The Composition and Performance of Spatial Music

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8.4 *Diffusion, and the legacy of Musique Concrète*

The legacy of *Musique Concrète* can still be seen in the international community of composers who create stereo electroacoustic works specifically for live diffusion to a loudspeaker orchestra. The term *acousmatic music,* meaning sound which is heard without a corresponding visible cause, is often used to describe this aesthetic. However, the exact definition of this term is disputed as it may simply refer to the means of production, i.e. music for loudspeakers alone, or to a particular style of composition [McFarlane, 2001].

Spatial diffusion was used in the very earliest performances of *Musique Concrète.* Pierre Schaeffer had introduced the idea of the movement of sound along sonic trajectories and the creation of spatial relief through the contrast of static spatial locations and dynamic sources which would be controlled manually by a performer using the *potentiomètre d'espace.* Over the next two decades two-channel stereo and magnetic tape were adopted as the medium of choice, and composers, led by Pierre Henry, began to formulate a performance practice based on the diffusion of a stereo source to a large number of loudspeakers using a special mixing desk. Unlike the multichannel approach adopted by Stockhausen and others, this loudspeaker orchestra consists of a diverse range of speakers, chosen for their specific tonal characteristics. This aesthetic focuses on the temporal, spectral and spatial development of sounds rather than the relationship between these parameters, and the diffusion process is therefore used to exaggerate the dynamic, spectral and spatial content of the musical material already present in the work. In early performances, the intervention of an engineer was already required due to the technical limitations of magnetic tape (such as tape hiss and a limited dynamic and spectral range) and in time, these technical considerations would come to include the diffusion process. The first formalized system based on this approach was the Acousmonium at the *Groupe de Recherches Musicales* (GRM), the collective founded by Schaeffer and Henry in 1958. The Acousmonium was developed by the composer and technician François Bayle, who took charge of the GRM in 1966, and the engineer Jean-Claude Lallemand [Gayou, 2007] and was conceived as a continuation of Jacque Pullin's work on the *potentiomètre d'espace*. The first concert was held in Paris in 1974 and featured a performance of Bayle's *Experience Acoustique*.

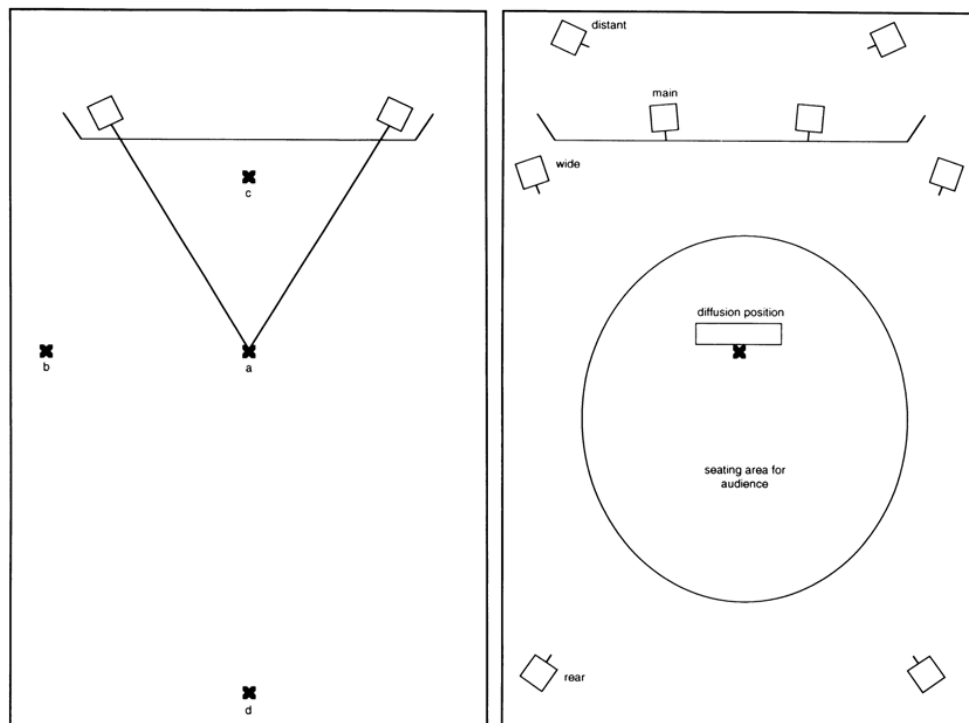Fig. 8.14 An early concert with the Acousmonium

Fig. 8.15 Standard stereo setup (left), diffusion setup (right)

The approach developed by Henry and Bayle was adopted by other composers and institutions such as the *Groupe de Musique de Bourges* in Belgium. The Birmingham ElectroAcoustic Sound Theatre (BEAST) at the University of Birmingham is another important centre for research in this area. Although these

groups differ in terms of the precise technical setup and loudspeaker layout, they use many similar working methods and techniques. The source material is generally a stereo CD, and is often the commercial CD release of the piece. The stereo track is routed to a special mixing desk which allows the diffusion engineer to control the routing of the stereo track to different loudspeaker pairs. Often this will be a commercial desk, reverse-engineered so that it takes a stereo signal as the input, and each individual fader channel feeds a different loudspeaker pair.

The diffusion process is as much concerned with adapting the material for the particular performance space as it is with the spatial articulation of the material. For this reason, the loudspeaker pairs are often specifically arranged in an attempt to preserve the stereophonic image for as much of the audience as possible. Jonty Harrison, who works at the University of Birmingham, illustrates this approach using the two layouts shown in Figure 8.15 [Harrison, 1999]. In a normal two-channel stereo system, only listeners seated in the sweet spot (point (a) in Figure 8.15 (left)) will perceive the stereo image correctly. At point (b), the stereo image will collapse to the left speaker due to the precedence effect, while at point (c) listeners will experience a significant hole-in-the-middle effect due to the wide loudspeaker angle at this location close to the loudspeakers. Meanwhile a distant listener at point (d) will perceive a drastically narrowed image. Diffusion systems attempt to overcome these problems through the introduction of additional pairs of loudspeakers and a typical layout is shown in Figure 8.15 (right). In this arrangement, the main stereo pair has been narrowed to reduce the hole-in-middle effect for listeners close to the stage. This is supported by another pair of similar loudspeakers positioned at a wider angle which can be used to increase the image width as necessary. Additional distance effects are supported through the use of a distant loudspeaker pair, positioned at the back of the stage and angled across the stage. Finally, a rear pair is added so that the stereo image can be extended out from the stage and around the audience. This group of loudspeakers is described as the "main eight" in the BEAST system and this layout is described by Harrison as the absolute minimum arrangement required for the playback of stereo tapes [Harrison, 1999]. More loudspeakers are often added to the main eight to further extend the capabilities of the system. For example, additional side-fill loudspeakers are often added to facilitate the creation of smoother movements from front to back. Various elaborate systems have been developed, such as the

BEAST system in Birmingham (shown in Figure 8.16) and the Acousmonium at GRM.
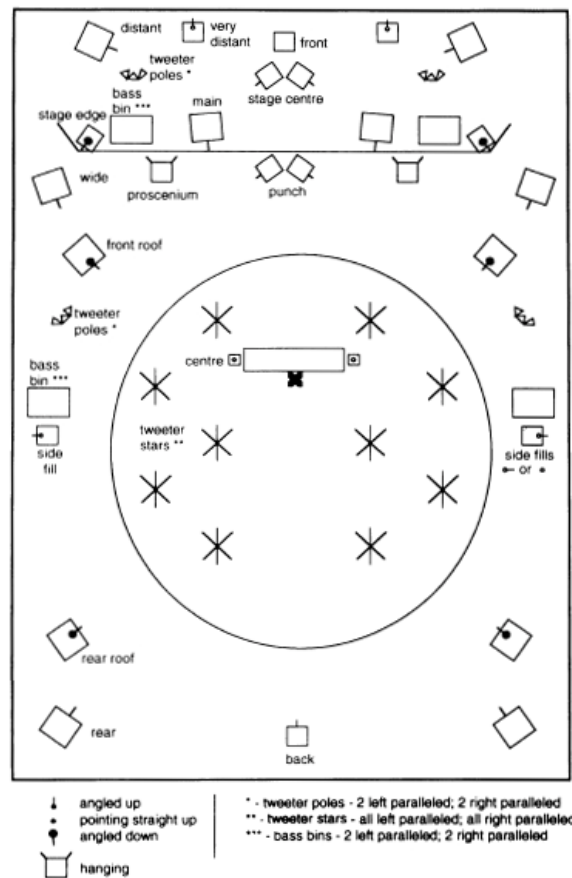

Fig. 8.16 The full BEAST system

Modern diffusion practice also attempts to articulate musical material by performing different passages through different sounding pairs of speaker. Composers do not generally provide a score or notation that indicates how the work should be diffused, instead it is up to the diffusion engineer to interpret the work and "perform" the piece in a way that highlights the musical content and also adapts it to the specific loudspeaker array and acoustics of the particular performance venue. The composer and theorist Denis Smalley describes this approach as follows;

> *"Sound diffusion is the projection and the spreading of sound in an acoustic space for a group of listeners – as opposed to listening in a personal space (living room, office or studio). Another definition would be the sonorizing of the acoustic space and the enhancing of sound-shapes and structures in order to create a rewarding listening experience* [Smalley *et al*, 2000]*".*

Diffusion has traditionally been controlled manually but some work has been carried out with automated processes and digital spatialization techniques [Truax, 1999; Moore, 1983]. Harrison suggests that this approach reflects the primarily manual processes used in the studio by composers in the early days of *Musique Concrète* [Harrision, 1999]. Others, like Smalley have compared the spatial gestures produced by the diffusion engineer to the physical gestures of traditional instrumental performers [Smalley, 2007]. However, although the diffusion process clearly adds something to the performance, the diffusionist can only emphasize the pre-existing material in the work. Clearly then for a successful performance of a diffusion piece, the composer must organize the material in a way that supports its eventual performance. Denis Smalley's theory of spectromorphology details how a gestural approach can be used as a structuring principle in electroacoustic, and particularly acousmatic music.

8.5 Spectromorphology and the Gestural use of Space

Denis Smalley developed the theory of spectromorphology as a means of describing and analysing the electroacoustic listening experience. Smalley studied with François Bayle at GRM and his compositional aesthetic and theoretical writings developed from the theories of Musique Concrète described by Pierre Schaeffer in *Traite des objects musicaux* [Smalley, 1997]. Schaeffer's approach emphasized *reduced listening,* that is the conscious focus on the intrinsic properties of the sound and the ignoring of extrinsic, referential properties. However, this form of listening is highly unnatural and difficult to maintain, as the natural instinct of any listener is to identify the source and cause of the sound. Smalley uses the term source-bonding to describe this natural tendency to relate sounds to supposed sources and causes, or to relate sounds to each other due to a shared origin. In instrumental music, this process is determined by the physical interaction of the performer with the instrument as the spectromorphological profile of the sound indicates how the instrument is excited by the performer. Smalley suggests that in the case of acousmatic music, both the source and cause of the perceived sound may be detached from a directly experienced or known physical gesture, a concept he refers to as gestural surrogacy. First order surrogacy refers to sounds produced by human gestures such as traditional instrumental music and singing. Second order surrogacy retains some aspects of

human gesture but the resulting spectromorphology is not identifiable as a known musical instrument. Remote surrogacy applies when the sound is not related to human gestural activity or any other known source, such as unusual synthesized sounds. Smalley suggests that the way electroacoustic music uses technology to develop musical gesture beyond the note-based instrumental paradigm is one of its greatest achievements [Smalley, 2007]. He describes gesture as an energy-motion trajectory which can be shaped by the composer through the manipulation of the attack and decay envelope of the sound object. The movement of the sound in space should therefore support and emphasize the inherent spectromorphological profile of the sound object. Smalley suggests that weak gestures which are stretched out in time or evolve slowly are detached from human physicality and are instead perceived in a more environmental sense. This results in a shift in attention away from the forward motion of a distinct gesture to a static environmental texture in which the internal activity of the sound object is the primary focus of attention [Smalley, 2007]. A composition could therefore utilize either a gesture-carried structure which implies a degree of forward motion, triggered by some external impetus, or a texture-carried structure which focuses more on the internal activity of the sound which appears to act without any obvious external stimulus. In this way Smalley suggests that gesture and texture can be used as forming principles in a composition and this process is illustrated in Smalley's acousmatic composition *Empty Vessels* (1997). This work is entirely constructed from environmental recordings made by the composer in his garden. The microphones were placed inside a number of large garden pots so the resulting recordings capture both the internal resonances of the pots and also the external environmental sounds of birds, rain and planes. Additional recordings were also made of just the environmental sounds without the filtering effect of the pots. The work begins with a struck chord of unknown origin which slowly transforms into the recorded environmental sounds. This smooth transformation is achieved through the careful matching of the initial struck chord with the resonant drone of the garden pots present in the original recordings. The descending glissandos of planes flying overhead are also smoothly transformed into abstract processed drones which again are related back to the environmental recordings via the internal resonances of the garden pots, the empty vessels of the title.

Smalley recognizes that the perception of the listener will be influenced not only by the spectromorphological profile created by the composer but also by the

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acoustic of the listening room. He therefore divides the perceived space into the *composed space* (which contains the spatial cues created by the composer), and the *listening space* (the space in which the composed space is heard), as shown in Figure 8.17. The *composed space* consists of both the internal space of the sounding object, such as the resonances of a struck enclosure, and the external space of the environment containing the sound object, which is made apparent through reflections and reverberation. The *listening space* is also subdivided into the personal space, which relates to the precise position of the listener within the venue, and the diffused space created by the various loudspeakers distributed around the venue. Smalley suggests that, in his experience, the perception of a number of parameters will be different when the work is transferred from a single listener in a studio to a large performance space [Smalley, 1997]. Spatial depth which is captured using stereo recording techniques or synthesized using artificial reverberation can easily create images which appear to originate from outside the array for a single listener. However, in a larger space these images may instead become superimposed within the space, rather than beyond the physical loudspeaker positions. Similarly, creating a sense of spatial intimacy [Smalley *et al*, 2000] becomes much more difficult as the size of the listening area increases. The spatial variants suggested by Smalley are shown in Figure 8.17 [Smalley, 1997].
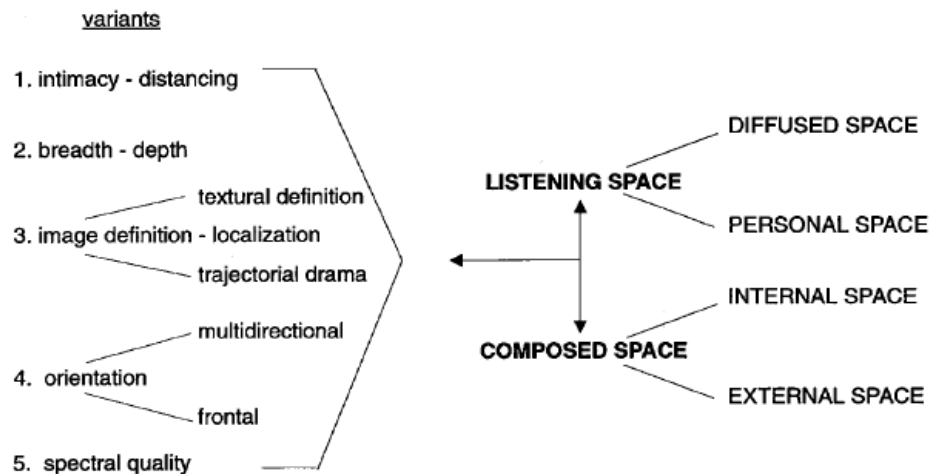

Fig. 8.17 Denis Smalley's perceived space

Although spectromorphology clearly originated from the acousmatic tradition and stereo diffusion, this approach can be applied to other compositional aesthetics

and technical formats. Spectromorphology can be used to relate and structure a wide variety of sounds as either gesture or texture, performance or environmental. Human activity, whether in the form of traditional instrumental performance or the manipulation of non-traditional instruments (such as the garden pots in *Empty Vessels),* can be related to synthesized sounds via the shaping of dynamic spatial and spectromorphological gestures. In addition, environmental recordings can be related to continuous synthesized or processed sounds without accented attack and decay envelopes. Soundscape composition [Truax, 2008] is a compositional aesthetic which utilizes the latter approach and is predominantly based upon environmental sounds and textures. Luc Ferrari's *Presque Rien No. 1* (1970), which consists solely of layered recordings from a day at the beach with a minimum level of manipulation of the material, is a well known example of this style of composition. *The Vancouver Soundscape* (1970) by the World Soundscape Project similarly consists of direct reproductions of natural soundscapes with a minimum level of human intervention. Since the seventies, soundscape composition has developed beyond this minimalist approach to include digital synthesis and multichannel techniques and the Canadian composer Barry Truax is one of the chief exponents of this aesthetic. His early work used granular synthesis and a quadraphonic speaker system to create highly textural works with a strong environmental character. In later works such as *Pacific* (1990), or *Basilica* (1992), Truax used granulated environmental recordings with an octophonic, eight-channel array and multiple decorrelated granular streams to create an immersive sonic environment. Truax has argued that the avoiding the representational meaning of environmental sounds is difficult, stating that "environmental sound acquires its meaning both in terms of its own properties and in terms of its relation to context" [Truax, 1996]. Despite this difficulty, environmental recordings have also been used in a more symbolic fashion in which the different recorded sounds and spaces are used to tell a sort of narrative. Various composers and theorists have explored this compositional aesthetic and suggested various symbolic interpretations of different spaces and movements [Trochimczyk, 2001; Wishart, 1985].

The gestural use of space suggested by Denis Smalley in his theory of spectromorphology originated in the acousmatic tradition of stereo diffusion, but this idea is equally applicable to compositions for multi-channel loudspeaker arrays, or mixed-media electroacoustic works. The notion of gestural shaping also suggests an

obvious approach to works which combine acoustic and spatialized electronic sounds as the spectromorphological profile of the synthetic sounds can be deliberately designed to match or mimic the instrumental gestures of the performers.