Composing with multi-channel spatialisation as an aspect of synthesis.

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Abstract
Spatialisation has played an important role in much electroacoustic music. For the most part, however, it has been used to articulate or decorate existing sound structures. This paper looks at ways in which multi-channel spatialisation can become an integral part of the structure of the music, both on the small and large scale. Examples are given from the author’s works.

1. Background
Since its inception electroacoustic music has encouraged greater use of parameters which usually only played a secondary role in earlier music. Indeed, for some composers, the ability to work in more detail with parameters such as timbre and amplitude was a major attraction in developing the medium. In the early days, serial composers, for example, saw electroacoustic music as a way of enabling precise control over all aspects of the sound. In a rather different way, electroacoustic music might be seen as one way of escaping from the straitjacket of Western music’s notationally dominated emphasis on pitch and rhythm (Wishart 1985).

Timbre is a particularly clear example of how electroacoustic music has enabled composers to give structural significance to parameters often more traditionally considered as merely decorative. Timbre, no longer something relatively static, determined by the choice of instrument, becomes something that can transform dynamically creating complex interactions. Such relationships have played a major role in structuring works, sometimes playing as important a role as pitch in more traditional Western music.

Spatialisation too has taken on a more significant role in electroacoustic music. It has sometimes also been significant in acoustic music. Giovanni Gabrieli, for example, using cori spezzati in St Mark’s Venice or, more recently, the spatial distribution of instrumentalists in works such as Stockhausen’s Gruppen. In some works, for example, Verses for Ensemble by Birtwistle, spatial distribution is not purely static. Soloists move position as their role in the ensemble changes. Nonetheless, the possibilities for spatial movement in acoustic music are relatively limited by the physical positioning of the players. Electroacoustic music with loudspeakers positioned around the audience does not have the same limitations and movements that would be physically impossible in acoustic music are easily performed. Not surprisingly, composers have taken advantage of this possibility and spatial positioning has become an important element of electroacoustic music. Sophisticated algorithms for spatial movement between loudspeakers and for simulating distance and acoustic environment have been developed.

Spatial movement has, however, for the most part been separate from the main process of synthesis or processing itself. Spatial positioning has sometimes been an important aspect of the recording of initial sound material. Other than that it has mainly been something imposed on the material later, as already formed material is mixed. The sounds are created and then they are positioned, statically or dynamically, as the piece is assembled. John Chowning’s spatialisation algorithms (Dodge and Jerse 1985:249), for example, are designed to take a pre-formed sound input and move it in space. Stockhausen, in the introduction to the score of Oktophonic, describes the procedures used to move pre-recorded synthesised sounds through complex trajectories in space. Spatialisation has also played a very significant role in the performance of electroacoustic music.
Especially since much electroacoustic music has been recorded in stereo, sound diffusion of a stereo tape over multiple loudspeakers as part of the performance has had a important role in presenting the music to the audience. In addition to the spatial aspect, it has been a means of introducing an element of live performance into an otherwise pre-determined recording.

All of this has enriched the music. It has rarely, however, made spatialisation a central part of the musical structure. It has decorated or helped articulate sound structures that have been formed primarily using other parameters. Rarely has the spatial dimension played the central role that timbre has begun to take on quite frequently in electroacoustic music. In part this has been due to technological restrictions. New developments are removing these barriers. The norm for recording digital work has been the stereo DAT tape but now 8-channel (DA88 and ADAT) formats are becoming viable alternatives for distributing work so encouraging multi-channel composition. Software for creating, processing and mixing sounds (e.g. Csound, MSP, ProTools) now frequently permits work in multiple channels, and multi-channel converters enable the process to be monitored as it evolves.

In recent compositions I have begun to explore the possibility and potential for making spatial movement a more significant and integral part of the process of shaping sound rather than something added afterwards. The studios at Huddersfield now offer permanent 8 channel monitoring of sounds created either on Mac (G3) or SGI (O2) platforms with digital recording to DA88 or ADAT.

2. TIM(br)E
TIM(br)E (1996) is a work using primarily granular techniques. A major feature of this work is the way in which timbres and textures form out of, and dissolve into, a sea of grains. FOF and FOG synthesis are used to create the grains and the precise control these algorithms provide permits the formation of carefully shaped timbres as well as more complex textures. Spatialisation plays a very important role in the way that these timbres form and dissolve. It is not something added post-synthesis but plays an equal role along with other parameters such as fundamental frequency, formant frequency etc. A vocal timbre, for example, in this piece is synthesised from five synchronised grain streams. A unified timbre will be created by co-ordinating all these parameters so that the streams all have the same fundamental frequency and spatial positioning. When a timbre dissolves into a texture the parameters become free, the frequencies and spatial movements of the grains become independent. There are of course many more possibilities, it is possible to counterpoint the actions of one parameter with those of another. Spatialisation is involved fully in the structuring of the music.

3. Prism
In Prism (1998) spatialisation plays an even more crucial role in the structure. The work is for trumpet and octaphonic tape and the tape part is made exclusively from recordings of a small number of trumpet notes. On one level the work is about the progressive dissolution of the trumpet timbre into its component parts revealing hidden beauty in often unnoticed harmonics. Spatial movement play a central role in pulling apart the trumpet timbre especially in the earlier sections of the work. So central is it that if the spatial dimension were to be removed the structure would no longer meaningfully exist.

In the first section the tape repeats an eight-note trumpet chord. There are eight blocks each comprising eight chords. Each of the eight notes has been split into eight component parts (harmonics) using phase vocoding (AudioSculpt) giving a total of sixty four harmonic components for the eight note chord. At first each of eight loudspeakers contains just the harmonics for one note. Gradually, as the passage proceeds, the harmonics are permuted between the loudspeakers, resulting in an increasingly diverse spatial distribution of the harmonics. By the end, each loudspeaker comprises eight different harmonics from different notes. Overall the same sixty four harmonics are still being sounded but spatially they have become mixed. The result is extremely subtle (even with the elaborate introduction of minute temporal differences), but spatial positioning is the main structural device in the development of the section.

In the following section a single pitch (with octave transpositions) is again split into eight harmonic components. The movement is now continuous with different harmonics being panned around the eight speakers at different speeds. Each harmonic's speed is in proportion to its frequency so that high harmonics move faster than low harmonics. Again the result is subtle, a gently undulating timbral variation.
These initial sections lead later in the piece to a more drastic dissolution of the trumpet timbre in which harmonics become separated not only in space but also in time. At the end of the work harmonics from different notes are combined to produce new timbres, everything has been derived from the trumpet but the sounds are quite different.

Spatial movement also plays an important role in the live trumpet part. The player is surrounded by eight microphones each sent to a different loudspeaker and, in some sections feeding different live computer transformation processes. Overall, spatialisation is an integral part of the concept of the whole piece. Its role is at least equally important to that of any of the other parameters.

4. Future developments
Further explorations of the possibilities of spatial movement as a structural feature of composition are planned. A companion piece for Prism, Cascade, will use mainly live computer transformation of the solo trumpet. Again eight microphones surrounding the performer will feed different transformation processes and lead to different spatial distribution.

A new octophonic tape piece will investigate further the use of spatialisation in granular synthesis. This is an area in which Barry Truax has already begun to work (Truax 1999) New variations of the FOF and FOG algorithms are planned to enable spatial distribution to be not only at the level of streams but also at the level of the individual grain. Just as in TIM(br)E and Prism grain streams and harmonics moved independently in space, at times merging to form unified timbres, so it is intended to devise algorithms for controlling the spatial positioning of individual grains in relation to the stream.

5. Summary
Amongst the rich variety of new possibilities provided by computer music the possibility of the spatial dimension taking on a structural role is one that has perhaps not yet been fully realised. New technological developments now make this a much more attractive possibility for the composer and one that I, and I hope others, will continue to explore.

References
