.

Of course, there is no single correct choice to be made, and no right or wrong answers. So long as composers maintain self-awareness and strive to focus their energies in learning techniques, processes, and literature that best serve the kinds of musical expression they seek, the results will be evident in the music that results.

Performance opportunities

An important part of compositional development - a part for which there is no substitute - is the feedback and experience that results from performances of one's works. The technical demands of an interactive composition can interfere with opportunities for performance in a variety of ways that were discussed earlier in this article. Composers who remain aware of this fact, and are vigilant in overcoming it, will provide themselves with more performance opportunities and therefore more potential for development.

As has been discussed throughout this article, numerous kinds of interference can exist that will serve to inhibit performance opportunities. Awareness of the potential for difficulty, and an energetic approach in negating the problems as they arise, will allow the composer of interactive music a greater number of performance experiences to learn from.

Ultimately, the best strategies are the same as those used by any composer seeking performances: be a zealous advocate for one's music, seek out performers who perform well in a given genre of music, and find ways to create opportunities.

Listening opportunities

It naturally follows that if performance opportunities are limited, then so are occasions when a composer can hear performances of interactive works. And, when the works involve technologies that are not easily translated to the recorded medium, there is

information that is lost. Also, for works involving more than two speakers, there are compromises made when listening outside of the concert hall in what are typically stereo listening environments.

Nonetheless, imperfect listening is better than no listening, which is another direct parallel with other kinds of musical composition, regardless of genre.

How to learn? Who to study with?

As with any genre of music composition, those interested in learning the practice of interactive composition are well served by selecting teachers with that specialized expertise. It should not be assumed that this knowledge and experience is omnipresent; it is the responsibility of the student to seek models and inspirations.

Again, the universal rules apply: through listening and score study, it is very useful to identify composers who create similar kinds of music, and examine how they have managed similar concerns. Also, as a composer begins to develop an area of interest or specialty, it is crucial for the composer to explore the existing scholarship on the topic. As stated earlier in this article, there is a large body of writing and study that exists with respect to interactive music, and this scholarship is often specialized and of considerable utility.

Conclusion

When all factors are considered, the issues of interference that confront interactive composers are not quantitatively different than those faced by other composers. Diligent and dedicated study, attention to detail as well as to large-scale issues, and commitment to creating music that is individually unique are all the characteristics required by a composer to be successful in composing interactive electroacoustic music.

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