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# Loudspeakers and Performers: Some Problems and Proposals

Perhaps some confusion has resulted in recent years from the continued use of the words *computer music* and *electronic music* to describe the medium in which many of us work. Indeed, Max Mathews's title for his paper "The Computer as a Musical Instrument" (1963) may have seemed appropriate at the time but suggested that our new music should be defined according to the means of signal generation rather than according to the transducer, which has always been the loudspeaker. The term *synthesizer* does not help us much either. In 1981 the differences among devices that generate sources for loudspeakers are growing less obvious and less important. Soon we may realize that we are working in a loudspeaker medium, regardless of how the signals for the loudspeakers are generated. Musicians working in real time and in performance using computers, synthesizers, and circuits might rather think of themselves as loudspeaker performers. During the 1970s we witnessed a revolution in the technology of loudspeaker music. Thousands of pieces have been composed for tape alone and for tape and performers. Those of us who were working 10 years ago have seen an incredible number of musicians and researchers begin to work in the tape medium.

What problems are encountered with use of loudspeakers in musical performance? The problems I will discuss here are nontechnical and are limited to the use of loudspeakers where performers do not control the sound-generating equipment directly. Many of the ideas expressed in this article have

grown out of my experience in performance over the past five years, first with a purely quad-tape program called *Rotations*, which I began doing in 1975, and later with a performer-tape series of programs called *Singing Circuits*. My awareness of the problems of using loudspeakers in performance began after 1978 when the newness of the "computer music" medium had worn off somewhat and I had repeated the *Singing Circuits* program many times. During the early part of 1975 I decided to spend part of my time performing my own "computer" music and that of some other composers. I felt it was important to see that this music went forward with some care and direction, and I was already very unhappy with the "electronic" music concerts that I had heard. Too often, the equipment for these programs was inadequate or the programs poorly constructed, and both music and composers suffered. I decided to organize my own equipment for concerts and to put together a basic program of music whose organization could begin to compete with more conventional programs. Whenever possible I would travel to a concert with my own equipment even if only one of my pieces was to be performed.

By definition, *loudspeaker composers* take on much of the performer's role because the music is fixed in some important ways. Because at least part of the piece is often stored on tape, the composer must find a way to add what is normally the performer's information. This task can slow down the composing process. The loudspeaker instrument through which the music is realized for an audience remains somewhat passive unless the composer can be actively involved with the equipment during each performance. We need to exert some control over the performance of our tapes, much as performers control the output of their instruments.

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The next five years will be critical ones for loudspeaker composers. Few resources and little money are available, our medium is no longer new, and we will need to demonstrate for our colleagues some good results if we hope to have their continued support. While the cost of hardware is declining rapidly, the overall cost of maintaining good studios will never be cheap.

### **Social Factors and Performance Spaces**

Some obvious improvements have been made in loudspeaker design over the past 10–20 years. The commercial music industry has contributed to development of recording techniques, and our understanding of equalization and concert hall acoustics has grown. The proliferation of loudspeaker uses is staggering. It has been used to broadcast antisocial ideas, advertising, social anger and frustration, pleasure, and even social healing. The loudspeaker invades our privacy constantly. It can be hidden, purchased at very low cost, and can have enough acoustic power to kill a human being. The loudspeaker may also represent the end of music that is often described as heroic. All of these facts about loudspeakers relate to the social implications of their use—implications that have a direct bearing on how composers use loudspeakers in performance.

Many musicians in the 1960s looked forward eagerly to the construction of new performance spaces. *New music*, as most widely defined, needed new spaces desperately. This expectation, for the most part, was never met. There are very few good spaces in Europe and the United States for the performance of new music. We may even be stepping backward in this respect; some new university music buildings have worse halls than were formerly available. What is available to musicians using loudspeakers are conventional spaces, usually proscenium stages, meant for frontal and conventional heroic performances. We cannot ignore these spaces if we expect to perform often, even though the loudspeaker is at a disadvantage in them. Problems regarding performance spaces are also faced by musicians performing much of the historical repertoire.

### **The Question of Balance**

I can vividly remember doing a concert of computer music at Colgate several years ago that consisted of some tape pieces and some pieces for performers and tape. The program began with two beautiful tape pieces and was followed by one that called for a performer. The audience reacted quite favorably to the first two pieces, but there was a sudden and noticeable increase in interest when the performer walked onstage. This phenomenon is well understood by most of us. It raises the question of roles and balance. My own guess is that in this mixed-media situation the performer commands about 80% of the audience's attention and the loudspeaker 20%. With supreme effort, the composer might equalize these percentages somewhat, but not much. Is there any reason to disturb this natural imbalance? I am not as interested in the imbalance itself as in the danger that we will end up composing a kind of "music minus one." This danger is rather great when we compose for loudspeakers and performers, and some considerable thought is required to overcome it.

Performers often respond to poor balance by turning up the loudspeakers. At a rehearsal recently, I heard a very nice piece for tape, piano, and saxophone. The performers were frustrated with the balance between themselves and the tape and tried the ineffective solution of turning up the amplifier. Acoustic power is rarely the reason for lack of balance. We can easily identify an instrument played softly against some loud competing noises because, as listeners, we are trained to pick out performance cues. The brief but powerful cues found in the attack portion of many natural instrument tones enable us to find that sound and follow it within a complex acoustic event. This is not unlike the cocktail party effect, where we can easily follow the conversation of a single person. A possible solution to the balance problem is to lessen the acoustic power of the loudspeaker and to limit its musical activity to one voice. If, as composers, we can generate a high level of information in one voice that is a processed signal, we can begin to create on tape enough musical information to balance that supplied by live performers. Henry Brant

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points to the problem of balance in his writing about space and musical composition (1966). He suggests that loudspeakers have a concentrated and directional projection that is at odds with the diffused sounds made by live performers. Although Brant's reasons for proposing a maximum diffusion of sound are somewhat different from my own, his notion of an expanded spatial effect relates to the problems discussed here.

Perhaps we can achieve balance by measuring the musical activity of the players against that of the loudspeakers. A complex tape's texture and rhythmic activity suggest that the performer is a soloist who plays in a concerto role rather than in a more balanced musical one. We who compose in studios, hearing only the tape portion of a work for tape and performer, are probably going to err on the side of tape complexity if we are somewhat unhappy with the tape-performer balance.

## Balance and Timbre

Most tape compositions are constructed with simple timbres. Often listeners are fooled when the sounds contain some unusual elements not heard before. But, too frequently, repeated hearings reveal that there is a low level of timbral information, and the music does not wear well. Although performers are not able to modify greatly many of the parameters that control their timbres, they do produce an enormous wealth of timbre information that may unfold rather slowly. Part of my initial and continuing excitement about using computers to generate acoustic signals is their great power in the area of timbre.

With Risset, Chowning, Grey, Beauchamp, Wessel, and others, I have felt that a natural task for composers of new music using computers is the study and synthesis of natural sounds. Our collective intuition was that we needed experience in simulating natural tones in order to build a solid base for unnatural or synthetic ones that we hoped would contain a high level of musical information. At least two other ideas are related to these interests: (1) the idea of interpolating synthetic timbres and (2) confusion between real and synthetic sound

sources. My *Studies* for trumpet and computer (1975) were directed at timbral confusion and balance with a live trumpet player. In the past five years the progress made in timbre research has been significant, and there has been a high degree of interest in simulating and processing the human voice. Petersen's cross-synthesis techniques and the Bennett-Rodet CHANT voice programs at the Institut de Recherche et Coordination Acoustique/Musique have produced startling results. Compositions that feature timbres similar to those of live performers have a potential for balance that might not otherwise exist, especially if loudspeakers are placed with care. In the case of my *Studies*, I found it important to have the loudspeakers elevated to the height of the trumpet bell and to have both the loudspeakers and the player a good distance from the audience. Jean-Claude Risset's *Inharmonique* is marvelous for its balance of voice and tape, even without synthetic voice timbres in the tape part. The opening is especially interesting and is enhanced if the singer gradually walks toward center stage from a distance.

Recent timbre research has led to the study of larger questions about phrasing and other musical elements that are not contained in the single note. We are not very far along on this path, and the amount of information gained and its management pose significant problems. We know that performers demonstrate a personality or style at the level of the phrase and that this information is communicated well to audiences. If the music emanating from loudspeakers does not also communicate some higher-level information, balance will be hard to achieve. In at least one sense, our apparent need for higher-level information in sound synthesis suggests that timbre may not help much to achieve balance in the mixed, tape-performer medium and that composition may have to do this. We do not attend string quartet concerts and hear complaints that the quartets all sound alike. This is because audiences always focus on variety in compositions, even if the timbre of the four string instruments is only rich in information within well-defined limits. Very little can compensate for poor musical ideas in compositions. As composers, we need to be sure that our musical ideas are sufficient for achieving

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the tape-performer balance we desire. Even if we are sometimes discouraged about the hall, the placement of speakers, the quality of sound that each speaker imposes on all sounds passing through it, the limited dynamic range available, and a host of other limitations, we can always capture the attention of listeners by musical means. That is, we can shift listeners' focus or attention through composition. Good performers will want to contribute to our desired balance by not always being in the foreground.

## Placement of Loudspeakers

The social and performance-space problems discussed earlier convince me that we cannot expect our concerts to be successful if we use a couple of ordinary loudspeakers, even if they are perfectly adequate to fill the room with sound and are of high quality. At least for the next few years, audiences will expect something special and unusual from our concerts, something that they feel they cannot hear in their own living rooms. If we place two speakers on a stage, audiences will form preconceived notions about what they are going to hear. An entire concert heard from speakers in one location can only be dull, and it is not much work to move them. It was established more than 30 years ago that to create a good stereo image the proper angle for two speakers is 30° from center (Wallach, Newman, and Rosenzweig 1949). Musicians still make the mistake of placing two speakers at the extreme right or left sides of a stage, thereby creating an enormous separation. In a large hall it is a good idea to use two or three speakers for each side and set them at different angles to the audience.

Musicians may want to use as many speakers as they can reasonably gather together and to place them in a variety of patterns. This does not mean that all of the speakers need to be used for each piece. If we are traveling with equipment, the limitations can be quite severe. But we might accomplish a good bit with a large number of very small speakers supported by two efficient woofers that can handle the low frequencies. Since low frequencies do not localize well, two woofers may be suffi-

cient. We rarely attempt to raise speakers because this is often difficult. Yet it is often worthwhile. I constructed four 6-ft portable stands from plastic plumbing pipe for my *Rotations* loudspeakers and found that the sounds were enhanced enormously. If we are going to be limited by frontal performance situations and constrained by time and resources, we should make every effort to achieve performance depth and height. Synthesis algorithms can create the feeling of depth through control of amplitude, reverberation parameters, and equalization of high and low frequencies for distance cues.

Composers do not use odd speaker arrangements often enough. Larry Austin has a delightful piece for viola and tape in which he uses one speaker. The limited dynamic range does not seem to be a problem, and I suspect that audiences may appreciate a piece that has a small and well-focused loudspeaker sound. Perhaps we should build sound equipment systems especially to meet our own performance needs. Planning and imagination can make up for the lack of expensive equipment. If we do not have a large power requirement, we should be able to use cheaper speakers and amplifiers chosen to work within a limited frequency range. In most cases, cheaper equipment produces acceptably low distortion if it is not operated at peak levels.

## Conclusion

In this century we have expanded performance possibilities with equipment, and we have radically altered performance spaces. The elaborate sound system at Bourges (GMEBaphone) and the one designed by Varèse for the Brussels World Fair are two successful examples. Twentieth-century compositions frequently require large forces, special equipment for sound reproduction, extramusical media, and the like. While we might admire composers for daring to impose these requirements, we might sometimes question their motives for doing so. Does the spectacular requirement reflect spectacular vision or an eye for publicity? At a concert I attended recently in the Centre Georges Pompidou, a few players were surrounded by a stage full of electronic equipment. It struck me that this music will



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have to go forward with a vast amount of electronic baggage (I might add, the same set of baggage). Perhaps technology will have some dirty tricks to play on the music of our century.

We will continue to find loudspeakers a challenge to use in performance, even if the available equipment is not elaborate. We will also discover a thousand compositional ways to compensate for loudspeaker-performer imbalance. And, if we pay some attention to the performance spaces and loudspeaker placement in them, the good compositions will succeed as always.

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